Cognitive Neuroscience Society

21st Annual Meeting, April 5-8, 2014
Marriott Copley Place Hotel, Boston, Massachusetts

2014 Annual Meeting Program

Contents

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Schedule Overview

Saturday, April 5

11:00 am – 3:00 pm	Exhibitor Check-In, 3rd Floor Back Bay Conference and Exhibition Hall
11:00 am – 7:00 pm	Onsite Registration & Pre-Registration Check In, 4th Floor Registration Desk
2:00 – 3:00 pm	**Keynote Address – Suzanne Corkin, Open to the Public, Grand Ballroom Salon A-F**
3:00 – 3:30 pm	Coffee Service, 3rd Floor Back Bay Conference and Exhibition Hall
3:00 – 5:00 pm	**Poster Session A**, 3rd Floor Back Bay Conference and Exhibition Hall
3:00 – 7:00 pm	Exhibits on Display, 3rd Floor Back Bay Conference and Exhibition Hall
5:00 – 6:00 pm	**George A. Miller Prize Lecture –Jon Kaas, Grand Ballroom Salon A-F**
6:00 – 7:00 pm	George A. Miller Prize & Welcome Reception, 3rd Floor Back Bay Conference and Exhibition Hall

Sunday, April 6

7:30 am – 7:00 pm	Onsite Registration & Pre-Registration Check In, 4th Floor Registration Desk
8:00 – 8:30 am	Continental Breakfast, 3rd Floor Back Bay Conference and Exhibition Hall
8:00 – 10:00 am	**Poster Session B**, 3rd Floor Back Bay Conference and Exhibition Hall
8:00 am – 7:00 pm	Exhibits on Display, 3rd Floor Back Bay Conference and Exhibition Hall, Closed during lunch, Noon - 1:00 pm
10:00 am – 12:00 pm	**Mini-Symposia** 1 - The Relational Memory Theory: Inspiring Novel Predictions Two Decades Post-Inception, Salon F 2 - Contributions of alpha-band oscillations in cognition, Salon E 3 - Putting Person Perception in Context: Insights from Social Neuroscience, Salon D
12:00 – 1:00 pm	Lunch Break, Exhibits Closed
1:00 – 3:00 pm	**Poster Session C**, 3rd Floor Back Bay Conference and Exhibition Hall
2:30 – 3:00 pm	Coffee Service, 3rd Floor Back Bay Conference and Exhibition Hall
3:00 – 5:00 pm	**Invited Symposium 1** - The Broader Applicability of Insights from Developmental Cognitive Neuroscience - **Silvia Bunge**, Chair, Grand Ballroom Salon A-F
5:00 – 6:00 pm	**Distinguished Career Contributions Award Lecture – Marsel Mesulam, Grand Ballroom Salon A-F**
6:00 – 7:00 pm	Distinguished Career Contributions Reception, 3rd Floor Back Bay Conference and Exhibition Hall

Monday, April 7

7:30 am – 7:00 pm	Onsite Registration & Pre-Registration Check In, 4th Floor Registration Desk
8:00 – 8:30 am	Continental Breakfast, 3rd Floor Back Bay Conference and Exhibition Hall
8:00 – 10:00 am	**Poster Session D**, 3rd Floor Back Bay Conference and Exhibition Hall
8:00 am – 5:00 pm	Exhibits on Display, 3rd Floor Back Bay Conference and Exhibition Hall, Closed during lunch, Noon - 1:00 pm

10:00 am – 12:00 pm	**Mini-Symposia**
	4 - The neuroscience of social networks, Salon F
	5 - A New Look at Neural Representation in the Prefrontal Cortex, Salon E
	6 - Prediction, adaptation and plasticity of language processing in the adult brain, Salon D
12:00 – 1:00 pm	Lunch Break, Exhibits Closed
12:00 – 1:00 pm	**NIH Funding**: Training and Research Grant Opportunities, Kathy Mann Koepke, NICHD, Salon D
1:00 – 3:00 pm	**Poster Session E**, 3rd Floor Back Bay Conference and Exhibition Hall
2:30 – 3:00 pm	Coffee Service, 3rd Floor Back Bay Conference and Exhibition Hall
3:00 – 5:00 pm	**Invited Symposium 2** - Symposium on Consciousness, **Wolf Singer**, Chair, Grand Ballroom Salon A-F
5:00 – 6:00 pm	**Young Investigator Awards** Lectures – **Daphna Shohamy** and **David Badre**, Grand Ballroom Salon A-F
6:00 – 7:00 pm	**Keynote Address – Marlene Behrmann**, Grand Ballroom Salon A-F

Tuesday, April 8

7:30 am – 5:00 pm	Onsite Registration & Pre-Registration Check In, 4th Floor Registration Desk
8:00 – 8:30 am	Continental Breakfast, 3rd Floor Back Bay Conference and Exhibition Hall
8:00 – 10:00 am	**Poster Session F**, 3rd Floor Back Bay Conference and Exhibition Hall
8:00 am – 5:00 pm	Exhibits on Display, 3rd Floor Back Bay Conference and Exhibition Hall, Closed during lunch, Noon - 1:00 pm
10:00 am – 12:00 pm	**Mini-Symposia**
	7 - Mechanisms of Memory Consolidation During Sleep, Salon F
	8 - MEG, EEG and fMRI based functional connectivity analysis: Relevance to cognition, Salon E
	9 - Oscillatory mechanisms of attentional control, Salon D
12:00 – 1:00 pm	Lunch Break, Exhibits Closed
1:00 – 3:00 pm	**Poster Session G**, 3rd Floor Back Bay Conference and Exhibition Hall
2:30 – 3:00 pm	Coffee Service, 3rd Floor Back Bay Conference and Exhibition Hall
3:00 – 5:00 pm	**Invited Symposium 3** - Mechanisms of Response Inhibition, **Yuko Munakata**, Chair, Grand Ballroom Salon A-F

NIH Funding: Training and Research Grant Opportunities

Monday, April 7th, 12:00 - 1:00pm, Salon D

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

Speaker: Kathy Mann Koepke, NICHD

Keynotes

Suzanne Corkin

Professor of Neuroscience, Emerita,
Department of Brain and Cognitive Sciences, MIT

Saturday, April 5, 2:00-3:00 pm, Grand Ballroom Salon A-F

Permanent Present Tense: The Unforgettable life of the amnesic patient, H.M.

At age 27, Henry Molaison (H.M.) received an experimental operation to alleviate intractable epilepsy. Bilateral removal of his medial temporal lobe structures left him with a dense amnesia but preserved intellect. I will highlight results from 55 yrs of behavioral and imaging studies showing that short-term, long-term, declarative, and nondeclarative memory rely on different brain circuits. H.M. died in 2008, leaving his brain to Mass General and MIT for further study. He continues to illuminate the science of memory.

Marlene Behrmann

Carnegie Mellon University

Monday, April 7, 6:00 – 7:00 pm, Grand Ballroom Salon A-F

Distributed circuits, not circumscribed centers, mediate visual recognition

Increasingly, the neural mechanisms supporting visual cognition are being conceptualized as a distributed but integrated system, as opposed to a set of individual, specialized regions each subserving a particular visual behavior. Consequently, there is an emerging emphasis on characterizing the functional, structural and computational properties of these broad networks. In this talk, I will present a novel theoretical perspective, which elucidates the developmental emergence, computational properties and vulnerabilities of integrated circuits using face and word recognition as a model domain, and I will offer empirical data from developmental studies, ERP, fMRI and neuropsychology to support this account. Additionally, I will argue that, rather than being disparate and independent, these neural circuits are overlapping and subject to the same computational constraints. Specifically, the claim is that both word and face recognition rely on fine-grained visual representations but, by virtue of pressure to couple visual and language areas and to keep connection length short, the left hemisphere becomes more finely tuned for word recognition and, consequently, the right hemisphere becomes more finely tuned for face recognition. Thus, both hemispheres ultimately participate in both forms of visual recognition but their respective contributions are asymmetrically weighted.

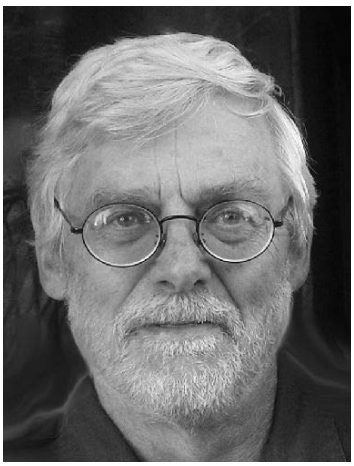
2014 George A. Miller Awardee

Congratulations to Dr. Jon Kaas for being awarded this honor!

Dr. Kaas will accept this prestigious award and deliver his lecture on Saturday, April 5, 2014, 5:00 – 6:00 pm, in the Grand Ballroom Salon A-F. Reception to follow at 6:00 – 7:00 pm in the Back Bay Conference and Exhibition Hall.

Sensorimotor processing streams involving posterior parietal, premotor and motor cortex of primates: Comparative studies

Jon Kaas
Distinguished Centennial Professor
Psychology Department, Vanderbilt University



Many studies have focused on the important issue of how posterior parietal cortex of humans and macaque monkeys is functionally organized and related to motor and premotor cortex in mediating basic motor behaviors such as reaching, grasping, and looking. Our approach has been comparative, studying at prosimian galagos, New World monkeys, and Old World macaques, and relating our results to those published on humans. Our principle method of investigation has been the use of electrical micro-stimulation to reveal as many as seven subregions or domains of posterior parietal cortex with matching domains in frontal motor cortex where different complex motor behaviors are evoked in anesthetized or awake primates. We have used anatomical tracers to reveal cortical and subcortical connections of domains identified by micro-stimulation, and optical imaging of cortical activation during micro-stimulation of domains. We have also determined the behavioral consequences of reversibly deactivating specific domains with a cooling chip or muscimol during micro-stimulation of other domains. Interactions between domains were studied by stimulating two at once. Our results allow a number of strong conclusions. (1) All primates have a large region of posterior parietal cortex where similar spatial arrangements of domains exist for reaching, running or climbing, looking, body and head protection, bringing hand to mouth, and grasping. In contrast, posterior parietal cortex is poorly developed in the non-primate relatives of primates, and does not appear to have this organization. (2) Domains matching those in posterior parietal cortex are found in motor and premotor cortex. Matching domains are preferentially interconnected, and arranged in a hierarchy from posterior parietal cortex to premotor cortex, and then to motor cortex. (3) Posterior parietal cortex domains vary in the sources and amounts of direct and indirect inputs from visual areas and somatosensory areas. (4) Interactions between domains in posterior parietal cortex or frontal motor cortex are complex, but they are often antagonistic, suggesting that domains mediating different behaviors mutually suppress each other in a race to allow one behavior to emerge over others.

About the George A. Miller Prize in Cognitive Neuroscience

The George A. Miller Prize in Cognitive Neuroscience was established in 1995 by the Cognitive Neuroscience Society to honor the innovative scholarship of George A. Miller, whose many theoretical advances has so greatly influenced the discipline of cognitive neuroscience. The first ten 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 their discipline and that has in the past, or has the potential in the future, to revolutionize cognitive neuroscience. Extraordinary innovation and high impact on international scientific thinking should be a hallmark of the recipient's work.

Previous Winners of the George A. Miller Lectureship

2013	Fred H. Gage, Ph.D., The Salk Institute
2012	Eve Marder, Ph.D., Brandeis University
2011	Mortimer Mishkin, Ph.D., NIMH
2010	Steven Pinker, Ph.D., Harvard University
2009	Marcus Raichle, Ph.D., Washington University School of Medicine
2008	Anne Treisman, Ph.D., Princeton University
2007	Joaquin M. Fuster, Ph.D., University of California, Los Angeles
2006	Steven A. Hillyard, Ph.D., University of California, San Diego
2005	Leslie Ungerleider, Ph.D., National Institute of Mental Health
2004	Michael Posner, Ph.D., University of Oregon
2003	Michael Gazzaniga, Ph.D., Dartmouth College
2002	Daniel Kahneman, Ph.D., Princeton University
2001	William Newsome, Ph.D., Stanford University
2000	Patricia Churchland, Ph.D., University of California, San Diego
1999	Giacommo Rizzolatti, Ph.D., University of Parma, Italy
1998	Susan Carey, Ph.D., New York University
1997	Roger Shepard, Ph.D., Stanford University
1996	David Premack, Ph.D., CNRS, France
1995	David H. Hubel, Ph.D., Harvard Medical School

Distinguished Career Contributions Awardee

Congratulations to Dr. Marsel Mesulam for being awarded this honor!

Dr. Mesulam will accept this prestigious award and deliver his lecture on Sunday, April 6, 2014, 5:00 – 6:00 pm, in the Grand Ballroom Salon A-F. Reception to follow at 6:00 – 7:00 pm in the Back Bay Conference and Exhibition Hall.

Primary Progressive Aphasia and the Language Network

Marsel Mesulam, M.D.
Ruth Dunbar Davee Professor of Neuroscience and Director of the Cognitive Neurology and Alzheimer's Disease Center at Northwestern University

Primary progressive aphasia (PPA) is a clinical syndrome diagnosed when three core criteria are met. First, there should be a language impairment (i.e., aphasia) that interferes with the usage or comprehension of words. Second, the neurological work-up should determine that the disease is neurodegenerative, and therefore progressive. Third, the aphasia should arise in relative isolation, without equivalent deficits of comportment or episodic memory. The language impairment can be fluent or non-fluent and may or may not interfere with word comprehension. Memory for recent events is preserved although memory scores obtained in verbally mediated tests may be abnormal. Minor changes in personality and behavior may be present but are not the leading factors that bring the patient to medical attention or that limit daily living activities.

This distinctive clinical pattern is most conspicuous at the initial stages of the disease, and reflects a relatively selective atrophy of the language network, usually located in the left hemisphere. Asymmetry of neuronal loss is the biological hallmark of PPA and persists until death. Its determinants are unknown but may include a familial vulnerability of the language network, as reflected by the higher prevalence of learning disability in patients and their first degree relatives. There are different clinical variants of PPA, each with a characteristic pattern of atrophy. The underlying neuropathological diseases are heterogeneous and can include Alzheimer's disease as well as frontotemporal lobar degenerations. Each PPA variant has a preferential (but not absolute) association with a specific cellular type of pathology. The relationship of clinical variant to underlying pathology is probabilistic so that novel biomarkers are playing an increasingly more important role in surmising the nature of the underlying neuropathology.

About the Distinguished Career Contributions Award

The Distinguished Career Contributions (DCC) award honors senior cognitive neuroscientists for their distinguished career, leadership and mentoring in the field of cognitive neuroscience. The recipient of this prize will give a lecture at our 21st annual meeting at the Boston Marriott Copley Place Hotel in Boston, MA.

Previous Winners of the Distinguished Career Contributions Award

2013 Robert T. Knight, M.D., University of California, Berkeley

2012 Morris Moscovitch, Ph.D., University of Toronto

Young Investigator Awardees

YIA special lectures take place on Monday, April 7, 5:00 – 6:00 pm, in the Grand Ballroom Salon A-F.

Congratulations to the 2014 Young Investigator Award Winners

Daphna Shohamy, Ph.D., Columbia University

David Badre, Ph.D., Brown University

The purpose of the awards is to recognize outstanding contributions by scientists early in their careers. Two awardees, one male and one female, are named by the Awards Committee, and are honored at the CNS annual meeting. Each award includes $500 US to be used by the winners toward travel costs to the meeting, or for any other purpose.

How different forms of learning guide decisions

Daphna Shohamy
Columbia University

Learning is central to adaptive behavior. From robots to humans, the ability to learn from experience turns a rigid response system into a flexible, adaptive one. How are decisions shaped by past experience? What are the neurobiological and cognitive mechanisms that allow everyday experiences to change the way we perceive and act in the world? Work in my lab aims to address these questions. We take as a starting point a longstanding idea in cognitive and systems neuroscience: that the brain learns in different ways by using multiple specialized learning systems. Implicit learning of habits is thought to depend on the striatum and its dopaminergic inputs, while explicit memory for specific episodes depends on the hippocampus. Surprisingly, however, despite progress in mapping these different forms of learning to different areas in the brain, the separation of learning into distinct systems has left open crucial questions about the nature of the interactions between them, the kinds of representations they build, and their role in guiding decisions. Work in my lab has made progress on these questions by adopting an integrative approach that draw on neuroscience to make predictions about how different forms of learning guide behavior. These predictions are tested with behavioral, imaging, patient, and pharmacological studies. Together, results emerging from this work challenge the traditional view of learning systems and advance understanding of the mechanisms by which multiple forms of learning interact to guide decisions and actions.

About Daphna Shohamy

Daphna Shohamy is an Associate Professor in the Department of Psychology at Columbia University and a member of the Kavli Center for Brain Science. Work in Shohamy's lab investigates the neural mechanisms of learning, memory and decision making in humans with an emphasis on how these processes interact. She received her Ph.D. in Neuroscience from Rutgers followed by a postdoctoral fellowship at Stanford University. Dr. Shohamy is the recipient of a National Science Foundation Career Development Award (2010), the Association for Psychological Science Janet Spence Award (2011), Columbia's Distinguished Faculty Award (2012), and a Young Investigator Award from the Society for Neuroeconomics (2013).

Hierarchical organization of the lateral prefrontal cortex

David Badre
Brown University

The prefrontal cortex (PFC) is known to be necessary for flexible and adaptive behavior. However, the functional organization of the PFC, if any, remains controversial. In this talk I will describe a line of research testing the hypothesis that lateral frontal cortex may be organized hierarchically along its rostro-caudal axis. Evidence from human fMRI and lesion studies of rule following and learning will be presented that support functional differences between rostral and caudal frontal cortex. I will then discuss recent work suggesting that this apparent hierarchical functional organization may emerge from overlapping loops between lateral frontal cortex and the striatum.

About David Badre

David Badre received his B.S. from the University of Michigan in 2000, and his Ph.D. from the Department of Brain and Cognitive Sciences at MIT in 2005. Following a postdoctoral fellowship at the University of California, Berkeley, he joined Brown's Department of Cognitive, Linguistic, and Psychological Sciences as Assistant Professor in 2008. He is also an affiliate of the Brown Institute for Brain Science and a trainer in the Neuroscience Graduate Program. His lab at Brown focuses on the cognitive neuroscience of memory and cognitive control with an emphasis on frontal lobe function and organization.

Cognitive Neuroscience Society Student Association Student Social Night

Sunday, April 6th, 7:00 pm, Meet in Marriott Copley Place Reception Area

Come and join us for the annual CNSSA Student Social Night, Sunday April 6th, after the Distinguished Career Contributions Award reception. We will meet at 7:00 in the conference hotel reception area (look for signs), and walk out to a nearby bar/restaurant around 7:15. There will be no cover charge and light snacks will be provided at the restaurant (cash bar). This event is open to all students and post docs of the Cognitive Neuroscience Society.

More information will be posted on the Cognitive Neuroscience Society Student Association Facebook page (http://www.facebook.com/CNSStudentAssociation). We look forward to meeting you!

General Information

Abstracts

Poster abstracts can be found in the printed program and in a PDF version which is downloadable from www.cogneurosociety.org.

ATM

An ATM is located on the first floor of the hotel for your convenience.

Audiovisual Equipment for Talks

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

Baggage Check

For assistance with luggage, packages and other items, please see the Bell Desk located near the Front Desk.

Business Center

The Business Center is located on the second floor of the elevator lobby. The following services are available: copy service, fax service, messenger service, overnight delivery/pickup, and post/parcel.

Catering

Catering will be available during the conference and is included in the registration fee. Please refer to the table below for the catering times.

Saturday, April 5

Coffee Service, 3:00 – 3:30 pm, *Exhibit Hall*

GAM and Welcome Reception, 6:00 – 7:00 pm, *Exhibit Hall*

Sunday, April 6

Continental Breakfast, 8:00 – 8:30 am, *Exhibit Hall*

Coffee Service, 2:30 – 3:00 pm, *Exhibit Hall*

DCC Reception, 6:00 – 7:00 pm, *Exhibit Hall*

Monday, April 7

Continental Breakfast, 8:00 – 8:30 am, *Exhibit Hall*

Coffee Service, 2:30 – 3:00 pm, *Exhibit Hall*

Tuesday, April 8

Continental Breakfast, 8:00 – 8:30 am, *Exhibit Hall*

Coffee Service, 2:30 – 3:00 pm, *Exhibit Hall*

Certificate of Attendance

A Certificate of Attendance is printed on the back of your Name Badge. To have your Certificate of Attendance signed, please visit the CNS Registration Desk, located on the 4th floor of the Boston Marriott Copley Place Hotel. If you require any changes, we will be happy to email a copy after the meeting. See also, Receipts.

Chair People

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

Contact Us

To contact us onsite, visit the CNS Registration Desk, located on the 4th floor of the Boston Marriott Copley Place Hotel, or send an email to meeting@cogneurosociety.org.

Disclaimer

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

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 Award in Cognitive Neuroscience (DCC) Reception on Sunday. Lost drink tickets cannot be replaced.

Exhibit Hall

The conference exhibit is located in the 3rd floor Back Bay Conference and Exhibition Hall of the Boston Marriott Copley Place Hotel. Located in this room are the posters, exhibit booths, and catering. The Exhibit Hall is open to all attendees at the following times:

Saturday	3:00 – 7:00 pm
Sunday	8:00 am – 7:00 pm
Monday	8:00 am – 5:00 pm
Tuesday	8:00 am – 5:00 pm

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

Facebook

Find us on Facebook. Search for "CNS Annual Meeting," and like us!

Hotel

The Boston Marriott Copley Place Hotel is our exclusive Hotel for the CNS 2014 Annual Meeting and where all CNS 2014 meeting events will be held. Boston Marriott Copley Place Hotel, 110 Huntington Avenue, Boston, Massachusetts, 02116 USA.

Hotel Restaurants

Champions Sports Bar, enjoy a daily breakfast, an all-American grill menu and a wide selection of group bites, plus signature cocktails and 36 beers on tap.

Connexion Lounge, stop off for late afternoon fare or a glass of wine.

Starbucks, known for its coffee, pastries and signature drinks made to order. Whether you stop in for a quick breakfast or for a caffeine fix throughout the day, you'll find a casual atmosphere waiting.

Internet Access

CNS attendees will receive complimentary wireless internet in their guest room, when reserved within the CNS block and before March 12, 2014.

Free internet terminals are located on the 4th floor near the CNS Registration Desk. Internet terminals are available during the meeting registration hours on Saturday, Sunday, Monday, and Tuesday when not needed for onsite registration. See Onsite Meeting Registration.

Complimentary hotel wireless access is available in the Lobby and public areas.

LinkedIn

Find us on LinkedIn. Search for "Cognitive Neuroscience Society (CNS)" under groups, and join our group!

Lost & Found

The meeting Lost and Found is located at the CNS Registration Desk on the 4th floor of the Boston Marriott Copley Place Hotel.

Member Services

The member services desk is located at the CNS Registration Desk on the 4th floor of the Boston Marriott Copley Place Hotel. The member services desk will be open at the following times:

Saturday, April 5	11:00 am – 5:00 pm
Sunday, April 6	7:30 am – 6:30 pm
Monday, April 7	8:00 am – 6:30 pm
Tuesday, April 8	8:00 am – 12:30 pm

Message Center

Messages for meeting registrants can be left and retrieved at the CNS Registration Desk on the 4th floor of the Boston Marriott Copley Place Hotel. A bulletin board will be available for announcements and job postings.

Mobile Phones

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

Name Badges

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

Entrance into sessions is restricted to registered attendees only. Entrance to the Exhibit Hall is limited to badge holders only. If you misplace your name badge, please go to the CNS Registration Desk on the 4th floor of the Boston Marriott Copley Place Hotel for a replacement.

Parking

The Boston Marriott Copley Place Hotel offers secured and covered Valet parking. Parking is $49.00 a day for hotel guests. Parking is very limited. The valet fee includes in/out privileges and self-parking. Offsite parking is available for $37.00 a day. (Rates are at time of print.)

Phone Charging Station

There will be a small phone charging station located at the CNS Registration Desk on the 4th floor of the Boston Marriott Copley Place Hotel.

Photo Disclaimer

Registration and attendance at, or participation in, the Cognitive Neuroscience Society meetings and other activities constitutes an agreement by the registrant/attendee to CNS's use and distribution (both now and in the future) of the registrant's or attendee's image in photographs of such events and activities.

Poster Sessions

Poster sessions are scheduled on Saturday, April 5, Sunday, April 6, Monday, April 7, and Tuesday, April 8. The presenting author must be present during the assigned session and other authors may be present to answer questions. The poster sessions are in the 3rd Floor Back Bay Conference and Exhibition Hall of the Boston Marriott Copley Place Hotel. Badges are required at all times. Do not leave personal items in the poster room.

Printed Program

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 CNS Registration Desk on the 4th floor of the Boston Marriott Copley Place Hotel 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 also have the option to view the program by downloading it from our website.

Press Room

Contact Lisa Munoz, CNS Public Information Officer (cns.publicaffairs@gmail.com) for more information.

Receipts

You received two receipts via email, one at the time of purchase and a second with your registration confirmation. Please email the registration desk if you require an additional copy. See also Certificate of Attendance.

Receptions

The GAM & Welcome Reception will be held in the 3rd Floor Back Bay Conference and Exhibition Hall, from 6:00 – 7:00 pm on Saturday, April 5, directly following the GAM Lecture honoring Jon Kaas winner of the 20th Annual George A. Miller Prize in Cognitive Neuroscience.

The DCC Reception will be held in the 3rd Floor Back Bay Conference and Exhibition Hall, from 6:00 – 7:00 pm on Sunday, April 6 directly following the DCC Lecture honoring Marsel Mesulam, winner of the 3rd Annual Distinguished Career Contributions in Cognitive Neuroscience.

Registration

The CNS Registration Desk is located on the 4th floor of the Boston Marriott Copley Place Hotel. The Registration Desk will be open at the following times:

Saturday, April 5	11:00 am – 7:00 pm
Sunday, April 6	7:30 am – 7:00 pm
Monday, April 7	7:30 am – 7:00 pm
Tuesday, April 8	7:30 am – 5:00 pm

Smoking

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

Speakers

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

Transportation

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Exhibit Hall open to all attendees:

Saturday		3:00 – 7:00 pm
Sunday	8:00 am – 12:00 pm	1:00 – 7:00 pm
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Tuesday	8:00 am – 12:00 pm	1:00 – 5:00 pm

Exhibit Hall closed for the day - no entry:

Saturday	7:00 pm
Sunday	7:00 pm
Monday	5:00 pm
Tuesday	5:00 pm

Invited-Symposium Sessions

#	Title	Date	Time	Location
1	The Broader Applicability of Insights from Developmental Cognitive Neuroscience	Sunday, April 6	3:00 - 5:00 pm	Grand Ballroom Salon A-F
2	Consciousness	Monday, April 7	3:00 - 5:00 pm	Grand Ballroom Salon A-F
3	Mechanisms of Response Inhibition	Tuesday, April 8	3:00 - 5:00 pm	Grand Ballroom Salon A-F

Invited Symposium Session 1

THE BROADER APPLICABILITY OF INSIGHTS FROM DEVELOPMENTAL COGNITIVE NEUROSCIENCE

Sunday, April 6, 3:00 - 5:00 pm, Grand Ballroom Salon A-F

Chair: Silvia Bunge, UC Berkeley

Speakers: John D. E. Gabrieli, Margaret Sheridan, Martha J. Farah, Helen J. Neville

The burgeoning field of developmental cognitive neuroscience is yielding important insights into how the human brain develops and changes with experience. These findings are proving to be of great interest not only to other scientists, but also to practitioners and policymakers from various corners of society. What have we learned so far that warrants consideration by those in a position to shape policy and practice in education, healthcare, or the judicial system? In this symposium, leading cognitive neuroscientists will discuss the potential applications of their research.

TALK 1: COGNITIVE NEUROSCIENCE AND EDUCATION

John D. E. Gabrieli; Massachusetts Institute of Technology

One goal of cognitive neuroscience is to discover properties of the human brain that are relevant for education. I will discuss two studies involving partnerships with schools, which both encourage the study of issues that are relevant to educators and also expand the representation of children from a wide variety of backgrounds in neuroimaging research. In one study, we aimed to discover brain differences in pre-reading kindergartners that predict reading ability after the onset of reading instruction. Over 1400 kindergartners were screened in 19 diverse schools, and 180 participated in neuroimaging. One finding with diffusion tensor imaging is that the volume and fractional anisotropy of the left arcuate fasciculus is positively correlated with phonological awareness, an oral language ability strongly related to learning to read. This finding suggests a structural basis of behavioral risk for dyslexia that predates reading instruction. A second study in over 1300 8th graders examined the relations between statewide school assessments and measures of fluid cognition. The school that a student attended accounted for up to 34% of variance on math test scores, but had little influence on measures of processing speed, working memory capacity, or fluid reasoning. Neuroimaging in 53 diverse 8th graders indicated that better performance on state tests was associated with greater parietal activation on a working memory task. These findings suggest a dissociation between crystallized cognitive skills that can be enhanced by some schools, and fluid cognitive skills that do not appear to be enhanced by current curriculum.

TALK 2: EFFECTS OF EARLY, PROFOUND DEPRIVATION ON BRAIN AND BEHAVIORAL DEVELOPMENT

Margaret Sheridan, Charles A. Nelson; Harvard Medical School, Boston Children's Hospital

Many aspects of postnatal brain development depend critically on experience for development to proceed normally. In this talk we will discuss what happens to children whose postnatal experience violates what we have come to expect as a species. The Bucharest Early Intervention Project (BEIP) was a randomized clinical trial of foster care as an intervention for early institutionalization. A total of 136 children who had been abandoned at birth and placed in various institutions in Bucharest, Romania were targeted for study, along with a sample of 68 children who lived with their biological parents in the greater Bucharest community. Following an extensive baseline assessment (average age 22 month), half the institutionalized children were randomly assigned to high quality foster care created by the research team and the other half to care as usual (institutional care). This sample has been carefully studied through the first 12 years of life. Key findings covering a variety of domains (including but not limited to executive functions, memory, and brain development) will serve as the focus of this talk.

TALK 3: SOCIOECONOMIC STATUS AND THE DEVELOPING BRAIN

Martha J. Farah; University of Pennsylvania

Childhood socioeconomic status (SES) predicts many important life outcomes, from physical health to academic achievement. Why is childhood SES so influential? The answer involves the effects of early life SES on brain development. SES is associated with differences in daily life stress, environmental stimulation and parenting practices. On the basis of research with animals and humans, these differ-

ences appear to shift children onto different developmental trajectories. In this presentation I will review converging research results from a number of labs indicating the neural correlates of childhood SES studied through behavioral tests, structural and functional MRI and electrophysiology. I will discuss what is known of the mechanisms by which SES shapes brain development, the later reversibility of these effects, and the role of SES-linked brain and cognitive differences on various life outcomes. I will conclude by considering whether and how developmental neuroscience can play a role in child policy.

TALK 4: NARROWING THE SOCIOECONOMIC GAP IN ACHIEVEMENT

Helen J. Neville; University of Oregon

Employing information from research on the neuroplasticity of selective attention and on the central role of successful parenting in child development, we developed and rigorously assessed a family-based training program designed to improve brain systems for selective attention in preschool children. One hundred forty-one lower socioeconomic status preschoolers enrolled in a Head Start program were randomly assigned to the training program, Head Start alone, or an active control group. Electrophysiological measures of children's brain functions supporting selective attention, standardized measures of cognition, and parent-reported child behaviors all favored children in the treatment program relative to both control groups. Positive changes were also observed in the parents themselves. Effect sizes ranged from one-quarter to half of a standard deviation. One and two years after post-test the children retain mature brain indices of attention. One year later parents in the intervention group have significantly reduced debt (only 6 % are in debt) compared to the control parents who remain at 28% in debt. These results lend impetus to the further development and broader implementation of evidence based education programs that target at-risk families. In a society committed to equal opportunity for all, many will find the opportunity to reduce the gaps between lower and higher socioeconomic children rewarding.

Invited Symposium Session 2

CONSCIOUSNESS

Monday, April 7, 3:00 - 5:00 pm, Grand Ballroom Salon A-F

Chair: Wolf Singer, Ernst Strüngmann Institute for Neuroscience in cooperation with Max Planck Society, Max Planck Institute for Brain Research, Frankfurt Institute for Advanced Studies (FIAS)

Speakers: Wolf Singer, Victor A.F. Lamme, Olaf Blanke, Melanie Boly

A few decades ago search for the neuronal correlates of consciousness (NCC) was considered both as technically intractable and philosophically questionable. Searching for a material substrate of phenomena accessible only from the first person perspective appeared as epistemically problematic. The development of non-invasive imaging technologies and the availability of intracranial recordings from patients alleviated the technical problems and conceptual advances in the field of social neuroscience paved the way for the assessment of subjective states. The scientific study of NCC has since become a major branch of Cognitive Neuroscience. The aim of the symposium is to review the state of the art, identify unresolved questions and to also examine what can be learnt from the investigation of altered states of consciousness.

TALK 1: CONSCIOUSNESS: UNITY IN TIME RATHER THAN SPACE?

Wolf Singer; Ernst Strüngmann Institute for Neuroscience in cooperation with the Max Planck Society, Frankfurt, Max Planck Institute for Brain Research, Frankfurt, Frankfurt Institute for Advanced Studies, FIAS, Frankfurt

The search for neuronal correlates of consciousness (NCC) often relies on comparisons of neuronal response patterns associated with conscious and non-conscious processing, respectively, that are evoked by physically identical stimuli. With this approach it is not always easy to clearly segregate the NCC proper from processes that just permit access to consciousness such as fluctuations in excitability in sensory pathways or from processes that follow conscious experience such as storage of perceived items in working memory. This problem can be reduced but not eliminated by determining the precise temporal sequence of events with electrophysiological techniques and to modulate access to consciousness by varying independently sensory evidence and priors. Experiments based on recordings in human subjects and animals will be described that were designed with these caveats in mind to test the hypothesis already formulated by Sherrington that "the unity of conscious experience does not require convergence in space (anatomical convergence) but in time" (temporal convergence). The results of these experiments are compatible with the view that the NCC is a particular dynamic state of widely distributed networks rather than the activation of circumscribed cortical areas.

TALK 2: WHEN IS A NEURAL REPRESENTATION A CONSCIOUS ONE?

Victor A.F. Lamme; Dept. of Psychology, University of Amsterdam, Amsterdam Brain and Cognition (ABC), Amsterdam, Netherlands

There is now considerable agreement on the fact that conscious visual processing requires recurrent or re-entrant interactions between widespread neural assemblies. Strong controversy exists, however, on the necessary extent of these interactions. Some argue that they must involve the fronto-parietal network, enabling a broadcasting of information to the whole brain. Others, however, claim that recurrent interactions localized to the visual cortex suffice for a conscious visual percept. Further broadcasting is then only required for attention, access and report, functions that go beyond the generation of conscious experiences per se. The difference has great consequences for understanding the

neural basis of consciousness, the interpretation of patient data (e.g. in vegetative state), and for age-old and fundamental questions about consciousness, such as its presence in animals or machines, the issue of qualia, or its molecular basis. Recent data on the controversy, obtained using EEG, fMRI, TMS, and pharmacological interventions will be discussed.

TALK 3: MULTISENSORY BRAIN MECHANISMS OF SELF-CONSCIOUSNESS

Olaf Blanke; Laboratory of Cognitive Neuroscience, Center for Neuroprosthetics & Brain Mind Institute, Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland

Experiences happen for someone, the subject or self, and are felt as "my" experiences. Past work has indicated that subjective aspects of consciousness, in particular the fact that consciousness is bound to the self, is based on the multisensory signal integration of visual, tactile, and proprioceptive stimuli in temporo-parietal cortex. Other prominent research, however, highlighted the importance of another source of bodily stimuli for self-consciousness, that is, the processing of interoceptive (bodily) signals in the insula and medial parietal cortex. I will present studies that investigated three key elements of bodily self-consciousness (body ownership, self-location, first-person perspective) by exposing subjects to ambiguous multisensory exteroceptive information about the location and appearance of their own body. Jointly with brain imaging, these studies have shown that activity in a network of brain regions centering in the temporo-parietal cortex reflects bodily self-consciousness. I will then present recent data that show that interoceptive (cardiac) signals are integrated with such exteroceptive multisensory signals and that they are equally powerful modulators of bodily self-consciousness and recruit insular cortex. Extended by data from neurological patients, these behavioral and neuroimaging findings show that bodily self-consciousness is based on the integration of specific multisensory bodily signals within key regions in temporo-parietal and insular cortex and that such integration includes signals from the inside and from the outside of the human body. I will argue that these brain mechanisms are not only crucial for self-consciousness, but also an important building block for the subjective, first-person properties of perceptual consciousness.

TALK 4: BRAIN CONNECTIVITY (AND COMPLEXITY) IN DISORDERS OF CONSCIOUSNESS

Melanie Boly; Dept. of Neurology, University of Wisconsin, Madison

The present talk will review recent results obtained using functional neuroimaging in patients with severe brain damage (e.g., in coma, vegetative state and minimally conscious state) using resting state EEG and fMRI paradigms as well as measurements of responses to non-invasive sensory and electromagnetic stimulations (the latter using TMS) coupled to high density-EEG recordings. Overall these studies suggest that 2 key ingredients could be necessary for the human brain to generate consciousness: both preserved brain activity differentiation, and preserved long-distance recurrent connectivity. Experimental results obtained using similar techniques in other unconscious states (i.e., anesthesia, generalized seizures, and deep sleep) will be reviewed and compared to coma studies. Practical and conceptual implications of these results will be discussed in light of recent theories of consciousness, especially the information integration theory.

Invited Symposium Session 3

MECHANISMS OF RESPONSE INHIBITION

Tuesday, April 8, 3:00 - 5:00 pm, Grand Ballroom Salon A-F

Chair: Yuko Munakata, University of Colorado Boulder
Co-Chair: Christopher Chatham, Brown University
Speakers: Jeff Schall, Sara Jahfari, Yuko Munakata, Adam Aron

How do we stop ourselves during ongoing action -- when making insensitive comments, reaching for tempting desserts, or darting into a busy intersection? This symposium will present advances in understanding the neural mechanisms supporting response inhibition, and address ongoing debates about the theoretical implications of such findings.

TALK 1: NEUROPHYSIOLOGICAL MECHANISMS OF STOPPING

Jeff Schall; Vanderbilt University

This presentation will survey years of research elucidating the neurophysiological processes mediating performance of the stop task. Single-unit recordings in multiple laboratories in both macaques and rats have distinguished a variety of patterns of modulation in cortical and subcortical structures. Particular neurons in motor circuits instantiate the racing GO and STOP processes. These neurons are located in primary motor and premotor cortex (for limbs) and in frontal eye field and superior colliculus (for eyes) as well as the basal ganglia. The identification of such neurons with the GO and STOP processes is verified through an interactive race model that fits performance like the Logan race model and replicates observed neural dynamics. Other neurons in these circuits respond to the stimuli guiding the actions but do not modulate in a manner or time necessary to be identified with the racing GO and STOP processes. Meanwhile, neurons in medial frontal cortex monitor countermanding performance and indirectly influence the neurons mediating the GO process to adjust performance. These neurons are located in supplementary motor area (for limbs), supplementary eye field (for eyes) and anterior cingulate cortex. The role of medial frontal circuits can be incorporated computationally as executive control of the interactive race model accounting for variation of performance according to stimulus, response and reward history. Overall, this body of work in conjunction with research using noninvasive measurement and manipulation methods provides a powerful example of translation across levels of description from computational model to neural circuits.

TALK 2: VISUAL INFORMATION SHAPES THE DYNAMICS OF CORTICO-BASAL GANGLIA PATHWAYS DURING PERCEPTUAL RESPONSE SELECTION AND INHIBITION

Sara Jahfari, Lourens Waldorp, Richard Ridderinkhof, Steven Scholte; University of Amsterdam, The Netherlands

Action selection often requires the transformation of visual information into motor plans. When information is transformed fast, response inhibition might require the suppression of prepared muscle activity and processing of visual input. We examined how the quality of visual information influences fronto-basal ganglia routes associated with response selection and inhibition. Human fMRI data was collected from a stop-task with faces containing low-, high-, or all spatial frequencies. Drift-diffusion model analysis indicated that the removal of spatial frequencies slowed information accumulation, and decreased cautiousness. On go-trials, effective-connectivity analysis showed action selection to emerge through the "direct" and "indirect" pathways, with projections from prefrontal and visual cortex into the basal ganglia. Importantly, slowed accumulation increased connectivity from both dorsolateral prefrontal cortex and fusiform face area into the putamen. Concurrently, presupplementary motor area connectivity into putamen, and lateral occipital connectivity into subthalamic nucleus were weakened to allow lowered criteria. During stop trials, both visual and prefrontal cortex projected directly into the basal ganglia. Notably, only when a stop signal followed unfiltered faces (with the highest drift rate) the optimal model contained additional connections from prefrontal to visual cortex. Inspection of individual differences related stronger prefrontal-visual connectivity to faster inhibition times. Therefore, prefrontal to visual cortex connections might suppress the fast flow of visual input for the go-task, such that the inhibition process can finish before the selection process. Together, these results indicate response selection and inhibition within the basal ganglia to emerge through top-down adjustments from prefrontal-, and bottom-up evaluations from sensory cortex.

TALK 3: TESTING THEORIES OF STOPPING THROUGH INTERVENTION

Yuko Munakata; University of Colorado Boulder

Many theories of response inhibition focus on cognitive and neural processes specialized for stopping per se. However, recent work suggests that a core component of mature inhibitory control, supported by the right inferior frontal cortex (rIFC), is the ability to proactively monitor the environment for signals that indicate the need to inhibit. We used the Stop Signal task to test a counterintuitive implication of this framework for intervention: the practice of responding a second time if a signal appears should improve the subsequent ability to stop when the same signal appears, because of the common demand to proactively monitor for the signal, and despite the mismatch in trained motor actions. We tested this prediction in 7-9 year-old children, given greater plasticity in childhood and suggestions that interventions in childhood are influential for outcomes. Children showed better response inhibition after practicing going again in response to signals, compared to children who had actually practiced stopping ongoing actions (under conditions that minimized proactive monitoring demands). These findings demonstrate the importance of proactive monitoring processes in developing response inhibition, inform theoretical debates regarding the role of rIFC, and suggest promising new directions for intervention.

TALK 4: THE RIGHT INFERIOR FRONTAL CORTEX IS PART OF A NETWORK FOR BRAKING RESPONSE TENDENCIES

Adam Aron; UC San Diego

Damage to the right inferior frontal cortex (rIFC) affects the ability to stop responses, and this was interpreted as disruption of a neurocognitive inhibitory control function. Consistent with this, many neuroimaging and several electrophysiological studies have revealed activation of the rIFC in stopping paradigms, but questions have been raised whether this reflects a putative inhibitory control function or something else such as attentional processing. In this talk I will survey new evidence, discuss ongoing controversies, and provide an updated theory. I will propose that the rIFC (along with one or more fronto-basal-ganglia networks) is best characterized as a brake. This brake can be turned on in different modes (totally – to outright suppress a response; or partially – to pause), and in different contexts (externally by salient signals; or internally by goals). This will affirm inhibitory control as a key component of executive functions, show that it relies upon rIFC and associated networks, and explain why rIFC disruption could sometimes underpin impulse response control disorders.

Mini-Symposium Sessions

#	Title	Date	Time	Location
1	The Relational Memory Theory: Inspiring Novel Predictions Two Decades Post-Inception	Sunday, April 6	10:00 am - Noon	Salon F
2	Contributions of alpha-band oscillations in cognition	Sunday, April 6	10:00 am - Noon	Salon E
3	Putting Person Perception in Context: Insights from Social Neuroscience	Sunday, April 6	10:00 am - Noon	Salon D
4	The neuroscience of social networks	Monday, April 7	10:00 am - Noon	Salon F
5	A New Look at Neural Representation in the Prefrontal Cortex	Monday, April 7	10:00 am - Noon	Salon E
6	Prediction, adaptation and plasticity of language processing in the adult brain	Monday, April 7	10:00 am - Noon	Salon D
7	Mechanisms of Memory Consolidation During Sleep	Tuesday April 8	10:00 am - Noon	Salon F
8	MEG, EEG and fMRI based functional connectivity analysis: Relevance to cognition	Tuesday April 8	10:00 am - Noon	Salon E
9	Oscillatory mechanisms of attentional control	Tuesday April 8	10:00 am - Noon	Salon D

Mini-Symposium Session 1

THE RELATIONAL MEMORY THEORY: INSPIRING NOVEL PREDICTIONS TWO DECADES POST-INCEPTION

Sunday, April 6, 10:00 am - Noon, Salon F

Chair: Deborah Hannula, University of Wisconsin - Milwaukee

Co-Chair: Melissa Duff, University of Iowa

Speakers: Neal Cohen, Alison Preston, Jennifer Ryan, Howard Eichenbaum

Two decades have passed since the relational memory theory, a neurobiological framework that outlines representational properties of memories mediated by the hippocampus and adjacent medial temporal lobe (MTL) cortical structures, was proposed (Cohen & Eichenbaum, 1993). Since its inception, this theory has inspired novel hypotheses about how exactly MTL subregions contribute to memory, with the hippocampus itself said to mediate relational memory binding and representation. Relational memories were characterized by three fundamental properties that distinguish them from rigidly bound or unitized representations mediated by MTL cortical structures - they cannot be derived from past experience, they exhibit compositionality, and they can be flexibly accessed and used. Results from recent investigations motivated by the relational memory theory suggest an extended reach of the hippocampus beyond long-term declarative memory to the domains of working memory, inferential reasoning, binding across time, language, and online processing. The speakers in this symposium will discuss the neural mechanisms and functional properties of relational memory, highlighting new findings about the role of the hippocampus in the spatial-temporal organization of experiences, building flexible memories that permit novel inferences, and contributions of the hippocampus to memory performance at far shorter time scales than traditional accounts would suggest. A converging methods approach will be emphasized, as speakers will discuss evidence from behavioral, neuroimaging, and neuropsychological investigations conducted with non-human animals, special populations, and neurologically intact individuals. Our intent is to highlight how far we have come, and how the relational memory theory has been instrumental in this process.

TALK 1: THE FUNCTIONAL PROPERTIES AND FUNCTIONALITIES OF RELATIONAL MEMORY

Neal Cohen; University of Illinois at Urbana-Champaign

Relational memory supports the ability to acquire, retain, retrieve, and flexibly use knowledge about facts and events. The hippocampus, in interaction with prefrontal cortex and neocortical processing and storage sites, provides (1) the ability to form representations of all manner of (even arbitrary or accidental) relations, binding together the constituent elements of experience; (2) a relational database critical not just for the creation, but also for the maintenance, updating, and integration of memory representations; and (3) rapid and automatic reactivation of elements of the relational database that are related to information currently being processed. Findings over the last twenty years have established that the ability of hippocampus and relational memory to support

the updating, integration, and flexible use of memory can be used in service of many aspects of cognition and behavior, beyond the traditional domain of conscious recollection and long-term memory. Relational memory processing can occur and contribute even on time-scales usually associated with working memory, capable of rapidly constructing, comparing, combining, and recombining on-line relational memory representations in service of flexible cognition and adaptive control of behavior. In so doing it provides a critical foundation for many aspects of spatial cognition and navigation, inferential reasoning, language, decision-making, creative thinking, and the guidance of adaptive choices.

TALK 2: HIPPOCAMPAL AND PREFRONTAL CONTRIBUTIONS TO THE FORMATION OF INTEGRATED MEMORY NETWORKS

Alison Preston; The University of Texas at Austin

Much memory research to date has focused on how our brains encode and retrieve memories for individual experiences. However, in the real world, it is rare that a decision can be made on the basis of a single memory alone; rather, the vast majority of decision and action requires drawing upon knowledge derived across multiple events. Relational memory theory proposes that the ability to extract new information across distinct episodes results from the formation of integrated memory networks, in which individual memories are connected to one another in terms of the people, places, and things they have in common. These networks would then allow memory to extend beyond direct experience and anticipate the relationships among events. In a series of human fMRI studies, we examine these predictions by having subjects learn overlapping associations (AB, BC) and later testing them on the inferential relationships among items (AC). Using pattern information analysis, we show that prior memories (A items) are reactivated during new BC learning, with the degree of reactivation relating to inference performance. Moreover, hippocampal and ventromedial prefrontal cortex (VMPFC) encoding activation tracked trial-by-trial reactivation of prior memories during new learning as well as subsequent inference. Finally during a rest scan following BC encoding, medial temporal lobe and VMPFC connectivity was enhanced relative to baseline rest, potentially reflecting post-encoding integration. Collectively, our data show that the hippocampus and VMPFC play key roles in constructing integrated memory networks and further demonstrate that these integrated memories are used in service of future decisions.

TALK 3: HIPPOCAMPAL RELATIONAL BINDING ACROSS SPACE AND TIME

Jennifer Ryan; Rotman Research Institute, Baycrest, University of Toronto

The hippocampus has a critical role in the binding of relations among distinct elements across space and time into a lasting representation. Such hippocampal relational memory binding is engaged rapidly and obligatorily, and the resultant representations may be used in service of multiple cognitive operations and over a variety of delays. Behaviorally, the formation of relational representations is reflected in increases in eye movement behavior, suggesting that eye movements may serve as the conduit by which information is integrated. On a neural level, findings from magnetoencephalography have shown that theta oscillations mediate hippocampal binding of relational representations. Specifically, increases in theta power track increases in binding demands and are predictive of subsequent visuospatial memory performance. Damage to the hippocampus, as observed in amnesia, disrupts eye movement binding behavior, reduces binding-related increases in hippocampal theta power and impairs memory for visuospatial relations, even over short delays. Similarly, aging, which is associated with a decline in hippocampal volume, results in altered eye movement binding behavior, reduced hippocampal theta power and relatively impaired memory for visuospatial relations.

TALK 4: THE NEURAL BASIS OF RELATIONAL MEMORY

Howard Eichenbaum; Boston University

I will discuss efforts to identify the neuronal mechanisms that underlie relational memory, specifically the nature of neuronal representations that can relate elements of memories in support of our ability to remember specific episodes and to integrate new experiences into networks of memories. Evidence from multiple approaches will be reviewed, indicating (1) separate anatomical pathways that converge onto the hippocampus the contents of memories and the spatial-temporal organization of experiences, (2) fundamental roles for the hippocampus in both spatial and temporal organization of memories, and (3) physiological evidence on how events are linked within a spatial and temporal organization. These studies reveal that relational memory is a product of a unique representational scheme within hippocampal networks that encodes all manner of relations among experiences and supports the flexible and inferential expression of memories.

Mini-Symposium Session 2

CONTRIBUTIONS OF ALPHA-BAND OSCILLATIONS IN COGNITION

Sunday, April 6, 10:00 am - Noon, Salon E

Chair: Heleen A. Slagter, University of Amsterdam

Speakers: Ali Mazaheri, Heleen A. Slagter, Bradley R. Postle, Markus Bauer

Historically, alpha-band oscillations have been thought to represent the activity of the visual cortex in an idle state. However, a growing body of research, mostly in the domain of visuospatial attention, suggests that alpha-band dynamics play an active role in information processing, including selection among competing brain networks, facilitation of information processing within task-relevant networks, as well as "task-positive" functions related to short-term memory. This symposium will present new empirical evi-

dence and theoretical views on the pivotal role of alpha oscillations in cognition. Mazaheri will start with a general introduction to the topic and show that alpha oscillations can be regarded as a general mechanism for information selection that operates across sensory modalities. Slagter will consider the relationship between pre-stimulus alpha oscillations and early stimulus selection processes (P1 and N1 attention effects), and propose that these neural mechanisms are dissociable and reflect qualitatively different aspects of attention. Next, Postle will present TMS-EEG data providing causal evidence for the notion that alpha oscillations may subserve multiple functional roles, including long-range effective connectivity and possibly the binding of individuated object identities to specific locations. Finally, Bauer will discuss the neurochemical basis of alpha oscillations and its implications for alpha's functional role in cognition. Collectively, these talks will present current debates and open questions in the study of the role of alpha oscillations in cognition to a broad audience. They will also highlight important avenues for future research.

TALK 1: REGION-SPECIFIC OSCILLATORY ALPHA ACTIVITY SERVES TO SUPPRESS DISTRACTING INPUT ACROSS VISUAL AND AUDITORY MODALITIES

Ali Mazaheri; University of Amsterdam

There have been a number of studies suggesting that oscillatory alpha activity (~10 Hz) plays a pivotal role in attention by gating information flow to relevant sensory regions. The vast majority of these studies have looked at shifts of attention in the spatial domain and only in a single modality (often visual or sensorimotor). I will present a series of studies which investigated the role of alpha activity in the suppression of a distracting modality stream. We used a cross-modal attention task where visual cues indicated whether participants had to judge a visual orientation or discriminate the auditory pitch of an upcoming target. The visual and auditory targets were either presented simultaneously or alone, allowing us to behaviorally gauge the "cost" of having a distractor present in each modality. We found that the preparation for visual discrimination (relative to pitch discrimination) resulted in a decrease of alpha power in the early visual cortex, with a concomitant increase in alpha/beta power) in the supramarginal-gyrus, a region suggested to play a vital role in short-term storage of pitch information The changes in alpha-power in the modality-relevant-cortices had direct consequences on performance on a trial-by-trial basis. Our work adds to increasing evidence that the top-down (i.e. attentional) modulation of alpha activity is a mechanism by which stimulus processing can be gated within the cortex. Here, we find that this phenomenon is not restricted to the domain of spatial attention and can be generalized to other sensory modalities than vision.

TALK 2: FACILITATION AND INHIBITION IN ATTENTION: FUNCTIONAL DISSOCIATION OF PRE-STIMULUS ALPHA ACTIVITY, P1 AND N1 COMPONENTS

Heleen A. Slagter; University of Amsterdam

Attention - the ability to attend to some things while ignoring others - can be best described as an emergent property of many neural mechanisms, facilitatory and inhibitory, working together to resolve competition for limited processing resources and control of behavior. To gain a better understanding of how attentional inhibition and facilitation are neurally implemented, here, participants continuously attended to one and the same hemifield for 80 minutes while their brain activity was recorded using EEG. We reasoned that the consistent assignment of relevance to one hemifield would allow us to better separate inhibitory and facilitatory attentional effects. Indeed, in striking contrast to previous studies which typically observed bilateral attentional modulations of early sensory processing when subjects alternated between attending left and right, we found perfectly lateralized P1 and N1 components and attentional modulations to, respectively, ipsilateral (P1) and contralateral (N1) posterior regions. This finding substantiates the idea that the P1 reflects inhibition and the N1 amplification. The fact that these early potentials only occurred over one hemisphere moreover indicates that they may not reflect exogenous sensory signals, as generally assumed, but top-down modulations of feed-forward sensory processing. Moreover, in further contrast to previous studies, greater pre-stimulus alpha activity was observed over relevant vs. irrelevant posterior regions, supporting proposals that alpha power reflects active inhibition only required when irrelevant regions compete for attentional resources. Together, these findings suggest a functional dissociation between pre-stimulus alpha, the P1 and N1, and highlight the influence of statistical task structure on attentional control dynamics.

TALK 3: SIMULTANEOUS (R)TMS AND EEG REVEALS MULTIPLE FUNCTIONAL ROLES FOR ALPHA-BAND OSCILLATIONS

Bradley R. Postle, Stephen Emrich, Jeffrey S. Johnson, Bornali Kundu; University of Wisconsin, Madison, North Dakota State University

Transcranial magnetic stimulation (TMS) offers a means to test causal hypotheses about functions supported by frequency band-specific dynamics in the EEG. One previous study, for example, has provided confirmatory evidence for an inhibitory role for alpha-band oscillations in posterior visual circuits, with repetitive (r)TMS-induced changes in alpha-band power negatively related to rTMS-related changes in visuospatial short-term memory (STM) performance. Here, we will present more recent work highlighting "ask-positive" functions of alpha-band oscillations. In one study, individual differences in delay-period alpha-band power were positively related to the strength of the TMS-evoked response in prefrontal cortex, when TMS was delivered to superior parietal lobule during the delay

period of a spatial STM task. Because this effect was largely attenuated during the ITI, this provides evidence that alpha-band oscillations underlie behaviorally specific patterns of effective connectivity in the dorsal control network. In a second study we used delay-period rTMS to effect a causal test of a hypothesized role for alpha-band oscillations in binding individuated object identities to specific locations. During a variant of the change-detection task - STM for the color-in-location of squares within an array - we delivered rTMS at 10Hz to the inferior IPS. Our results revealed a positive association between rTMS-related change in delay-period alpha-band power and rTMS-related change in STM capacity. They thus provide causal evidence for a role of for posterior alpha-band oscillations in supporting visual STM performance, perhaps by maintaining the bindings between stimulus dimensions in STM.

TALK 4: FEEDFORWARD AND FEEDBACK INFLUENCES IN VISUAL ATTENTION TASKS: EVIDENCE FOR FUNCTIONAL AND NEUROCHEMICAL DISSOCIATIONS BETWEEN ALPHA AND GAMMA-OSCILLATIONS

Markus Bauer; University of Nottingham, University College London

There is abundant evidence for the involvement of both alpha- and gamma-oscillations in selective attention. Despite the regular co-occurence of these spectral phenomena we provide evidence here that they reflect distinct phenomena. While it is known that attentional modulation of alpha-oscillations occurs in the prestimulus-period and that of gamma-oscillations in the post-stimulus period, this could in principle be attributed to different neuronal excitation states (stimulus on/off), known to have opposite effects on these frequency-bands. Here, we provide clear evidence that this is not the case and that instead alpha- and gamma-oscillations are modulated separately and are caused by different top-down signals with different functional characteristics: whereas alpha-oscillations represent mere prediction-signals, gamma-oscillations appear to respond to exogenous and endogenous attentional components. This dissociation resonates with the differential sensitivity we have recently found for these frequency bands to cholinergic neuromodulation. More specifically we have shown that the cholinergic system, which has been closely associated with attentional performance, specifically enhances attentional alpha-/beta-lateralization in visual cortex. I will discuss the presumed pathway and mechanisms how alpha-oscillations are modulated by attentional top-down signals and how this may impact processing of upcoming stimuli.

Mini-Symposium Session 3

Sunday, April 6, 10:00 am - Noon, Salon D

PUTTING PERSON PERCEPTION IN CONTEXT: INSIGHTS FROM SOCIAL NEUROSCIENCE

Chair: Jonathan Freeman, Dartmouth College
Co-Chair: Jay Van Bavel, New York University
Speakers: Jay Van Bavel, William Cunningham, Reginald Adams, Jonathan Freeman

Many prominent models of face and person perception ignore the role of the social context. This mini-symposium features emerging social neuroscience research to shed new light on how various forms of social context shape perceptual and evaluative responses to other people using a wide range of methodologies (univariate and multivariate fMRI, EEG, MEG, modeling, behavioral). The first two presentations will focus on the role of social motives. Jay Van Bavel will explore how the motivational context of identifying with a social group impacts the Fusiform Face Area and early (P100) perceptual responses to in-group and out-group faces, suggesting that initial components of face perception are highly malleable. Wil Cunningham will show how processing goals shape evaluations of other people, reflected in amygdala and anterior cingulate activity. The final two presentations will focus on the impact of perceptual contexts, such as facial cues that contextualize focal perceptions. Reginald Adams will discuss how eye gaze contextualizes facial emotion to signal threat value (e.g., direct-gaze fear and averted-gaze anger convey ambiguous threat). He finds exacerbated amygdala responses to threat-ambiguous vs. threat-specified combinations that vary as a function of neural temporal dynamics, suggesting earlier processing of threat-congruent information. Jon Freeman will examine how stereotypes lead multiple social categories (sex, race, emotion) to mutually interact and shape each other's perception, implicating fusiform regions involved in face perception and prefrontal regions involved in stereotype access and top-down visual predictions. Together, this mini-symposium will help illuminate the fundamental role that the social context plays in person perception.

TALK 1: SOCIAL IDENTITY SHAPES SOCIAL PERCEPTION AND EVALUATION: EVIDENCE FROM BEHAVIORAL, ELECTROENCEPHALOGRAPHY AND NEUROIMAGING EXPERIMENTS

Jay Van Bavel; New York University

Correctly identifying group members is critical for successfully navigating the social world. I will present behavioral, electroencephalography, and neuroimaging experiments that demonstrate the dynamic influence of social identity on perception and evaluation. We assigned people to one of two mixed-race groups and had them respond to faces of Black and White in-group and out-group members. This allowed us to compare the effects of a minimal social identity with a salient social category-race. Across methodologies,

assigning people to mixed-race groups eliminated ostensibly automatic racial biases by leading people to categorize others on the basis of their group membership. Specifically, group membership influenced BOLD activity in core (Fusiform Face Area) and extended (amygdala) components of the face processing network, emerged as early as 100 milliseconds (P100), and shaped consequential downstream behavior (automatic evaluations and recognition memory). This pattern was evident despite the fact that the intergroup distinction was arbitrary, there were no visual cues to distinguish groups, and exposure to the faces was equivalent and brief. Behavioral experiments confirmed that in-group bias was mediated by visual attention and moderated by social motives (e.g., the need to belong). However, multi-voxel pattern analyses of BOLD data revealed that membership in a mixed-race group does not make the visual system "color-blind" to race. Taken together, this program of research suggests that ostensibly automatic forms of racial bias are not inevitable, but are sensitive to seemingly trivial social identity motives that shape the value of social targets.

TALK 2: SHAPING AMBIVALENT RESPONSES IN PERSON PERCEPTION

William Cunningham; University of Toronto

An important aspect of person perception involves our ability to generate useful evaluations that are contextually appropriate. This is particularly important when one's evaluation can shift dramatically, from positive to negative, as in the case of ambivalent attitudes. That is, although people can have objective ambivalence (defined as the existence of conflicting representations), this ambivalence is often times solved by aspects of the situation. Yet, in other situations, ambivalence remains when the situation cannot resolve the ambiguity (subjective ambivalence). In two fMRI studies, I will present data showing how ambivalent attitudes are resolved either through a giving participants a goal to attend to positive or negative features of ambivalent people (Study 1), or how the context of evaluation can resolve ambivalence (Study 2). Specifically, modulation of amygdala and anterior cingulate activation to ambivalent targets were modulated by goals and context. These data support the idea that "top-down" processes inhibit or emphasize parts of the associations to prevent subjective ambivalence and generate more univalent responses.

TALK 3: AMBIGUITY AND THE TEMPORAL DYNAMICS OF THREAT-RELATED ATTENTION

Reginald Adams, Kestutis Kveraga; The Pennsylvania State University, Athinoula A. Martinos Center for Biomedical Imaging, Harvard Medical School

In this talk, we present research examining the intersectional impact of compound facial cues on attention. Early on, using fMRI, we found greater amygdala responsivity to ambiguous (e.g., direct gaze/male fear) versus clear (e.g., averted gaze/female fear) combinations of threat cues. This work helped to resolve a long standing puzzle in the literature as to why amygdala activation was consistently found to fear displays, yet not to anger displays, when anger (at least when coupled with direct gaze) is arguably a clearer signal of threat. We have since also found the opposite pattern of results, with greater amygdala activation to clear- versus ambiguous-threat cues. In an effort to address this apparent discrepancy, we examined whether different adaptive attunements across the temporal stream moderate these effects. Using a dot-probe paradigm, we found greater attentional orienting to rapid presentations of clear combinations of threat cues, and greater sustained attention to ambiguous threat-cue combinations. Paralleling these effects, again using fMRI, we likewise found greater amygdala responses to clear-threat cues when rapidly presented (33ms and 300ms), and to ambiguous-threat cues when presented for more sustained times (1s, 1.5s, 2s). Using MEG, we then examined the neurodynamics of threat perception as it unfolds. Our findings implicate magnocellular "action-related" vision in the processing of clear threat cues, and parvocellular "analysis-related" vision in the processing of ambiguous cues. These findings support an adaptive dual-process framework that favors quick and efficient attentional orienting toward threat-congruent information and later attentional maintenance required to process threat-ambiguous information.

TALK 4: PERSON PERCEPTION AT THE INTERSECTION OF MULTIPLE SOCIAL CATEGORIES

Jonathan Freeman; Dartmouth College

Individuals effortlessly categorize other people along any number of social dimensions, such as sex, race, and emotion. Although often assumed to be independent, in this talk I will propose that these dimensions may intersect in meaningful ways. I will discuss neuroimaging, behavioral, and computational-modeling studies documenting systematic interactions between multiple social dimensions, either due to bottom-up (shared facial cues) or top-down (shared stereotypes) factors, or both. Using a mouse-tracking technique that records hand movements en route to category responses, I discuss evidence that certain social dimensions become perceptually linked. For example, it was found that stereotypes lead Black faces or male faces to partially activate the angry category and appear angrier (even when they express no anger), which was corroborated by computational simulations of the categorization process. Neuroimaging studies involving correlational analyses between mouse-tracking and neural data suggested that the medial and dorsolateral prefrontal cortices play dissociable roles in instantiating these social category interactions and subsequently inhibiting them, thereby allowing faces to be perceived accurately. Finally, multi-voxel pattern analyses characterized the inherent overlap of these different social category representations (e.g., male, Black, anger) in lower-level fusiform regions involved in face perception vs. higher-order prefrontal regions involved in stereotype access and top-down visual predictions. Taken together, this research demonstrates that perceptions of social categories are not independent but rather systematically interact, and implicates both bottom-up and top-down processes in driv-

ing social category interactions. The findings bolster recent intersectional and dynamic-interactive frameworks of social categorization.

Mini-Symposium Session 4

Monday, April 7, 10:00 am - Noon, Salon F

THE NEUROSCIENCE OF SOCIAL NETWORKS

Chair: Kevin Ochsner, Columbia University

Speakers: Lisa F. Barrett, Emily B. Falk, Dharshan Kumaran, Kevin N. Ochsner

Humans are a fundamentally social species that evolved to live and thrive in social groups. For decades, sociologists and ethologists have studied the nature and characteristics of these groups in terms of their network size, structure and an individual's status within them. Until recently, however, little was known about the brain systems governing how we recognize, represent, and act on the basis of own and others status in our social networks. This symposium will highlight how cognitive neuroscience has begun to shed new light on these issues by showing how variables that quantify the kind of social network(s) to which we belong - and our status in them - relate to brain structure and function. Lisa F. Barrett will describe how individuals who are members of larger social networks show structural and connectivity changes in brain systems for emotion and social behavior. Emily Falk will explain how being a connector that links individuals in a friendship network is related to neural markers of the ability to influence other's opinions. Dharshan Kumaran will focus on the fundamental importance of memory systems in allowing individuals to make precise assessments of the social rank and affiliations of others. Finally, Kevin Ochsner will present data documenting how the recognition of who is popular in our networks is supported by the concerted activity of brain systems for affect, social cognition and social perception. Together, these talks illustrate the value of combining the methods of sociology, psychology and cognitive neuroscience.

TALK 1: THE ROLE OF AMYGDALA STRUCTURE AND CONNECTIVITY IN SOCIAL COGNITION

Lisa F. Barrett, Kevin C. Bickart, Bradford C. Dickerson; Northeastern University, Massachussetts General Hospital

This talk will present data from three studies in which we examined the relation of amygdala structure and connectivity to social network size and complexity. Using structural MRI, Study 1 demonstrated the first evidence that amygdala volume uniquely predicts the size and complexity of social networks in healthy adults. Using resting-state functional connectivity analysis, Study 2 demonstrated that healthy adults who have larger and more complex social networks not only have larger amygdala volumes but also amygdalae with stronger functional connectivity within several intrinsic brain networks. Study 3 used structural MRI and a newly developed and validated clinician-based rating scale to demonstrate that atrophy in large-scale brain networks anchored in the amygdala predicted specific social cognitive impairments in a sample of frontotemporal dementia (FTD) patients. From these studies, we have discovered that the amygdala is a component of at least three partially distinct anatomical networks that are important for forming and maintaining social bonds. These findings provide a powerful componential framework for understanding the neural underpinnings of social cognition.

TALK 2: SOCIAL NETWORK STRUCTURE MODULATES NEURAL PROCESSES INVOLVED IN SUCCESSFUL COMMUNICATION AND MESSAGE PROPAGATION

Emily B. Falk, Matthew B. O'Donell, Christopher N. Cascio, Joseph B. Bayer; University of Pennsylvania, University of Michigan

The opinions, behaviors and recommendations of others fundamentally affect human decision-making. At a macro level, sociologists have shown that there is variation in the extent to which people are connected to others and in positions to exert such influence. However, relatively little is known about the neural mechanisms that lead people to share information and what positions them to be successful in persuading others. In a series of studies we have examined the neural processes that promote being a good "idea salesperson" and how these processes interact with broader social environments, including one's position in their social network. We have combined fMRI data gathered during tasks relevant to social influence and message propagation with network data analyzed using tools from social network analysis (SNA). SNA provides a rich set of measures and techniques to quantify the size, structure and scope of an individual's social environment as well as operationalizations of sociological concepts such as opportunities for information brokerage. We find that individuals with more opportunities for information brokerage show increased activity in mentalizing and affective systems that respond to social cues when making recommendations and receiving social feedback about their recommendations. Neural responses within these same brain systems are also associated with successful message propagation and being a good "idea salesperson". The combination of neural and SNA metrics offers a powerful way to analyze links between mechanisms involved in message propagation and the positions occupied by individuals in their social networks.

TALK 3: THE NEURAL MECHANISMS UNDERLYING KNOWLEDGE OF SOCIAL STRUCTURES

Dharshan Kumaran; University College London

Primates have a range of highly developed cognitive abilities that enable individuals to meet the challenging pressures of living in large social groups. In this talk, I will focus on the fundamental importance of memory in prospering in such an environment: whilst perceptual cues (e.g. body posture) may provide a coarse heuristic with which to rapidly evaluate others, detailed knowledge of social structures (e.g. hierarchies, networks) - gradually accrued through a history

previous interactions and experiences - is needed to make more precise assessments of rank and affiliations. I will present a series of experiments in which we used a range of experimental paradigms (e.g. involving "navigation" through one's own real social network, learning of a social hierarchy involving unfamiliar others) in combination with functional and structural brain imaging (fMRI and VBM). Together, I will argue that this work provides insights into the neural substrates underpinning knowledge of complex social structures at several different levels: the brain regions involved (e.g. hippocampus, amygdala, medial prefrontal cortex, superior temporal sulcus), putative computational mechanisms that may underlie learning, and the nature of the representations and information coding schemes involved.

TALK 4: NEURAL SYSTEMS TRACKING POPULARITY IN REAL WORLD SOCIAL NETWORKS

Kevin N. Ochsner, Noam Zerubavel, Peter Bearman; Columbia University

Successfully navigating our complex social world requires understanding the relative status of members of our groups. Sociologists and social psychologists have historically emphasized two kinds of status that have important implications for behavior: power-based status, where individuals vary in their control over resources and outcomes, and affiliation-based status, where individuals vary in the extent to which they are liked by other group members. To date, the majority of neuroscience research has focused on power-based hierarchies rather than affiliation-based popularity. Here we present the first imaging research to examine the neural systems tracking the popularity of members of real-world social networks. To do this we first used social network analysis (SNA) to determine the relative popularity of individuals in in the context of a friendship-based network to which they belonged. We then had members of each network view photographs of other group members and asked, on a trial-by-trial basis, how brain activity parametrically scaled with the popularity the target group member viewed on that trial. We found that activity in three kinds of brain regions tracked target popularity: systems involved in affective evaluation (e.g. vmPFC, amygdala, ventral striatum), social cognition (e.g. dorsal MPFC, TPJ), and social perception (e.g. FFA). Importantly, activity in the affective evaluation systems mediated the relationship between target popularity and activity in other brain regions, suggesting that a history of learning about the affective outcomes associated with popular individuals organizes our responses to them. These data have implications for models of affect, person perception and group behavior.

Mini-Symposium Session 5

Monday, April 7, 10:00 am - Noon, Salon E

A NEW LOOK AT NEURAL REPRESENTATION IN THE PREFRONTAL CORTEX

Chair: Earl Miller, M.I.T.

Speakers: Jonathan Wallis, Earl Miller, Mattia Rigotti

The traditional view of the cortex is like clockwork: Different areas and even individual neurons each have their own specific functions, often organized about sensorimotor information. But from recent work in the prefrontal cortex (PFC), a different view is arising. There are gradients of representations with a large degree of overlap and many multifunctional "mixed selectivity" neurons. We will present evidence for this and discuss its implications. In the first part of the symposium, we will discuss gradients of representations in the PFC. David Badre will show that the human PFC is organized along a hierarchy of rules. Jon Wallis will show that more anterior regions of the monkey orbitofrontal cortex (OFC) encode value in a more abstract form than in posterior OFC. Next, we will turn to the overlap in PFC representations and the mixture of signals on the neuron level. Earl Miller will show that the monkey PFC contains large proportions of multifunction mixed-selectivity neurons whose representations change with task demands, a property that underlies mental flexibility. Finally, Mattia Rigotti will discuss the computational advantages of mixed selectivity. Their high-dimensionality may endow PFC neurons with the flexibility to learn a wide range of tasks, but at the same time they are susceptible to noise, sometimes causing errors.

TALK 1: GRADIENTS OF FUNCTION IN ORBITOFRONTAL CORTEX

Jonathan Wallis; University of California at Berkeley

Several studies have argued that the frontal lobe is organized along a gradient of abstraction, with progressively more abstract information encoded by progressively more anterior frontal areas. In addition, a prominent theory of orbitofrontal cortex (OFC) organization argues that there is a valence gradient, with positive outcomes encoded medially and negative outcomes encoded laterally. To test these ideas, we trained two monkeys on a task that required them to use secondary reinforcement (tokens that could later be exchanged for juice) in order to learn optimal behavior. We could reward the subject by giving them a token and punish the subject by taking tokens away. This enabled us to test whether OFC contained an abstraction gradient (secondary reinforcement is more abstract than primary reinforcement) and/or a valence gradient. We found no evidence to support the valence gradient: throughout OFC, neurons encoding reward were interspersed with those encoding punishment. In addition, there was no evidence that neurons encoding secondary reinforcers were located more anteriorly to those encoding primary reinforcers. However, neurons in the posterior OFC tended to encode the value of either the second-

ary or primary reinforcer, whereas neurons in anterior OFC encoded the value of the reinforcer independent of whether it was secondary or primary. Thus, although our results are not what we expected, they are nevertheless consistent with a more abstract value signal encoded in more anterior OFC regions.

TALK 2: FLEXIBLE NEURONS FOR A FLEXIBLE MIND

Earl Miller; Massachusetts Institute of Technology

The picture emerging from many years of neurophysiological investigation of the prefrontal cortex (PFC) is that of a highly adaptive, non-linear, system. Many neurons do not have fixed functions; they seem to have "mixed selectivity". PFC neurons are tuned to mixtures of multiple task-related aspects. This is in contrast to typical sensory or motor cortical neurons that are selectively activated by relatively few, often related properties (e.g., spatial location, direction of motion, edges, etc.) and whose activity is thought to always "mean" the same thing like "leftward motion there". Instead, many PFC neurons have more extensive and eclectic inputs from a wide range of external (sensory, motor) and internal (values, memories, etc.) information sources. The result is a large population of neurons that can participate in many functions, the "meaning" of their activation changing depending on behavioral context: the task at hand. I will show examples of this mixed selectivity and argue that they are key to a hallmark of intelligence: mental flexibility.

TALK 3: UNDERSTANDING ERRORS IN COMPLEX COGNITIVE TASKS: THE ROLE OF MIXED SELECTIVITY

Mattia Rigotti; Columbia University

Prefrontal cortex (PFC) neural activity is characterized by a striking diversity: in animals engaged in cognitive behavior, PFC neurons are reliably but idiosyncratically tuned to mixtures of multiple task-related aspects (mixed selectivity). The responses of individual neurons are consequently difficult to interpret, but these interpretative difficulties readily dissolve when we take a neural population perspective. This approach reveals that mixed selectivity at the level of individual neurons is a signature of high-dimensionality at the level of population activity. The importance of high-dimensionality resides in the impressively large repertoire of downstream response functions that it accommodates. We recently showed (Rigotti et al. Nature 2013) that such computational advantage is probably important for subserving the cognitive functions ascribed to the PFC, since the dimensionality of the activity patterns is predictive of animal behavior, as it collapses in error trials. Surprisingly, the selectivity to individual task-related variables does not appear to decrease during errors. We present a model of the neural responses that reconciles these seemingly contradictory observations. We show that the mixed selectivity component of the response greatly contributes to the dimensionality of the patterns of activity but is fragile to noise. In the error trials this component is most strongly affected, impairing the ability of the animal to perform the task. However, the non-mixed component, which is more robust, still encodes the individual task-related variables. The model explains the PFC neural recordings collected in (Warden, Miller 2009) and analyzed in (Rigotti et al 2013).

Mini-Symposium Session 6

Monday, April 7, 10:00 am - Noon, Salon D

PREDICTION, ADAPTATION AND PLASTICITY OF LANGUAGE PROCESSING IN THE ADULT BRAIN

Chair: Gina Kuperberg, Tufts University & MGH

Speakers: T. Florian Jaeger, Matthew H. Davis, Kara D. Federmeier, Gina R. Kuperberg

This mini-symposium focuses on adaptation and plasticity of language processing in the healthy adult brain. It explores the idea that prediction in language is inherently linked to language adaptation and learning. We bring together several leaders who will discuss these relationships from different perspectives, presenting data collected using multiple techniques. First, Florian Jaeger, together with Dave Kleinschmidt, will situate the relationship between prediction and learning in a changing environment within a rational "ideal observer" framework, discussing data from computational Bayesian models. Second, Matt Davis will discuss a series of magneto-encephalography (MEG) and functional MRI (fMRI) experiments suggesting that the brain's adaptation to degraded speech depends on the accuracy of prior predictions, linking these findings to predictive coding models of neural processing. Third, Kara Federmeier, together with Eddie Wlotko, will discuss a large body of electrophysiological research examining the impact of prediction violations at the levels of semantic, lexical, and perceptual features, highlighting how quickly we adapt to such errors, and how this varies across the lifespan. Finally, Gina Kuperberg will discuss electrophysiological and fMRI studies examining prediction at the semantic-syntax interface, suggesting that the certainty of our predictions can directly influence the neurocognitive mechanisms we engage to comprehend real-world events in different discourse contexts. This symposium is timely and important. It revisits key questions about the architecture of language comprehension in the brain in the light of core computational and neural principles of learning, adaptation and executive function.

TALK 1: EFFICIENT LANGUAGE UNDERSTANDING IN A VARIABLE WORLD: PREDICTION AND ADAPTATION

T. Florian Jaeger, Dave F. Kleinschmidt; University of Rochester

Whether reading, listening, or viewing sign language, the linguistic signal comprehenders receive is perturbed by noise. This makes language understanding a problem of inference over noisy input. The ideal solution to this problem is to take advantage of prior (top-down) knowledge in predicting the signal, thereby facilitating efficient inference of the intended message. In line with such ideal observer models, prediction is an essential part of language processing. However, producers differ in their realizations of linguistic sounds as well

as lexical and syntactic preferences. As a consequence the statistics required for efficient prediction actually differ (i.e., are subjectively non-stationary) between environments (e.g., between speakers/writers). How then is efficient prediction even possible? We propose that the brain achieves this by a) recognizing previously encountered environments (e.g., a familiar speaker or experimental testing room), b) generalizing across environments based on similarity to previous experience, and c) implicitly learning the statistics of novel environments (e.g., a new speaker). That is, not only do we continuously learn, but we do so while imputing and updating structure over linguistic environments (e.g., groups of speakers that share an accent or dialect). We discuss existing evidence that supports this view and present a computational framework that guides future work on how the brain integrates prediction errors by learning at multiple levels of representation. Language is an ideal domain to pursue the question of how we navigate a variable world, because of its comparatively well-understood rich structure.

TALK 2: PREDICTIVE MECHANISMS SUPPORT RAPID ADAPTATION AND SLOW CONSOLIDATION IN LEARNING TO UNDERSTAND SPEECH

Matthew H. Davis; University of Cambridge

Processes of learning and adaptation are key to successful perception and comprehension of the degraded, novel, and ambiguous speech that we encounter in our everyday life. I will here contrast two forms of learning: (1) rapid adaptation processes that operate over the course of minutes to enhance comprehension of ambiguous or degraded speech, and (2) episodic encoding and overnight consolidation processes that integrate novel input into longer-term knowledge during overnight sleep. Behavioural and neuroimaging evidence shows both learning processes operate at phonetic, lexical, and semantic levels. I will argue, however, that key neural computations supporting these different forms of learning are distinguished not by the level of the comprehension system that is modified, but rather by the accuracy of prior prediction at the time that variant input is heard. Rapid adaptation is achieved by reinforcing accurate predictions and suppressing inaccurate predictions for upcoming speech sounds, words or meanings. Thus, adaptation is enhanced when prior knowledge permits more accurate predictions: if listeners hear degraded spoken words after seeing their written form (cf. Sohoglu et al, 2012, J Neuroscience), or ambiguous words are presented after disambiguating contexts (Rodd et al, 2012, Cerebral Cortex). In contrast, novel and hence unpredicted speech sounds, words or meanings are encoded by hippocampal, episodic mechanisms (Davis & Gaskell, 2009, Philosophical Transactions), and online predictions are only modified after overnight consolidation (Gagnepain et al, 2012, Current Biology). I will propose a predictive coding account of speech perception and learning that unifies these different neural mechanisms.

TALK 3: BETTER OR WORSE THAN EXPECTED? ERPS REVEAL DYNAMIC MODULATION OF PREDICTIVE PROCESSING MECHANISMS DURING LANGUAGE COMPREHENSION

Kara D. Federmeier, Edward W. Wlotko; University of Illinois, Tufts University

Current views of language comprehension have been importantly shaped by compelling electrophysiological evidence that language processing can be facilitated by expectations for semantic, lexical, and perceptual features of likely upcoming words. This evidence for facilitative effects of prediction is complemented by findings of processing consequences when predictions are disconfirmed. Prediction thus requires processing resources, whose deployment may be difficult for some people (e.g., older adults) and may be disadvantageous in some processing circumstances. Our research shows that multiple language comprehension mechanisms are implemented in parallel and that the brain adapts its use of these mechanisms, not only over the long-term, in response to changing neural and cognitive abilities with age, but also over the short-term, in response to situational and task demands. For example, when the utility of prediction for comprehension is reduced, by repeatedly substituting unexpected synonyms for strongly expected words, electrophysiological signatures of predictive comprehension are diminished. However, when participants are given an additional task for which prediction can be beneficial, indices of predictive processing reappear for those same stimuli. Our results thus show that the brain evaluates the utility and/or success of a predictive mode of comprehension on the fly and dynamically adjusts comprehension strategies vis-a-vis the situational and task context, such that resources can be allocated to most effectively achieve comprehension aims. We link these results to emerging understandings of domain-general mechanisms of cognitive and neural control.

TALK 4: COMPREHENDING EVENTS IN CONTEXT: LANGUAGE COMPREHENSION IS LANGUAGE LEARNING

Gina R. Kuperberg; Tufts University, Massachusetts General Hospital

Comprehending language requires us to decode rapidly-unfolding sequences of letters or sounds in noisy environments. Some have proposed that, to meet this challenge, we use our stored linguistic and real-world knowledge to predict upcoming information ahead of bottom-up input. Others, however, have argued that prediction is counterproductive: why predict, only to be proved wrong? This controversy may stem from several assumptions about the nature of prediction: that prediction necessarily equals lexical prediction, that it is necessarily an all-or-nothing phenomenon, and that inaccurate predictions necessarily lead to inefficient comprehension. I will summarize evidence from multimodal neuroimaging studies suggesting that these assumptions are wrong. First, we can predict at the level of syntactic and coarse semantic features, which can map on to one another ahead of the bottom-up input,

thereby predicting event structure(s), without necessarily committing to specific lexical forms. Second, these predictions are probabilistic, generated with various degrees of certainty. Third, the neurocognitive mechanisms engaged when these predictive semantic-syntactic mappings are violated depend on the certainty with which they were generated, and equate to the neural costs of unifying an incoming word into its context. I discuss two general implications of this framework: (1) the spatiotemporal patterns of neural activity evoked by an incoming word in context depend on the representational level and the certainty of our prior predictions; (2) language comprehension is language learning: the costs of our prediction errors are what drive us to adapt to our wider statistical environment in a continuous attempt to refine these predictions.

Mini-Symposium Session 7

Tuesday, April 8, 10:00 am - Noon, Salon F

MECHANISMS OF MEMORY CONSOLIDATION DURING SLEEP

Chair: Susanne Diekelmann, University Tuebingen, Germany

Speakers: Ken A. Paller, Jessica D. Payne, Rebecca L. Gómez, Susanne Diekelmann

It is a relatively new insight that sleep facilitates the consolidation of newly acquired memories. Sleep after learning typically leads to better memory performance at a later retrieval test compared to equivalent periods of wakefulness. Although current evidence overwhelmingly suggests that sleep consolidates memory, we are only starting to understand the psychological and neurophysiological mechanisms underlying this intriguing effect. The present symposium provides an overview of hot topics and new opportunities for understanding mechanisms of sleep-dependent memory consolidation in humans. The first contribution by Ken Paller (Northwestern University) introduces memory reactivation during sleep as a presumed consolidating mechanism and shows that it is possible to trigger specific memories during sleep by using auditory cues that are associated with single memory contents. The second talk by Jessica Payne (University of Notre Dame) reports data on the role of rapid eye movement (REM) sleep for the consolidation of emotional memory, indicating that physiological reactivity to emotional stimuli at encoding channels the preferential consolidation of this information during subsequent REM sleep. The third talk by Rebecca GÃ³mez (University of Arizona) examines the role of sleep in the abstraction of underlying rules from newly learned material in infants and young children, showing that sleep might serve different functions for memory abstraction during development. The fourth contribution by Susanne Diekelmann (University Tuebingen, Germany) discusses how sleep, particularly slow wave sleep, preferentially consolidates memories that are relevant for future behavior, such as prospective memory for intended actions.

TALK 1: TARGETED MEMORY REACTIVATION DURING SLEEP

Ken A. Paller; Northwestern University

A fundamental feature of memory is the propensity for changes in storage after initial encoding. Recent findings favor the possibility that memory consolidation during sleep might be instrumental for determining the nature of long-term memory, by actively maintaining the memories that we carry through our lives. In other words, the information that is ultimately available for retrieval may tend to be that which is reactivated during sleep. Some support for this idea comes from studies of healthy elders and patients diagnosed with amnestic Mild Cognitive Impairment. We showed, for example, that overnight retention of verbal information was related to intervening slow-wave sleep, and that defective slow-wave sleep can contribute to age-related memory impairment. What factors determine which information is reactivated and what memories we keep or lose? Studies of young, healthy individuals have shown that memory processing during sleep can benefit memory storage, particularly for information that is valued for future use. Moreover, we can proactively determine what memory processing takes place during sleep. We used subtle auditory cues during slow-wave sleep to promote the reactivation of specific spatial associations and of specific skills. Research elucidating the mechanisms of this targeted memory reactivation provides important clues about memory consolidation during sleep and about how we can make the best use of this understudied aspect of memory function. Moreover, novel applications of methods of targeted memory reactivation offer potential advantages, and may prove helpful for applications when learning is critical for recovery from disease or for overcoming maladaptive prior learning.

TALK 2: EMOTIONAL MEMORY AND PSYCHOPHYSIOLOGICAL REACTIVITY FOLLOWING A NIGHT OF SLEEP

Jessica D. Payne; University of Notre Dame

Negative objects are typically better remembered than the neutral backgrounds on which they are placed, while neutral objects and backgrounds tend to be remembered equivalently. This preferential reinforcement of negative arousing stimuli within scenes is known as the emotional memory trade-off effect, and it has been shown to increase following periods of sleep. Here we examined 1) the sleep stage correlates of this selective benefit to emotional objects within scenes, 2) whether the degree of physiological reactivity (as measured by heart-rate deceleration) to images at encoding would predict subsequent memory for these objects, and 3) whether physiological reactivity in response to scenes at encoding would be depotentiated following sleep compared to wakefulness. Results suggest that preferential memory for emotional objects was associated with rapid eye movement (REM) sleep, that the degree of heart rate deceleration to negative scenes at encoding predicted selective memory for negative objects, but only in the sleep group, and that sleep globally depotentiated physiological reactivity to both negative and neutral scene components. These results sug-

gest that selective emotional memory consolidation during sleep is largely associated with time spent in REM sleep, that larger visceral reactions to negative pictures at encoding set the stage for this preferential memory for negative objects following a night of sleep, and that sleep has a net depotentiating effect on physiological reactivity to images, regardless of valence.

TALK 3: THE (COMPLICATED) ROLE OF SLEEP IN ABSTRACTION IN INFANTS AND YOUNG CHILDREN

Rebecca L. Gómez; University of Arizona

Abstraction is a crucial form of learning involving retention of key aspects of experience while enabling generalization to new information. This ability is critical for infants and young children who must generalize to similar but not identical instances to those encountered during learning (e.g., a familiar grammatical form instantiated in novel vocabulary or a new referent for an existing word). We investigate contributions of sleep to abstraction in children for whom memory structures are developing. At 15 months of age, a period of less mature memory, sleep in an interval immediately after learning enables abstraction of a linguistic rule and portability of that rule to new vocabulary after a 4-hour delay. With increased maturity of memory structures the relationship between sleep and abstraction becomes more complex. Preschoolers (2-3 years of age) who successfully form an abstraction during learning must sleep soon afterwards to demonstrate abstraction 24 hours later. However, in preschoolers unable to form an abstraction during learning, immediate sleep may be disadvantageous: the high levels of NREM sleep characteristic at this age appear to contribute to consolidation of irrelevant details and an inability to abstract later. The findings suggest that sleep plays different roles for memory and abstraction at different points in development perhaps as a function of the learning systems most involved, with cortical systems prevailing in infancy as compared to increased hippocampal functioning thought to come online in early childhood.

TALK 4: THE ROLE OF FUTURE RELEVANCE IN SLEEP-DEPENDENT MEMORY CONSOLIDATION

Susanne Diekelmann; University Tuebingen, Germany

Memories are of the past but serve to regulate future behavior. While sleep is well known to benefit the consolidation of memories for past events, the role of sleep for memories of future relevance is less well understood. Recent research provides initial evidence that consolidation processes during sleep are not non-selective but target preferentially those memories that are relevant for future behavior, such as memories for which participants expect a retrieval test and memories that are associated with monetary reward. In a series of studies, we have also shown that the prototype of future-relevant memory, prospective memory for intended actions, is especially facilitated by sleep. Sleep improves the ability to execute intended actions after a delay of two days, and this improvement specifically depends on slow wave sleep rather than REM sleep. Sleep thereby enhances both components of prospective memory, (i) to remember that something has to be done and (ii) to remember what has to be done. Moreover, the facilitative effect of sleep on prospective memory is particularly evident under conditions of reduced attentional resources at retrieval, suggesting that sleep strengthens intentional memory representations so that the intention automatically comes to mind at the appropriate time without the need for additional attentional resources. This evidence collectively indicates that some memories gain preferential access to sleep-dependent memory consolidation based on their relevance for future behavior.

Mini-Symposium Session 8

Tuesday, April 8, 10:00 am - Noon, Salon E

MEG, EEG AND FMRI BASED FUNCTIONAL CONNECTIVITY ANALYSIS: RELEVANCE TO COGNITION

Chair: Satu Palva, Neuroscience Center, University of Helsinki

Speakers: Satu Palva, Nathan Weisz, Joerg Hipp, Jonathan Power

Recent advances in functional neuroimaging have highlighted the role of inter-areal interactions and functional connectivity in human cognition. Non-invasive electrophysiological recordings with electro- and magnetoencephalography (EEG / MEG) with excellent temporal resolution permit the monitoring of functional connectivity in the sub-second time-scale of human cognitive operations. Functional magnetic resonance imaging (fMRI) recordings have further revealed a reliable and spatially detailed organization of human functional networks during rest. This symposium will discuss recent results which show that when MEG and EEG are combined with source reconstruction techniques and graph theory metrics, large-scale functional connectivity and inter-areal synchronization can be revealed in several temporal scales and anatomical networks. The strength and spectro-anatomical patterns of these inter-areal interactions predict the behavioral task-performance in perceptual, working memory, and attention tasks. We also present data showing that plastic changes in congenital blindness are associated with changes in local and large-scale neuronal interactions during rest and an auditory task. Further, we will discuss the spatial organization of fMRI-derived human functional connectivity and ways to identify important nodes in correlation networks and examine the differential impact, in cognitive terms, of human brain lesions in different parts of the network. Our symposia attempts to argue that the rich hierarchy of functional connectivity in sub-second time-scales may underlie the integration of information across brain regions to mechanistically support human cognition. We will further argue that both sub-second time-scale connectivity observed with MEG and slow BOLD fluctuations in fMRI predict sensory and cognitive impairments and plasticity of neuronal networks.

TALK 1: INTER-AREAL SYNCHRONY IN FRONTO-PARIETAL AND SENSORY NETWORKS UNDERLIES PERFORMANCE IN WORKING MEMORY AND ATTENTION TASKS.

Satu Palva, Sheng Wang, Roosa Honkanen, Santeri Rouhinen, J. Matias Palva; Neuroscience Center, University of Helsinki

Attention and working memory (WM) are associated with large-scale neuronal activity distributed across the cortex. Neuronal mechanism underlying the coordination of this anatomically distributed processing into introspectively coherent cognition has remained largely unknown. Synchronization of neuronal activity in beta- and gamma- frequency bands gives rise to transient neuronal assemblies that may through relational coding beget the coordination and integration of distributed processing. I will present data investigating the functional role of local and large-scale neuronal interactions in attention and working memory (WM). We have estimated inter-areal synchronization and local oscillation amplitudes from concurrent MEG and EEG recordings in individual cortical anatomy by using source reconstruction techniques and graph theory metrics during visual WM and attention tasks. The strength of inter-areal synchronization in several distinct anatomical networks and sub-second time-scales predicts the task-performance and individual variations in behavioral accuracy and capacity of both attention and WM. To estimate neuronal correlates of multi-object visual attention, we used fMRI based sub-network structures to identify the strength of synchronization in distinct subsystems. These data reveal that the behavioral performance and attentional capacity is mainly predicted by concurrent synchronization in fronto-parietal and sensory networks. We have furthermore observed that both local and inter-areal synchronization during working memory retention period in task-relevant visual and fronto-parietal regions are correlated with and predict the performance and features maintained in visual working memory task. Together these data reveal that local and inter-areal synchronization in several sub-second time-scales may mechanistically underlie the performance in human attention and WM tasks.

TALK 2: PRE-STIMULUS FUNCTIONAL NETWORKS FORM PREDISPOSITIONS FOR UPCOMING CONSCIOUS PERCEPTS OF NEAR-THRESHOLD STIMULI

Nathan Weisz, Julia Frey, Sabine Leske, Thomas Hartmann, Philipp Ruhnau; Center for Mind and Brain Sciences, University of Trento, Italy, Department of Psychology, University of Konstanz, Germany

Near-threshold (NT) stimuli are often used to study neural processes associated with conscious experience. An increasing amount of works show that already prior to stimulation reduced alpha power in task-relevant regions are predictive of perceiving the NT stimulus. This has been mainly interpreted within the context of the functional inhibition hypothesis, stating relevant areas to be in a state of relatively reduced excitability. In a series of MEG studies, we show that reduced alpha power prior to hits is accompanied by increases on network measures that imply a stronger integration of the respective regions in a distributed functional network. Our findings argue for pre-established pathways of neural communication that form "windows" to upcoming conscious access. The lecture intends to introduce this framework and will exemplify how the combination of functional connectivity and graph theory to MEG data helps to gain deeper insights into the predispositions of conscious perception.

TALK 3: ALTERED NEURONAL INTERACTIONS IN THE CORTEX OF THE BLIND

Joerg Hipp, David J. Hawellek, Andreas K. Engel, Markus Siegel; Center for Integrative Neuroscience (CIN), University of Tubingen, Center for Neural Science, New York University, University Medical Center Hamburg-Eppendorf

In congenital blindness, the brain develops under severe sensory deprivation and undergoes remarkable plastic changes in both structure and function. However, the neuronal mechanisms that underlie this altered functional state remain largely unknown. I will present MEG experiments investigating local and large-scale neuronal interactions in the visual cortex of the blind during resting, and in an auditory task. Comparing resting activity in the blind and sighted visual cortex revealed dramatic differences in neuronal interactions that dissociate from effects in local signal power. Furthermore, we found specific oscillatory processes that reflect non-visual auditory processing in the visual cortex of the blind, and found that these processes were functionally coupled with the auditory cortex. This work reveals intact electrophysiological activity in deprived visual cortex and suggests that it is functionally integrated into a larger network serving non-visual functions.

TALK 4: HEALTHY BRAIN NETWORK ORGANIZATION PREDICTS COGNITIVE OUTCOMES AFTER BRAIN LESIONS

Jonathan Power, David Warren, Joel Bruss, Natalie Denburg, Haoxin Sun, Steve Petersen, Daniel Tranel; Washington University in Saint Louis, University of Iowa

The systems-scale organization of the human brain has become much better understood in the last decade, largely because of the realization that task-associated regions display correlated spontaneous fluctuations in fMRI BOLD signal. Several groups have now partitioned the human cortex into 1-2 dozen distributed systems, many of which have (partially) known functional attributes (e.g., the visual system, the dorsal attention system, etc.). Here, we will discuss one such strategy for partitioning the brain into functional systems. We then identify locations (target locations) in the brain that 1) are proximal to elements of many systems, and 2) exhibit spontaneous BOLD correlations to many systems. We predict that lesions to such locations may disrupt interactions among different systems, leading to broad and potentially severe impairments in cognition. We then test this hypothesis by examining the behavioral and cognitive profiles of subjects with focal, stable brain lesions at target locations. We contrast the effects of lesions at target

locations with the effects of lesions at control locations that do not possess either of the properties mentioned above, but which have been previously identified as "cortical hubs" using methods we have argued against. Lesions to target locations (N=19) uniformly produced widespread impairment across many cognitive domains that far exceeded the deficits predicted by traditional neuropsychological principles. In contrast, lesions to control locations (N=11) uniformly produced impairment in one or few cognitive domains, in accord with clinical expectations. These preliminary results substantiate our predictions and suggest revisions of current understanding of brain hubs.

Mini-Symposium Session 9

Tuesday, April 8, 10:00 am - Noon, Salon D

OSCILLATORY MECHANISMS OF ATTENTIONAL CONTROL

Chair: Tom Marshall, Donders Institute for Brain, Cognition and Behaviour, Nijmegen (Netherlands)

Co-Chair: Ole Jensen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen (Netherlands)

Speakers: Lisa Payne, Tom Marshall, Saskia Haegens, Clayton Curtis

The alpha rhythm is the most prominently observable feature in human EEG and MEG. Originally believed to reflect "cortical idling", a body of evidence suggests that alpha in fact reflects functional inhibition. Specifically, alpha oscillations in sensory cortex are believed to reflect active inhibition of task-irrelevant information and of task-irrelevant brain-regions, allowing efficient communication between task-relevant regions and processing of task-relevant information. In this framework, alpha reflects a top-down inhibitory drive whereas gamma-band oscillations reflect active processing. This interaction between high and low frequency oscillations may represent a fundamental mechanism by which the brain operates as a network, however the mechanisms by which the alpha rhythm is generated locally in sensory cortex, the mechanisms controlling its deployment, its spatiotemporal scope, and the interaction between alpha and gamma oscillations are not yet fully understood. In this symposium we will draw on a range of methods - scalp and intracranial EEG, MEG, laminar recordings from non-human primates, and non-invasive brain stimulation (TMS) - to attempt to characterize the oscillatory mechanisms which manifest attentional control. Particularly, we will address the following questions: 1) Which brain regions exert top-down control allowing alpha oscillations to be deployed in a task-appropriate manner? 2) What is the underlying neurophysiological mechanism by which the sensory alpha rhythm is generated? 3) What is the spatial and temporal specificity of the active inhibition produced by alpha? 4) How can the interaction between alpha oscillations and gamma oscillations be characterized?

TALK 1: ALPHA-BAND OSCILLATIONS PROTECT SELECTIVE AUDITORY AND VISUAL PROCESSING

Lisa Payne, Chad Dube, Robert Sekuler; Brandeis University, Waltham, MA, USA

Change in cortical alpha band oscillations (8-14 Hz) has been used as a marker of attentional control. We demonstrated that cued, intentional ignoring of task-irrelevant information gives rise to increased electroencephalogram (EEG) alpha-band power for auditory, linguistic, and visual stimuli. In experiment one, subjects' attention was directed either to an auditory attribute of spoken words or to an orthographic attribute of printed words. Right-lateralized posterior alpha band power increased after a cue to ignore the spoken word, consistent with previous results of auditory selective attention. During a word recognition test after all trials had been completed, subjects performed at chance for recall of voice gender for words they had been cued to ignore. Strikingly, when subjects were cued to ignore the font of a printed word, alpha oscillations increased over left fronto-temporal regions commonly associated with verbal processing. In experiment two, subjects' attention was directed either to the first or second of successive, briefly-presented study Gabors. A cue preceding each Gabor signified whether that Gabor should be remembered or ignored. After a brief retention period, subjects reproduced the spatial frequency of the to-be-remembered Gabor. When the to-be-ignored Gabor appeared second in the sequence, pre-stimulus, posterior alpha power predicted the degree to which that task-irrelevant stimulus distorted subsequent recall of the to-be-remembered stimulus. Together the two sets of results demonstrate that timely deployment of attention-related alpha-band oscillations can aid short-term memory by filtering out task-irrelevant information.

TALK 2: A CAUSAL ROLE FOR FEF IN TOP-DOWN CONTROL OF ALPHA AND GAMMA OSCILLATIONS DURING ATTENTIONAL ALLOCATION

Tom Marshall, Ole Jensen, Til Ole Bergmann; Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands

Directing attention produces frequency-specific modulation of neuronal oscillations in sensory cortex; anticipatory alpha band activity decreases contralaterally and increases ipsilaterally to attention, whereas stimulus-induced gamma band activity increases contralaterally and decreases ipsilaterally to attention. We investigated the role of the Frontal Eye Fields (FEFs) in providing top-down control of these modulations. Previous research has suggested that the right FEF is dominant; right FEF disruption produces stronger effects on both attention and perception. We inhibited activity in left FEF, right FEF, or vertex (control) in separate sessions using continuous theta burst stimulation (cTBS), before measuring magnetoencephalography (MEG) whilst participants performed a cued spatial attention task. Individual FEF sites were functionally localized using fMRI. Analysis of the control condition revealed characteristic modulations of alpha and gamma oscillations: anticipatory alpha power decreased contralaterally and increased ipsilaterally to attention; stim-

ulus-induced gamma power increased contralaterally and decreased ipsilaterally to attention. cTBS produced site- and frequency-specific disruptions of these effects: right FEF cTBS inhibited anticipatory alpha modulation in the right hemisphere; left FEF cTBS inhibited alpha modulation in the left hemisphere. Stimulus-induced gamma modulation in left hemisphere was increased following right FEF cTBS, whereas left FEF cTBS produced no effects. Thus, whilst the alpha effects were symmetric, the gamma effects were specific to right FEF stimulation, suggesting that the previously reported right-hemisphere dominance in this network is mediated by high-frequency stimulus-induced oscillatory activity. These data demonstrate a causal role for FEF in the direction of visual attention by top-down control of both alpha and gamma oscillations.

TALK 3: LAMINAR PROFILE OF THE SENSORY ALPHA RHYTHM

Saskia Haegens; Columbia University College of Physicians and Surgeons, New York Cognitive Neuroscience and Schizophrenia Program, Nathan Kline Institute, Orangeburg

Recent work suggests that oscillatory brain activity in the alpha band (8-14 Hz) reflects functional inhibition and plays an important role in attention. However, the underlying neurophysiological mechanisms remain fairly ill-understood. Here, we studied the laminar profile of the alpha rhythm in primary visual (V1), somatosensory (S1) and auditory (A1) cortex of the macaque monkey. We used linear-array multi-electrodes to record laminar profiles of spontaneous and sensory event-related local field potentials (LFP) and multi-unit activity (MUA) in S1, V1 and A1. We examined the laminar profile of the alpha rhythm both in the LFP signal and in its second derivative, the current source density (CSD) signal, which helps to localize underlying current generators. First, we asked in which layer alpha activity is most prominent. In accordance with earlier reports, we found that in the LFP profiles, alpha was strongest in infragranular layers. However, based on the CSD profiles, alpha was strongest in supragranular layers. Next, we showed that the reference location substantially affects the LFP but not the CSD spectra. We propose that the LFP signal partly reflects volume-conducted activity, while the CSD allows us to zoom in on local generators, hence leading to this seemingly surprising difference. We then asked how alpha interacts with neuronal processing as reflected by MUA, and found that granular MUA aligned with supragranular alpha phase. Furthermore, we explored how different attention conditions affect alpha activity per layer. We conclude that the laminar pattern of alpha band activity might be more complex than generally assumed.

TALK 4: PHASIC CHANGES IN GAMMA POWER AND THE MECHANISMS OF WORKING MEMORY

Clayton Curtis, Sangita Dankedar; New York University

Past research on the neural mechanisms of working memory has almost exclusively focused on persistent neural activity, which is thought to integrate perception and action over time. In contrast, phasic changes in neural activity during working memory have remained largely unexplored. Here, we examine phasic changes in the power of gamma oscillations during working memory maintenance. We acquired intracranial electroencephalography recordings from the posterior parietal cortices of human patients with pharmacologically intractable epilepsy performing a memory-guided saccade task. Significant cross frequency coupling was observed between gamma power and the phase of alpha oscillations. In addition to sustained, spatially specific changes in gamma power, we also observed phasic changes in gamma power during the working memory delay period, with the phasic changes in gamma power occurring at predominantly frequencies in the alpha range. The results suggest that phasic high frequency power changes are involved in working memory maintenance. Low frequency (phase-locking) oscillations and cross frequency coupling could be mechanisms employed to mediate the timing and amplitude of high frequency localized activity. We hypothesize that these phasic changes - the periodic coupling between local populations of neurons in parietal cortex and spatially separated regions of cortex - are the means by which top-down attention signals coordinate large-scale brain networks.

Poster Schedule

Poster sessions are scheduled for Saturday-Tuesday in the 3rd Floor Back Bay Conference and Exhibition Hall of the Boston Marriott Copley Place Hotel. All attendees must present their CNS 2014 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 registered poster presenters, wearing a CNS 2014 meeting badge, 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.

Please remove your poster promptly at Take-Down Completed time, so that the next presenter may set up their poster.

Poster Session	Date	Setup Begins	Session Begins	Session Ends	Take-Down Completed
A	Saturday, April 5	2:30 pm*	3:00 pm	5:00 pm	7:00 pm
B	Sunday, April 6	7:30 am*	8:00 am	10:00 am	12:30 pm
C	Sunday, April 6	12:30 pm*	1:00 pm	3:00 pm	7:00 pm
D	Monday, April 7	7:30 am*	8:00 am	10:00 am	12:30 pm
E	Monday, April 7	12:30 pm*	1:00 pm	3:00 pm	5:00 pm
F	Tuesday April 8	7:30 am*	8:00 am	10:00 am	12:30 pm
G	Tuesday April 8	12:30 pm*	1:00 pm	3:00 pm	5:00 pm

* Please note that only scheduled registered poster presenters may enter the exhibit hall during the half hour set-up time. All other attendees may only enter when the exhibit hall opens.

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Vote for your favorite poster during each Poster Session. One winner will be selected per session to receive a $125 Award! Voting will take place at the Exhibit Hall entrance. Winners will be posted each morning at the Member Service Desk.

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Be sure to check out their poster presentations!

Poster Session A

ATTENTION: Nonspatial

A1

CONTRIBUTIONS OF SUPPRESSION TO OBJECT BASED SELECTIVE ATTENTION Jane Couperus[1], Colin Quirk[1]; [1]Hampshire College — Object-based attention studies have shown that facilitation spreads across objects (Egly, Driver, and Rafal, 1994), enhancing processing to unattended locations on attended objects. However, less is known about suppression in object-based attention despite previous research suggesting suppression contributes to space-based attention (Couperus and Mangun, 2010). This investigated suppression during object-based attention. Twenty adults (ages 18-22) completed an object-based attention task similar to Egley et al. (1994). Participants were asked to identify the orientation of a target object at one of four ends of two rectangles. The target location was validly cued on 70% of trials. The remaining 30% of targets were located on either the same object or a different object. Participants completed 2 blocks of trials; one containing a target and a distractor on either the same or different object for 70% of trials and the other in which only 30% had a distractor. As in previous studies, results show the spread of attention across the attended object when no distractor was present ($F(2,38)=24.31$, $p<.001$). Moreover, participants were faster when no distractor was present during a block where distractors were frequent and the location of the target was validly cued ($F(2,38)=4.24$, $p=.023$). However, when a distractor was present, participants were faster to targets located on the different object as compared to the same object when invalidly cued to location ($F(3,57)=68.05$, $p<.001$). These data indicate that suppression within an object may be stronger than across objects, suggesting a biased competition model of visual selective attention for object-based attention.

A2

THE EFFECTS OF DISTRACTION ON THE ELECTROPHYSIOLOGICAL MEASURES OF SELECTIVE ATTENTION. Elise Demeter[1], Marty Woldorff[1]; [1]Duke University — Previous work demonstrates right frontal regions activate when attentional control is challenged by a continuous, flickering, global distractor (dSAT task, Demeter et al., 2011). However, questions remain about the precise role of these regions and the timing and sequence of the brain's response to distractors. Here, we leveraged the high temporal resolution of electrical brain recordings (EEG) during a novel distraction version of the Rapid Serial Visual Processing task (dRSVP task) to investigate the transient modulation of attentional focus induced by brief, unpredictably occurring distractor stimuli. Participants covertly attended a rapid stream of nontargets (letters) and relatively infrequent targets (numbers, button-press responses) presented above fixation. A brief checkerboard distractor appeared below fixation every 500-1050 ms. Behaviorally, target detection was impaired when distractors were presented co-temporaneously. Event-related potentials (ERPs) time-locked to the target onsets revealed an early frontocentral positivity followed by a larger P3-like positivity largest at midline parietal electrode sites. These effects were reduced in missed targets relative to detected targets, and the P3-like positivity was further reduced in missed targets when distraction was present. ERPs time-locked to the distractor onset revealed a right-lateralized frontal negativity, the right-left asymmetry of which correlated with participants' distractor-related behavioral impairment - i.e., participants who showed greater right-than-left frontal negativity also showed less impairment from distraction. This work demonstrates the usefulness of the dRSVP task for studying the mechanisms of distraction, selective attention, and attentional control and supports the idea right frontal cortex is involved in maintaining attentional focus in the face of distraction.

A3

THE SUSTAINED POSTERIOR CONTRALATERAL NEGATIVITY (SPCN) INDICATES RE-ENTRANT TARGET PROCESSING IN VISUAL CHANGE DETECTION Daniel Schneider[1], Sven Hoffmann[1], Edmund Wascher[1]; [1]Leibniz Research Centre for Working Environment and Human Factors — The present study investigated the attentional mechanisms that contribute to the detection of visual feature changes between stimulus displays by means of event-related lateralizations (ERLs; i.e. contralateral minus ipsilateral activity) of the electroencephalogram (EEG). Participants were instructed to respond to a change of luminance in either of two lateralized stimuli that could randomly occur alone or together with an irrelevant orientation change of the same or contralateral stimulus. Response times and accuracy were decreased when relevant and irrelevant feature changes were presented contralateral to each other (lateral distractor condition) compared to the remaining stimulus conditions. On EEG level, we were interested in the co-variation of posterior ERLs reflecting the visuo-spatial processing of the lateralized stimulus material and response times. Since ERLs cannot be obtained in single-trial EEG data, we introduce a new vincentization method for estimating response time dependent ERLs. These analyses revealed that the continuation of the sustained posterior contralateral negativity (SPCN) that followed EEG correlates of visual selective attention (N2pc) covaried with response times within feature change conditions. Since comparable posterior scalp topographies were observed for earlier ERL deflections and SPCN, this sustained component might reflect the re-activation of sensory areas in order to form a stable spatial representation of relevant information in visual short-term memory that can serve as a template for response selection and the initiation of goal-directed behavior.

A4

ERP EVIDENCE CHALLENGING HIERARCHICAL PROCESSING MODELS OF SELECTIVE ATTENTION Katherine Mott[1], Brittany Alperin[1], Eliza Ryan[1], Phillip Holcomb[2], Kirk Daffner[1]; [1]Harvard Medical School/Brigham and Women's Hospital, [2]Tufts University — Many theories of selective attention suggest that early selection involves filtering stimuli based on fundamental physical characteristics such as color. Late selection involves processing more complex features within an attended dimension to identify specified target forms. In the current study, ERPs were used to investigate this hierarchical processing model. Fifty-five subjects with high and average executive capacity participated in a visual oddball task. Letters were presented in an attend or ignore color, and specified letters within the attend color were designated as targets under low and high task loads. The posterior selection negativity (SN), an index of early selection, was robustly produced when measured conventionally by comparing ERP responses under the attend vs. ignore condition. A negative-deflecting component within the SN temporal window was also identified by computing the difference between target and nontarget letters, which was strongly left-lateralized, of similar magnitude in response to stimuli presented in the attend or ignore color, and smaller under high task load. Executive capacity correlated with the amplitude of the target-nontarget SN, but not the attend-ignore color SN. Higher executive capacity and larger target-nontarget SN amplitude independently predicted greater accuracy. These results are not consistent with a hierarchical model of selective attention, but suggest that complex features associated with target forms are processed early and in parallel with operations involved in selection based on attention to a readily identifiable characteristic like color. Processing indexed by this preliminary discrimination between target and nontarget stimuli appears to augment task performance and depend on capacity-limited resources.

A5

MOTIVATIONAL SIGNIFICANCE DOES NOT SELECTIVELY MODULATE EARLY VISUAL DISCRIMINATION PROCESSES IN A DIFFICULT DISCRIMINATION TASK Emma P Shaw[1], George A Buzzell[1], Craig G McDonald[1]; [1]George Mason University — The occipital-temporal N1 component of the event-related potential (ERP) has been shown to index a stimulus discrimination process modulated by top-down control. Although previous studies have expanded current knowledge of the discrimination process indexed by the N1 component, the selectivity of top-down control for targets and non-targets in relation to the motivational significance of the stimuli remains unclear. In the present study, a difficult perceptual discrimination task was utilized in which participants discriminated between two equiprobable stimuli (Gabor patches of differing spatial frequency).

In order to examine the influence of motivational significance on the sensory discrimination of stimuli, participants were required to alternate between responding only to targets (one-handed response condition) and responding to both stimuli (two-handed response condition). As expected, analysis of the ERP data revealed that the P3 was enhanced for targets in the one-handed response blocks, indicating that targets were indeed of greater motivational significance for this condition. However, there was no difference in N1 amplitude when comparing targets to non-targets for either response condition, suggesting that motivational significance does not selectively modulate the sensory discrimination process. The data suggest that when stimulus discrimination is difficult, there is a general activation of top-down control for both task-relevant and task-irrelevant stimuli. These findings are in line with the similarity gain model of feature-based attention.

A6

EVIDENCE FOR SPATIAL AND NON-SPATIAL FORMS OF VISUAL PROCESSING IN THE PARAHIPPOCAMPAL PLACE AREA Jonathan S. Cant[1]; [1]University of Toronto Scarborough — Recently, I demonstrated that the scene-sensitive PPA is more active for judgments of the material properties of objects (whether an object is made of soft or hard material; Cant & Goodale, 2011), compared to judgments of their shape. This appears inconsistent with the view that PPA is specialized for processing scenes, since the single objects used did not invoke scene imagery. But material-property judgments are important in scene processing as they can affect the strategies used to recognize and navigate through an environment (soft or hard terrain affects the posture and stability used to navigate through a scene). Thus, the material-property task in my previous study may have invoked a type of processing in PPA that is distinct from its role in processing the geometry of scenes. Specifically, these findings suggest that PPA represents scenes by processing both spatial (shape) and non-spatial (material) aspects of the environment. To investigate this possibility, I used fMRI to examine activity in PPA while participants made shape and material-property judgments of both objects and scenes (images consisted of a central object located within an indoor scene). Replicating my previous results, activation was higher for judgments of object material compared with object shape. But importantly, activation for both shape and material judgments of scenes was higher than activation for judgments of object features. This demonstrates that PPA does indeed process both spatial and non-spatial aspects of scenes, and that the processing within this region is specialized for visual features of scenes, not single objects.

ATTENTION: Spatial

A7

THE CAPTURE OF ATTENTION BY REWARD-ASSOCIATED OBJECTS Sarah E. Donohue[1], Jens-Max Hopf[1], Mandy V. Bartsch[1], Mircea A. Schoenfeld[1], Hans-Jochen Heinze[1], Marty G. Woldorff[2]; [1]Otto-von-Guericke University Magdeburg, [2]Duke University — Reward and attention are two highly intertwined cognitive processes, with reward-associated stimuli tending to receive increased attentional allocation. For example, when reward is associated with a low-level feature (e.g., color), the speed and magnitude of attentional shifts to items with that feature are enhanced. It is unknown, however, whether the shift of attention to complex objects can be similarly modulated as a function of their reward associations. Here, we used magnetoencephalography (MEG) in 24 participants to investigate how the shift of attention to an object might be modulated by such reward associations. Participants were bilaterally presented with two squares of different colors, each containing an embedded object image, and instructed to shift attention to a particular color (e.g., blue) and perform a discrimination task on the squares' corners. The embedded objects were randomly selected from either a rewarded category (e.g., clothing) or unrewarded category (e.g., furniture), and when the target stimulus contained a reward-category object, participants could earn extra money for a correct response. We observed that when an object from the rewarded category was embedded in the target stimulus, the attentional-shift-related N2pc MEG response (peak latency ~250 ms) was earlier and larger, suggesting that the reward association had induced a more rapid and robust shift of attention to the target. Conversely, when the rewarded object was present in the nontarget (distractor) stimulus, the N2pc to the target was later and smaller. Together, these data suggest that complex objects can rapidly capture attention when associated with a reward.

A8

THE TEMPORAL CASCADE OF NEURAL EVENTS UNDERLYING THE IDENTIFICATION OF AND FOCUSING OF ATTENTION TOWARDS A VISUAL TARGET IN A DYNAMIC VISUAL SCENE. Marissa Gamble[1], Brittany Zulkiewicz[1], Marty Woldorff[1]; [1]Duke University — Previously, we investigated auditory Target search in a dynamic acoustic environment with temporally and spatially distributed sounds (Gamble & Woldorff, In Revision) and found ERP evidence of a rapid mechanism for identifying pitch-deviant auditory Target stimuli. This very early (60 ms) Target-specific bilateral differentiation, relative to acoustically equivalent Nontarget deviant stimuli, occurred 70 ms prior to the onset of the focusing of spatial attention reflected by the lateralized N2ac component (Gamble & Luck, 2011), suggesting that incoming stimuli were compared to a bilateral auditory Target template to facilitate rapid identification. To investigate whether a similar early Target identifying mechanism existed in vision, we created an analogous temporally and spatially distributed visual paradigm where participants had to identify a pre-defined Target popout. Ten 50 ms-duration ellipses were presented (16 ms ISIs), randomly to the left and right of fixation. Eight of the ten ellipses were grey, with one blue and one red. Participants had to identify the Target-color ellipse, focus their attention to it, and discriminate its orientation. The results showed an attentional-shift-related N2pc ERP component contralateral to the Target, starting at ~160-180 ms and lasting for 300 ms. Importantly, we also found an early Target-Nontarget differential activation ~40 ms prior to the N2pc onset, namely a bilateral occipital negativity, followed by a centrally distributed positivity. Analogous to our previous finding in the auditory domain, these results indicate the presence of a bilateral visual target-template that facilitates target identification during visual search, prior to a shift of visuo-spatial attention.

A9

MULTIFOCAL ATTENTION MODULATES EARLY VISUAL PROCESSING WHEN ATTENTION IS DIVIDED ACROSS HEMIFIELDS (BUT NOT WITHIN A HEMIFIELD) Viola S. Störmer[1], George A. Alvarez[1], Patrick Cavanagh[1,2]; [1]Harvard University, [2]Université Paris Descartes — It is much easier to divide attention across hemifields than within a hemifield (Alvarez & Cavanagh, 2005). For example, two moving targets can be tracked much faster when they appear in opposite hemifields (bottom-left and bottom-right), than when they appear within the same hemifield (bottom-left and top-left). Using EEG, we investigated whether this across-hemifield advantage is evident at early cortical processing stages or at later processing stages. We assessed target and distractor processing in early visual areas by recording the steady-state visual evoked potential (SSVEP) over occipital scalp sites while participants performed a tracking task. Target processing was continuously facilitated relative to distractors when participants tracked one target in each hemifield, but these attentional modulations disappeared when both targets were tracked in the same hemifield ($F(1, 11)=6.22$, $p=0.03$). These effects were not due to differences in task difficulty, because performance was matched across the tracking conditions by adjusting target speed. To investigate later processing stages, we examined the P3 component over central-parietal scalp sites that was elicited by the test probe at the end of the trial. The P3 amplitude was larger for targets than distractors ($F(1, 11)=7.26$, $p=0.02$), regardless of whether attention was divided across or within hemifield, indicating that higher processing stages were not constrained by visual hemifield. These results show that selective attention facilitates early visual processing of multiple targets when they are presented separately in the left and right visual hemifields, but fails to similarly modulate early areas when they appear within the same hemifield.

A10

READING ABILITY AND TOP-DOWN ATTENTIONAL CONTROL Jessica Green[1], Mario Liotti[2], John McDonald[2]; [1]University of South Carolina, [2]Simon Fraser University — The event-related potential (ERP) markers of voluntary visuospatial attention have been well documented - frontal and parietal lobe control processes followed by preparatory modulations of

visual cortex in advance of the target. There can, however, be large variation between subjects in both behavior and ERP measures in these tasks. Based on one prominent theory of dyslexia that postulates that reading deficits stem from abnormalities in the attention system, we hypothesized that some of this variability may result from between-subject differences in reading ability. To test this hypothesis, we examined top-down attentional control in a group of Low-ability Readers (LR) identified by a dyslexia screening measure along with a control group of High-ability Readers (HR). All of the participants were university students, fluent in English, and none had been previously diagnosed with any learning disabilities. HR individuals showed significantly larger amplitude ERPs to attention-directing cues than LR individuals, both in terms of fronto-parietal control processes and visual preparatory activity. Moreover, the HR group showed an effect of reading direction on both behavioral performance and ERP measures - performance was better when attention was shifted in a left-to-right direction and differential ERP responses were seen for left and right shifts of attention. In the LR group, however, no such reading direction bias was evident. Our results suggest that reading and attention abilities are tightly linked even in those without reading disabilities and individual differences in reading ability can account for much of the variability observed in voluntary visuospatial attention.

A11

CONVERGENCE OF SUPERIOR PARIETAL, ORBITOFRONTAL AND LATERAL PREFRONTAL INPUTS INTO THE HUMAN STRIATUM

Kevin Jarbo[1], Timothy Verstynen[1]; [1]Carnegie Mellon University — Reward contingencies have been shown to constrain the allocation of spatial attention in object selection tasks (Lee & Shomstein 2013), suggesting an integration of spatial, reward and executive processes during reinforcement learning. Previous work has already shown a convergence of reward and executive control information in the striatum through overlapping projections from orbitofrontal and lateral prefrontal cortex (see Haber & Knutson 2010). It remains unclear whether spatial attention areas of parietal cortex also project directly to this convergent zone of reward and executive function. Using deterministic tractography on diffusion spectrum imaging data of 60 healthy human participants, we visualized white matter connections from orbitofrontal, lateral prefrontal and parietal cortex into the striatum. We observed consistent termination fields in the striatum from all cortical areas tested (FDR-corrected $p < 0.05$), along with several areas with convergent cortical inputs in both the caudate and putamen. More specifically, maps of the termination fields within the striatum showed a high degree of overlap in ipsilateral cortical projections from the superior parietal lobule, orbitofrontal cortex and dorsolateral prefrontal areas. The overlapping anatomical connectivity follows patterns sometimes reported in non-human animal tracer studies and provides a structural framework that may underlie the integration of reward, executive control, and spatial attention information during reinforcement learning.

A12

RIGHT-HEMISPHERIC PROCESSES, INTERHEMISPHERIC TRANSFER, AND PSEUDONEGLECT: A QUANTITATIVE EEG STUDY

Stephanie Simon-Dack[1], Kristina Hernandez[1], Keisha Woodall[1], Christopher Thomas[1], Gabrielle Andrick[1], Zachary Bailey[1], Heather Daly[1], Heather Helminger[1], Kirsten Shirley[1], Benjamin Stettler[1], Andrew Davis[1], Tom Holtgraves[1]; [1]Ball State University — The goal of the current study is to examine electrophysiological (EEG) recordings in participants at rest and correlate these with a behavioral measure of interhemispheric transfer (IHT). A review of the literature demonstrates that right-to-left hemisphere (RH) IHT can often be negative, such that a condition requiring information to cross the corpus-callosum (CC) before a response is generated seems to occur faster than a condition that does not require a transfer. It was hypothesized that individuals demonstrating a robust negative RH IHT would also demonstrate differential non-task specific EEG activity at rest that correlates with behavioral processes (i.e., individual differences in neural function). Furthermore, it was hypothesized that these individuals would be more likely to demonstrate right-hemispheric dominance in other spatial processes. In this case, we expected these same participants to demonstrate increased pseudoneglect, a phenomenon in which people tend to over-attend to the left side of space that is most likely due to high right hemispheric activation. Preliminary results are replicating previously collected pilot data that suggest participants with a negative RH IHT have lower beta frequency EEG rhythms relative to those with a positive RH IHT. Furthermore, these participants appear to be demonstrating increased pseudoneglect, indicating that right-hemispheric activation and beta frequency neural firing patterns may be, in part, responsible for the puzzling negative RH IHT phenomenon.

A13

DEVELOPMENTAL INVARIANCE IN IMPLICIT SEQUENCE LEARNING

Caroline Lejeune[1], Murielle Wansard[1], Thierry Meulemans[1]; [1]Department of Psychology, Behavior and Cognition, University of Liège, Belgium — This study was intended to test the age invariance hypothesis on implicit learning abilities using the serial reaction time paradigm and focusing on the comparison of second-order conditional (SOC) sequences of two different lengths (8 and 12 elements). A total of 128 participants from 4 age groups (4 years, 7 years, 10 years, and adults) were tested. The results showed significant and similar learning effects in 4-, 7-, and 10-year-old children, as well as adults. The learning effect was more pronounced for the 8-element sequence than for the 12-element sequence for all age groups, suggesting that the shorter sequence was better learned than the longer one. In addition, the degree of explicit sequence awareness was comparable between age groups and sequence lengths. These results, showing that 4-year-old children are able to learn 8- and 12-element-long SOC sequences as well as adults, provide further support for the hypothesis that implicit learning abilities are developmentally invariant.

A14

PLEASANT EMOTIONAL INDUCTION AFFECTS OUR PERCEPTION OF THE FOREST, NOT THE TREES: AN ERP INVESTIGATION DURING A GLOBAL/LOCAL TASK.

Nicolas Poirel[1,2], Grégory Simon[1], Mathieu Cassotti[1], Arlette Pineau[1], Olivier Houdé[1,2], Virginie Beaucousin[3]; [1]LaPsyDÉ, Unité CNRS 3521, Université Paris Descartes, Université de Caen, PRES Sorbonne Paris Cité, [2]Institut Universitaire de France (IUF), Paris, [3]EA 2027, Laboratoire de Psychopathologie et Neuropsychologie, Université Paris 8 — Our visual environment consists of global structures (e.g., a forest) that are composed of local parts (e.g., trees). Converging paradigms using compound stimuli (large global letters composed of small local letters) evidenced that global information is processed in automatic and effortless manner, whereas processing local information is more difficult and effortful. The present event-related potential (ERP) paradigm investigates the impact of pleasant emotional induction on global and local visual processes. Indeed, it has been showed that emotional events are processed in specific brain areas but also modify our perception of the visual environment, by influencing brain activity as soon as the primary visual areas. Using a rapid display of letter compound stimuli, pleasant emotional induction lead to reduced occipito-temporal N2 amplitude during global task (in comparison to global control task without emotional induction), whereas pleasant emotional induction had no effect on occipito-temporal N2 amplitude during local task. In agreement with the view that pleasant emotional context broaden the scope of attention the present results further suggest that processing global information in a pleasant emotional context requires even less neural resources as early as 230-330 msec post-stimuli. On the other hand, during the more difficult and effortful local task, emotional induction had no effect on the amplitude of N2. Taken together, these results show that emotions do not affect in an all-or-none manner visuo-attentional process: ERPs reveals that pleasant emotional induction affects our perception of the global forest, not the local trees.

A15

LINKING SOCIAL ATTENTION WITH EVERYDAY SOCIAL FUNCTIONING

Dana Hayward[1], Jelena Ristic[1]; [1]McGill University — It is well documented that gaze direction causes shifts of attention. However, it remains unclear whether this attentional effect relates to social functioning in daily life. Data with clinical populations (i.e., individuals with autism spectrum disorder; ASD) suggest that a reduced interpretation of the social meaning of gaze in individuals with ASD might result from their susceptibility to irrelevant perceptual changes in the environment like pupil motion, which often accompany gaze shifts. Thus, typical individuals who are less socially competent might also be more susceptible to irrelevant changes in the perceptual environment, which in turn may reduce their ability to attend to a

social gaze cue. Thirty-nine undergraduate students completed: (i) a gaze cuing task, in which an irrelevant perceptual change entailed presenting gaze cues as either an onset or an offset; (b) the Autism quotient questionnaire, which measures social competence in typical populations; and (c) the Social network questionnaire, which measures social network size. Performance of socially competent participants did not vary with the tasks' perceptual changes. However, in agreement with clinical data, less socially competent participants showed reduced magnitudes of social orienting when the task contained an irrelevant perceptual change, i.e., when cue onset and offset trials alternated. Furthermore, their scores on both questionnaires accounted for a significant amount of variability in their social orienting magnitudes under conditions of perceptual change. These data link social attention and social functioning and show that performance of typically developing individuals with lower social competence mirrors performance measured in clinical populations.

EMOTION & SOCIAL: Emotion-cognition interactions

A16

SUBSEQUENT MEMORY EFFECTS IN REPRESSIVE COPING

Lauren Alston[1], Nathan Bartlett[1], Andrea Shafer[1], Anthony Singhal[1], Esther Fujiwara[1]; [1]University of Alberta — Repressive coping is a combination of low self-reported anxiety and high defensiveness. In contrast to self-report, repressors show high physiological arousal during stress. Cognitively, repressors are thought to show increased early attention towards threat followed by avoidance (vigilance-avoidance). Memory reductions for threat information have been less consistent. Relationships between attention and memory in repressors have never been tested directly. Participants (N=107) were exposed to a stressful mental arithmetic task during which skin conductance levels (SCL) and self-reported mood were measured. These were combined to an index of "autonomic-response dissociation (ARD)": High ARD scores indicate under-reported physiological arousal (repressive coping). Participants incidentally encoded negative and neutral pictures presented alone or with scrambled distractors while eye-tracking was recorded, followed by surprise free recall and recognition tests. ARD positively correlated with picture viewing time, regardless of valence. ARD was unrelated to memory quality (free recall, d-prime). Subsequent memory effects were calculated by subtracting viewing durations of later not recalled/not recognized pictures from viewing durations of later recalled/recognized pictures. ARD selectively correlated with the size of the subsequent memory effect in free recall of negative solitary pictures, and less pronouncedly so, in recognition memory of negative solitary pictures. Thus, people with high ARD (repressors) did not show avoidance but spent longer looking at all pictures and this was selectively more predictive of later memory only in the condition with the highest threat-level, negative pictures without distractors. Overt visual attention promotes rather than decreases memory for negative, non-avoidable information as a function of repressive coping.

A17

WEAK REWARD SOURCE MEMORY IN DEPRESSION REFLECTS BLUNTED ACTIVATION OF VTA/SN AND PARAHIPPOCAMPUS

Daniel Dillon[1,2], Ian Dobbins[3], Diego Pizzagalli[1,2]; [1]McLean Hospital, [2]Harvard Medical School, [3]Washington University in Saint Louis — Several studies report a memory advantage for positive relative to neutral material in healthy adults that is absent in depressed individuals. However, the neural mechanisms responsible for this group difference are unclear. Therefore, we performed functional magnetic resonance imaging (fMRI) as healthy and depressed adults completed an associative recognition memory experiment. Participants encoded drawings followed by reward or zero tokens, and a source memory test immediately followed encoding. As expected, the controls showed a reward source memory advantage but the depressed group did not. Critically, analysis of the fMRI data from encoding revealed significant Group x Token Type interactions in the ventral tegmental area/substantia nigra (VTA/SN) and the right parahippocampus. In these regions, controls showed stronger activation in response to reward versus zero tokens, while depressed individuals showed the opposite pattern: stronger responses to zero versus reward tokens. Moreover, compared to the depressed group, the controls showed a significantly stronger VTA/SN response to reward tokens. Within controls, the strength of the neural response to reward tokens was positively correlated across the VTA/SN and right parahippocampus, but no such correlation was observed in the depressed group. Finally, in controls - but not depressed participants - the magnitude of the difference in VTA/SN responses to reward versus zero tokens predicted the size of the reward source (versus zero source) memory advantage. Collectively, these findings suggest that poor memory for positive material in depression reflects blunted activation of the dopaminergic midbrain and medial temporal lobe memory regions during encoding.

A18

EMOTIONAL TASK MANAGEMENT: FRONTOSTRIATAL MECHANISMS OF SWITCHING BETWEEN AFFECTIVE AND NON-AFFECTIVE TASK-SETS

Crystal Reeck[2], Amelia Abbott-Frey[1], Tobias Egner[1]; [1]Duke University, [2]Columbia University — Action plans are regularly updated in response to changes in the environment or shifting priorities. While this capacity to switch tasks has been extensively investigated, the impact of affective salience on task-switching remains unclear. Numerous theories suggest that processing the affective content of stimuli may be difficult to inhibit, and this affective primacy leads to two divergent hypotheses regarding task-switching. First, the prioritized processing of affective features may enhance accessibility of affective task-sets, promoting faster switches from non-affective to affective task-sets than vice versa. Conversely, research on task-switching has demonstrated that more dominant task-sets experience greater switch costs "counterintuitive asymmetric switch costs"). According to this work, dominant task-sets need to be actively inhibited during performance of a less entrenched task, and this inhibition must be overcome when switching back to the dominant task-set. This perspective predicts slower switches to affectively-relevant tasks as they must be released from inhibition. The present experiment adjudicated between these two hypotheses by developing a paradigm that involved switching between affective and non-affective task-sets. While undergoing functional magnetic resonance imaging (fMRI), participants viewed face stimuli and indicated either the gender (male vs. female, non-affective task) or the emotional expression (happy vs. fearful, affective task) of the face. Participants were slower to switch to the affective task, consistent with the hypothesis that such switching involves overcoming previous inhibition of the dominant, affective task-set. Activation in a right-lateralized frontostriatal network tracked these asymmetric task-switching effects, potentially reflecting the disinhibition of affective processing when transitioning to the affective task-set.

A19

DIFFUSE SHIFTS IN WHOLE-BRAIN FUNCTIONAL CONNECTIVITY DURING TEMPORAL UNCERTAINTY

Alea C Skwara[1], Erik K Kastman[1], Stephanie F Sasse[1], Leah H Somerville[1]; [1]Harvard University — Unpredictability is a key environment feature that heightens salience detection and anxiety-related processes. In addition, physiological and subjective responses of aversion are heightened when experiencing an unpredictable aversive stimulus. The current study sought to determine whether dynamic changes in functional connectivity differentiated uncertain and certain cues that preceded a forthcoming image presentation. Healthy adult participants underwent an fMRI scan during which they viewed negative and neutral pictures preceded by a predictable (denoting when the picture would be presented) or unpredictable cue (providing uncertain timing). The current analysis focuses on cue period neural activity to identify differences in connectivity in unpredictable versus predictable contexts within regions differentially active during the cue period of the task. To do so, first-level analyses estimated cue-related responses on a trial-by-trial basis and "betacourses" were created by concatenating parameter estimates within a trial type within a participant. Group analyses calculated differential condition-wise correlations indicating significantly different degrees of coupling for unpredictable, relative to predictable, cues. Unpredictable cues led to increased connectivity between the amygdala and parietal regions, parietal regions and the dorsal anterior cingulate and the posterior cingulate, and within regions of the prefrontal cortex. Subsequent analyses assess the degree to which these coupling relationships influence the magnitude of subsequent emotional response to aversive images, and modulation by

individual differences in trait anxiety. These findings suggest that distal subcortical-cortical and cortical-cortical functional connectivity may be one mechanism underlying heightened vigilance in uncertain contexts.

A20

THE NEURAL BASIS OF A SENSE OF HUMOR IN CHILDREN Jessica M. Black[1,2], Pascal Vrticka[2], Allan L. Reiss[2,3]; [1]Graduate School of Social Work, Boston College, [2]Center for Interdisciplinary Brain Sciences Research, Department of Psychiatry and Behavioral Sciences, Stanford University, [3]Department of Radiology and Pediatrics, Stanford University — Humor is a prototypical human positive social state. Recent neuroimaging evidence suggests that humor involves two core processes in both children and adults: incongruity detection and resolution (cognitive humor component) and a subsequent feeling of amusement or mirth (emotional humor component). In the present investigation, we asked the outstanding question of how a low versus high sense of humor (SOH) was associated with brain responses in both cognitive and emotional humor areas. 22 healthy children aged 6-13 years watched funny versus enjoyable (positive but nonfunny) movie clips in the fMRI scanner. We chose SOH as our primary, self-reported measure, because a high SOH has been linked to reduced negative emotionality as well as improved social, cognitive and physiological functioning in adults. Moreover, as a SOH is believed to be acquired in childhood and to help children cope with stressors during daily life, we were particularly interested in examining early developmental aspects of SOH on brain activity in response to humor. Our findings (controlled for participant age, sex and IQ) revealed that SOH in children almost exclusively affected brain responses to funny (versus enjoyable) movie clips in cognitive humor areas, including the temporo-parietal-occipital junction, posterior superior temporal gyrus, anterior superior temporal gyrus, and prefrontal cortex. Within those areas, there predominantly was a negative relation between SOH scores and brain activity: the lower the children's SOH score, the higher their brain activity was to humor. We interpret these data that children with a low SOH need increased cognitive effort to understand humor.

A21

NEURAL MECHANISMS OF EMOTIONAL-COGNITIVE DYSCONTROL IN ALS Martin Goldstein[1], Michael Silverman[1], Rebecca Bind[1], Amy Aloysi[1], Bender Heidi[1]; [1]Icahn School of Medicine at Mount Sinai — Background: Cognitive and imaging data indicate that ALS can be complicated by neuropsychological dysfunction. While a fronto-temporal dementia can emerge, more commonly patients manifest subtler behavioral dyscontrol, especially regarding emotional regulation. Prior studies have attributed ALS-related cognitive impairment to executive dysfunction, presumably secondary to prefrontal involvement. However, precise neural substrates of ALS-related neurobehavioral dysregulation remain inadequately characterized. We designed a neuropsychological visual Go/No-Go fMRI protocol aimed to specifically probe aberrant emotional regulation and associated executive dyscontrol in ALS. Methods: 11 non-demented ALS patients and 11 healthy matched control subjects, all right-handed, participated. Neuropsychological activation task involved serial presentation of emotionally-valenced images in tilted or non-tilted manner. Discrimination of tilt/non-tilt attribute formed basis of Go/No-Go response selection: subjects instructed to button press (or withhold) in response to tilted (or non-tilted) stimulus. Task performance was concurrent with gradient EPI-BOLD fMR image acquisition. Stimuli were positive, neutral and negative selections from International Affective Picture System (Lange). All stimulus presentations counterbalanced for valance, arousal (high/low), and presentation as Go or No-Go signal. SPM5 software employed for image analysis (initial threshold $p<.01$). Present study focused on differential neural responsivity to high vs. low arousal stimuli. Results: ALS patients had reduced anterior cingulate, superior frontal, and caudate activity, and enhanced visual cortex activation, while processing emotional visual stimuli. Conclusions: ALS patients demonstrated reduced recruitment of a fronto-striatal executive network, with simultaneous aberrant potentiation of visual cortex, while processing emotional stimuli, suggesting a potential neural mechanism for pathologic laughing and crying, and associated executive dyscontrol, in ALS.

A22

COGNITIVE REAPPRAISAL AND STIMULUS AVAILABILITY BOTH REDUCE CRAVING FOR UNHEALTHY FOODS Laura Martin Braunstein[1], Michael Grosz[1], Esther Kim[1], Melanie Silverman[1], Jon Morgenstern[1], Kevin Ochsner[1]; [1]Columbia University — Appetitive cues signal the opportunity to obtain rewards and therefore can trigger craving or desire. The ability to control these affective responses is important for wellbeing and the maintenance of goal-directed behavior and may vary as a function of context. Although we know a great deal about explicit strategies for reducing craving such as cognitive reappraisal, less is known about how contextual factors like stimulus availability might influence craving and reappraisal success. Assessing reappraisal and availability simultaneously is important, as emotion regulation occurs under different conditions in everyday life. We probed the influence of both reappraisal and stimulus availability on craving for unhealthy foods in healthy participants. Using a 2 X 2 design, we manipulated reappraisal (distancing or natural responding) and stimulus availability (food was physically available or not) within-subjects. We predicted that reappraised and unavailable foods would elicit lower craving, because distancing and inaccessibility would both reduce the appetitive pull. Participants completed a computer task in which they viewed and rated craving for food pictures while engaging in distancing or responding naturally. Prior to the task, participants were shown all the available foods. During the task, they were reminded which foods were available by the color of the frame surrounding the picture. Both reappraisal and availability decreased craving, and there was no interaction. Reappraisal and availability seem to independently affect desire for foods, potentially by different mechanisms. Future work will explore the mechanism of availability's effect by testing whether it requires working memory and identifying the underlying neural systems.

A23

NEURAL RESPONSES TO NEGATIVE OUTCOMES AND DECISIONS TO PERSIST OR GIVE UP ON A GOAL Jamil Bhanji[1], Megan Speer[1], Mauricio Delgado[1]; [1]Rutgers University — Negative outcomes are an important component of many learning endeavors but some outcomes prompt contrasting responses. For example, a student who fails a required class can decide to persist with the original goal to complete the major (try again to pass the class) or give up the goal (change majors). An important factor is whether outcomes are perceived as controllable (due to willful choices such as studying) or uncontrollable (due to uncontrollable factors such as unfair test questions). How does the brain respond to controllable and uncontrollable negative outcomes and how do these responses lead to persisting or giving up after negative outcomes? Participants in the present research decided after every negative outcome to persist with a chosen goal or give up on it for a lower value goal. Participants persisted more after controllable than uncontrollable negative outcomes. Consistent with previous observations, neuroimaging data showed decreased ventral striatum and medial prefrontal cortex activity in response to negative outcomes. This decrease was greater for controllable compared to uncontrollable negative outcomes. Moreover, the decrease in ventral striatum correlated with greater persistence after controllable negative outcomes. In contrast, the medial prefrontal cortex response correlated with negative affect experienced with uncontrollable negative outcomes and mediated the relationship between increased negative affect and the tendency to persist after uncontrollable negative outcomes. The findings highlight the role of frontostriatal circuitry in changing behavior based on negative feedback, and represent an important step toward understanding how people process setbacks and adapt their behavior for future goal pursuit.

A24

HOW DO NEGATIVE EMOTIONS AFFECT INHIBITORY CONTROL IN IMPULSIVE VIOLENT ADOLESCENTS? Chiao-Yun Chen[1], Xin-Min Bai[1]; [1]National Chung Cheng University — Interpersonal violent behavior is often induced by extreme emotional states. While there is increasing interest in the neurological bases of violent behavior, the effects of emotional stimuli on such behavior are poorly understood. Repeated violent offenders are often described as having impairments in emotion and inhibitory control and impulsive violent behavior could be a consequence of either a greater generation of pre-potent responses or a deficit in inhibition of

such responses. These can be indexed using a stop signal task. If violent offenders are characterized by higher behavioral activation system activity, their go RTs on such a task may be lower than controls whereas if they have lower inhibitory activity, their SSRT, which indexes inhibitory control, might be elevated. We compared the effects of emotional stimuli on behavior in adolescents who had a history of impulsive violence using a stop signal task to investigate how negative emotions affect inhibitory control in this group. The SSRTs of impulsive violent adolescents in the negative emotional condition were significantly longer than matched controls. This shows this group may be either unable to regulate negative emotions arising as a result of errors in this condition or use such error information to adjust their behavior effectively. This helps to characterize differences in these individuals and may indicate avenues to help reduce the likelihood that they will carry out violent acts.

A25

MINDFUL ATTENTION MODULATES IMMERSION IN STRESSFUL THOUGHTS Lauren McDonough Lebois[1], Esther Papies[2], Romeo Cabanban[1], Karen Quigley[3], Kaundinya Gopinath[1], Lisa Feldman Barrett[3], Lawrence Barsalou[1]; [1]Emory University, [2]Utrecht University, [3]Northeastern University — An fMRI experiment addressed the neural activity that contributes to experiencing an event as stressful, and in contrast, that which contributes to mindfully attending to an event. Specifically, we compared neural activity when participants were absorbed in their thoughts about stressful scenarios (immersion) to periods when they observed their thoughts as fleeting mental states (mindful attention). Part of what makes thoughts stressful is that they seem real, almost as if they are happening in the moment, and because of this we hypothesized that immersion would involve the mental reenactment of a stressful situation, such that the reenactment triggers a stress response and negative emotion. Conversely, mindful attention would prevent individuals from becoming immersed in stressful thoughts, such that stress responses no longer result. Immersion in stressful scenarios activated regions involving the senses (e.g. primary visual cortex), action and the body (motor cortex, cerebellum), spatial processing (superior parietal lobule), self-referential and emotion processing (e.g., mPFC, temporal pole). All these areas were significantly less active when participants were mindfully attending to the same stressful scenarios, suggesting that mindful attention disabled stressful simulations. Instead, during mindful attention, an interoceptive circuit became active, including the middle cingulate, motor, somatosensory areas, along with visual cortex. Notably, these differences were not evident when participants thought about non-stressful scenarios, suggesting that affect is necessary for immersion and mindful attention to have differential effects. These findings shed light on the mechanisms that contribute to reenacting stressful events, and also to those that allow mindfulness to have therapeutic effects.

EMOTION & SOCIAL: Emotional responding

A26

A SNEAKING SUSPICION: ERP EFFECTS OF SUBLIMINAL EMOTIONAL PRIMES ON THE PROCESSING OF NEUTRAL PICTURES Marianna Eddy[1,2], Nate Delaney-Busch[2], He Pu[2]; [1]U.S. Army Natick Soldier Research, Development, and Engineering Center, [2]Tufts University — In the current study we presented masked positive, negative, and neutral images from the International Affective Picture Set (IAPs) as primes for 33 ms, immediately followed by images of common, everyday objects. Participants rated the valence of the target objects while event-related potentials were recorded. Previous research suggests the P300 is sensitive to phasic shifts in attention, likely reflecting the early stages of evaluative processing of emotional stimuli, while the late posterior positivity (LPP) reflects more subjective evaluation of the motivational significance of emotional stimuli. In line with this distinction we found that the P300, specifically a frontally distributed P3a, was more positive going for targets preceded by negative primes than those preceded by neutral and positive primes (regardless of how participants rated the target) while the LPP was not. When examining ERP effects on the basis of how targets were rated, we found the opposite pattern of effects with the P3a not being sensitive to the perceived valence of the target and LPP showing a greater positivity for stimuli rated as more negative or more positive than those rated as neutral. These results suggest subliminal presentation of emotional images does influence perception of common everyday objects, but only during the initial stages of processing. In addition, we also replicated that the LPP is sensitive to perceived valence.

A27

FMRI AND ERP MEASURES OF REWARD REACTIVITY CORRELATE WITH MIDBRAIN VOLUME Joshua Carlson[1], Dan Foti, Eddie Harmon-Jones, Greg Proudfit; [1]Northern Michigan University, [2]Purdue University, [3]The University of New South Wales, [4]Stony Brook University — Reward processing in the brain can be measured by ventral striatal fMRI BOLD activation and the amplitude of the feedback negativity ERP. We recently found that these two neural measures of reward processing are correlated with each other, such that increases in ventral striatal activity are associated with increases in the amplitude of the feedback negativity. The midbrain dopamine system has long been implicated in reward processing. However, there has been little research into the possibility that structural variability in the midbrain may be linked to functional variability in reward reactivity. In the current study, we utilized a simple gambling task to probe fMRI and ERP measures of functional reward reactivity and midbrain volume was assessed with structural MRI. Voxel-based morphometry was used to assess the relationship between functional measures of reward reactivity and midbrain volume. We found that as midbrain volumes increase, fMRI reward reactivity in the ventral striatum and medial prefrontal cortex also increase. Additionally, we found that as midbrain volumes increase, the amplitude of the feedback negativity also increases. The relationship between midbrain volume and feedback negativity amplitude is mediated specifically by activity in the ventral striatum. In sum, we found that structural variability in the midbrain relates to variability in fMRI and ERP measures of functional reward reactivity, which demonstrates convergence across neuroanatomical, hemodynamic, and electrophysiological measures. This structure-function relationship may play an important role in reward-related psychopathologies and the treatment of these disorders.

A28

PULVINAR AND ORBITOFRONTAL CORTEX DEMONSTRATE SELECTIVE AND DISSOCIABLE REDUCTIONS IN NEURAL RESPONDING TO REPEATED SIMULATIONS OF EMOTIONAL FUTURE EVENTS Karl Szpunar[1,2], Helen Jing[1,2], Daniel Schacter[1,2]; [1]Harvard University, Department of Psychology, [2]Harvard University, Center for Brain Science — People frequently simulate what might occur in the future. Moreover, the tendency to repeatedly simulate future outcomes has been identified as a predictor of the onset of anxiety and depression-related disorders. Nonetheless, next to nothing is known about how the human brain processes repeated simulations of emotional future events. In this study, we present a paradigm that can be used to study repeated simulations of the emotional future in a manner that overcomes phenomenological confounds between positive and negative events. The results show that pulvinar nucleus and orbitofrontal cortex respectively demonstrate selective and dissociable reductions in neural activity in response to repeated, as compared to non-repeated, simulations of negative and positive future events. Implications for future research on repeated simulations of the emotional future in both non-clinical and clinical populations are discussed.

A29

EXAMINING EMOTIONAL HABITUATION TO REPEATED NEGATIVE STIMULI IN BORDERLINE PERSONALITY DISORDER PATIENTS AND HEALTHY CONTROLS: EVIDENCE FOR DIFFERENTIAL PATTERNS OF BEHAVIOR, NEURAL ACTIVITY, AND FUNCTIONAL CONNECTIVITY Bryan T. Denny[1], Jin Fan[1,2], Xun Liu[3], Stephanie Guerreri[1], Sarah Jo Mayson[1], Liza Rimsky[1], Antonia S. New[1,4], Marianne Goodman[1,4], Larry J. Siever[1,4], Harold W. Koenigsberg[1,4]; [1]Icahn School of Medicine at Mount Sinai, [2]Queens College, City University of New York, [3]Institute of Psychology, Chinese Academy of Sciences, [4]James J Peters VA Medical Center — Emotional habituation during repeated exposure to aversive stimuli is an adaptive process and represents a key component of many desensitization-based psychotherapies. Borderline personality disorder (BPD) patients are characterized by severe affective instability and have been shown to exhibit diminished

habituation responses, though the neural mechanisms supporting this phenomenon remain unclear. We aimed to probe these mechanisms by repeatedly presenting negative images to 19 BPD patients and 25 healthy controls (HC's) and recording behavioral and neural responses using functional magnetic resonance imaging (fMRI). We were particularly interested in the role of insula and amygdala activity given their strong association with emotion reactivity in prior work. Behavioral self-reports indicated that HC's habituated, whereas BPD patients did not. Neurally, while increasing mid-posterior insula activity was parametrically related to greater self-reports of negative affect in both groups, BPD patients showed exaggerated insula and amygdala activity to negative images overall relative to HC's. Further, repeated negative image presentation led to increased functional connectivity between insula and amygdala in HC's, but not BPD patients, and this functional connectivity was correlated with increasing behavioral habituation in both groups. Finally, dorsal anterior cingulate activity, previously implicated in salience detection, was shown to be recruited upon repeated presentation in HC's but not BPD's, and the magnitude of recruitment negatively predicted individual differences in affective instability in both groups. These results shed light on the neural mechanisms that subserve emotional habituation and suggest potential neurobiological substrates for the exaggerated affective instability and diminished emotional habituation shown by BPD patients.

A30

SUBCALLOSAL CINGULATE DBS PRODUCES CURRENT- AND LOCATION-DEPENDENT CHANGES IN AUTONOMIC AROUSAL

Cory Inman[1], Patricio Riva Posse[1], Steven Garlow[1], Andrea Crowell[1], Scott Danielson[1], Helen Mayberg[1], Stephan Hamann[1]; [1]Emory University — Subcallosal cingulate (SCC) deep brain stimulation (DBS) has shown preliminary long-term efficacy and safety for treatment-resistant depression (TRD). Immediate changes in mood and behavior during intra-operative testing have also been observed. Spontaneous self-reported intra-operative effects include, "feeling lighter, calmer," and "more awake, more aware, more reactive," indicative of changes in autonomic arousal. Autonomic changes have been observed within seconds of initiating acute stimulation tests during surgery and appear to correlate with the optimal white matter targets mediating long-term antidepressant effects. Skin conductance response (SCR) and change in heart rate (HR) were measured during an acute stimulation protocol performed 1- and 3-months post-operatively. Nine participants in an ongoing study of SCC DBS for TRD were tested. To assess autonomic effects of SCC DBS, time-locked changes in SCR and HR were recorded in separate, sham-controlled experiments that varied either current amplitude or stimulation location. As stimulation current amplitude was increased, both measures of autonomic arousal (SCR and HR) increased. In addition, stimulation of optimal target versus non-optimal contacts increased autonomic arousal. At both 1- and 3-months post-operatively, SCC DBS causes a current- and location-dependent increase in autonomic arousal in patients with TRD. These findings suggest that SCC DBS modulates activity in brain regions involved in autonomic regulation. This is consistent with known anatomical connectivity of SCC to cingulate cortex and brainstem in humans and animals. Further, current- and location-dependent changes in autonomic arousal with SCC DBS provide a novel strategy for examining the interactions of affective experience and the autonomic nervous system.

A31

ERP EVIDENCE FOR EMBODIED EMOTION SIMULATION

Heath Matheson[1], Aaron Newman[1], Ivy-Lee Kehayes[1], Shannon Johnson[1]; [1]Dalhousie University — Background: Theories of embodied cognition propose that understanding the emotions of other people entails a partial neurophysiological reenactment of emotional expression. Behavioural research shows that interfering with overt simulations of emotional expressions with a concurrent motor task impairs expression recognition. However, it is unknown when a concurrent motor task interferes with emotion processing. We measured the N170, a face specific event-related potential, to investigate the neurophysiological correlates of emotion simulation. Methods: Participants (n = 18) made emotion judgments of faces (happy vs. angry). On some trials, participants performed a motor interference task, disrupting the production of a smile (holding a chopstick in the teeth); on others, participants performed a control task that did not disrupt this process (holding the chopstick in the lips). It was hypothesized that, in response to happy faces, the N170 component would be modulated when participants held a chopstick in their teeth, therefore interfering with a happy simulation, than when they held it in their lips; conversely, the concurrent motor task would not alter the N170 to angry faces. Summary of Results: The N170 was larger when participants viewed happy faces with a chopstick in their teeth than in their lips; the concurrent motor task did not affect the N170 to angry faces. Conclusion: Results suggest that the face-specific N170 is altered when emotional simulation is blocked, demonstrating that simulation effects are reflected within the first 170 ms of face processing. We conclude that embodied simulation of emotion begins at the earliest stages of face processing.

A32

THE EFFECT OF REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION TO THE LEFT DORSOLATERAL PREFRONTAL CORTEX ON SOCIAL EXCLUSION

Bernadette Fitzgibbon[1], Melissa Kirkovski[1], Amity Green[1], Naomi Eisenberger[2], Paul Fitzgerald[1], Peter Enticott[1]; [1]Monash University, Australia, [2]UCLA — Social pain describes the experience of actual or potential damage to one's feeling of social connection or value and has been shown to activate similar neural networks as seen in physical pain; the experience that comes with actual or potential tissue damage. Although etiologically dissimilar, brain stimulation methods applied to induce pain relief may therefore also reduce the negative experience of social pain. In this study, we used low-frequency (1Hz) repetitive transcranial magnetic stimulation (rTMS) applied to the left dorsolateral prefrontal cortex (DLPFC) in 18 healthy participants (8 active; 10 sham). Following stimulation, participants played the "Cyberball task"; an online ball-tossing game where the subject is included or excluded. Following each condition, participants completed a questionnaire exploring levels of social distress, ostracism, group cohesion and mood. Compared to the sham rTMS group, participants who underwent active rTMS reported increased behavioural scores (i.e. more positive) in response to the inclusion condition. No differences were seen between groups in response to the exclusion condition. In a secondary analysis, we explored whether there was a relationship between trait empathy as measured by the Interpersonal Reactivity Index (IRI) and behavioural responses following the Cyberball task. Within the active group only, we found a relationship between greater negative mood following the exclusion condition and lower scores on the perspective taking subscale of the IRI. These pilot findings suggest left DLPFC rTMS may increase positive emotion during social interactions in general and highlight the need to further explore the effects of interpersonal differences on rTMS response.

A33

AESTHETICS & AMUSEMENT: COMPARING DIVERSE FORMS OF PLEASANT EXPERIENCE

Christy Wilson-Mendenhall[1,2], Nicole Betz[1], Maria Gendron[1], Ajay Satpute[1,2], Lisa Barrett[1,2]; [1]Northeastern University, [2]Martinos Center for Biomedical Imaging, Massachusetts General Hospital — Although people feel pleasant (or positive) during many different activities, little research has directly compared the diverse forms of pleasant experience. We examined the hypothesis that different pleasant experiences (e.g., visual aesthetics vs. conceptual amusement) are realized when common, shared neural elements (i.e., the circuitry that supports salience and reward) couple with other, distinguishing neural elements (e.g., the circuitry that supports basic sensation vs. social inference). To test our hypothesis, we made use of the simple visual and novel conceptual features of "droodle" designs, which are meaningless visual designs that only become interpretable (and often amusing) when a caption is supplied. During an fMRI study, aesthetic color versions of the designs were initially presented without captions to evoke pleasant sensory experiences, and then verbal captions were presented with the same designs (classic "droodles") to evoke pleasant conceptual experiences. Participants rated the feeling evoked by each design directly after viewing each block of images, and individuals' ratings were entered into amplitude modulation analyses to capture individual preferences. The results supported our hypothesis, with activity in salience (e.g., amygdala) and reward (e.g., ventral striatum) circuitry increasing as the intensity of participants' pleasant feelings increased, while viewing the color designs and while viewing the conceptual designs. Moreover, whereas posterior neural circuitry involved in visual processing was asso-

ciated with the pleasant feelings evoked by the color designs, more anterior neural circuitry involved in social inference was associated with the pleasant feelings evoked by the conceptual designs.

EMOTION & SOCIAL: Self perception

A34

META-ANALYSIS OF FMRI REVEALS ROLE OF CLAUSTRUM IN DISSOCIATION

Matthew Jerram[1], Samantha Bates[1]; [1]Suffolk University — Dissociation is defined by disruptions in integrated consciousness that can range from normative, such as daydreaming, to pathological, such as symptoms found in PTSD and dissociative disorders. However, few neuroimaging studies have examined dissociative processes directly. The claustrum is a thin sheet of gray matter near the insula that is hypothesized to coordinate functioning of various cortical regions into coherent conscious experience. Therefore, it is likely an important brain region in dissociation. The goal of this study was to examine the neural correlates of dissociation through the use of meta-analysis with a hypothesis of the involvement of the claustrum. Meta-analysis was performed with GingerALE 2 using data extracted from published studies examining dissociation using fMRI. Studies for inclusion were identified through keyword search (such as ("MRI" AND "dissociation") or ("MRI" AND "dissociative")). Nine studies that examined dissociative processes directly during scanning were used in the analysis. Peak voxels for significant clusters of these studies were entered into GingerALE 2, along with sample sizes, and activation likelihood estimate (ALE) maps were obtained. These maps were thresholded at an error-corrected $p<.05$ for cluster-level inference. Meta-analysis revealed significant ALE clusters in several regions of the brain, including the claustrum bilaterally, left postcentral gyrus, right caudate, right inferior frontal gyrus and left insula. The results suggest the claustrum is an important brain region in dissociation, which is consistent with its hypothesized functional role. Further, results indicate the role of other important regions involved in abstract thought, emotion regulation and interoception.

A35

INCREASED VENTROLATERAL PREFRONTAL CORTEX ACTIVITY IN RESPONSE TO POSITIVE SELF-JUDGMENTS AMONG SUICIDAL ADOLESCENTS

Sarah Henderson[1], Amy Johnson[1], Michael Milham[2], Vilma Gabbay[1]; [1]Icahn School of Medicine at Mount Sinai, [2]Child Mind Institute — Though past research has examined altered self-processing in adults with major depression (MDD), little research has examined relationships between these self-related thoughts and suicidality, particularly among adolescents. Importantly, adolescents with low self-esteem report greater suicidal ideation and an increased frequency of suicide attempts. The current study sought to examine neural responses to positive self-judgments in suicidal and non-suicidal depressed adolescents, as well as healthy controls (HC). Using functional magnetic resonance imaging (fMRI), participants viewed positive or negative trait adjectives and answered whether the trait described them, was an objectively good trait, or contained the letter "e." Participants were divided into three groups according to Beck Scale for Suicide Ideation scores: healthy controls (N = 19), non-suicidal MDD (N = 14), and suicidal MDD (N = 9). The suicidal MDD group endorsed (i.e., responded yes) significantly less positive traits about themselves than the non-suicidal MDD group, who also endorsed significantly less positive traits than the HC group. A whole-brain ANOVA using neural responses to positive self-related judgments revealed increased activity in the precuneus, two clusters in the right ventrolateral prefrontal cortex (VLPFC), and the left premotor cortex in the suicidal MDD group compared to HC. Only the VLPFC clusters, however, showed significantly different activity between all three groups: suicidal MDD group > non-suicidal MDD > HC. Given the role of the VLPFC in inhibition, our findings extend previous research demonstrating increased inhibition to positive stimuli among depressed adults by suggesting that this up-regulated inhibition is also associated with suicidality in adolescents.

A36

NEURAL CORRELATES OF INTEROCEPTION AND CONCEPTUALIZATION DURING RESPIRATORY LOAD

Ian Kleckner[1], Karen Quigley[1], Lisa Feldman Barrett[1]; [1]Interdisciplinary Affective Science Lab; Northeastern University; Boston, MA, USA — Certain emotion theories propose that one's affective state can be understood as a perception of both physiological and exteroceptive sensory input that is formed when this input is conceptualized. Here, we explored the neural circuitry underlying the ability to conceptualize a physiological stressor in different ways. Twenty-one participants completed an inspiratory breathing restriction fMRI task where each participant alternated between thinking about (a) respiratory sensory features (e.g., lungs, throat) or (b) an emotionally evocative scenario (e.g., suffocating) inspired by the fact that it was harder to breathe in for 30 sec. We predicted that both conditions involve networks important for interoception (e.g., insula, somatosensory cortex) and networks important for conceptualization (e.g., mOFC, PCC). As expected, we observed increased BOLD signal in interoceptive regions including the dorsal mid insula and somatosensory cortex during the interoception breathing load compared to the exteroceptive baseline (counting a flashing "X"). Additional analyses will consider behavioral ratings of valence, arousal, and task immersion per trial to reveal how interoceptive sensations were perceived in the two conceptualizations conditions.

A37

TRACKING THE TEMPORAL SIGNATURE OF THE AUDITORY SELF: ELECTROPHYSIOLOGICAL INDICATORS OF PRE-REFLECTIVE (EARLY) SELF-RELATED PROCESSING

Christoph Justen[1], Cornelia Herbert[2]; [1]German Sport University Cologne, Institute of Psychology, Department of Performance Psychology, Cologne, Germany, [2]University of Tübingen, Department of Psychiatry and Department of Biomedical Magnetic Resonance, Tübingen, Germany — To successfully interact with our environment, it is necessary to differentiate between self- and other-generated information, also known as self-related processing. Especially the processing of movement information plays a major role in our daily lives as we are often engaged in social physical activities requiring hand- and finger movements. So far, studies on this topic have mainly focused on investigating reflective (late) self-related processing of movement-related unimodal visual or multimodal stimuli. The present study used self- versus other-generated movement sounds (finger snapping) and electroencephalography (EEG) to examine the temporal and neural dynamics of pre-reflective self-related processing based on complex (movement-related) auditory information. Event-related potentials (ERPs) were recorded from 64 electrode sites while healthy participants (N=8, 6 males, 2 females) listened to self or other-generated finger snapping sounds. Stimuli were presented during a passive oddball paradigm consisting of 2 blocks ("self" as standard, "other" as deviant stimulus and vice versa). Block order was counterbalanced across subjects. Preliminary data analysis revealed that electrophysiological responses elicited by the subject's self-generated finger snapping sounds were significantly different from those evoked by other-generated finger snapping sounds. In particular, an early differentiation was observed between the processing of self- and other-related movement sounds, starting already in the time-window of mesogenous ERP components (between 100 to 250 ms). Topographic maps revealed that this early differentiation seems to be most prominent at parieto-occipital electrode sites. Our findings provide first evidence for an early, bottom-up driven differentiation mechanism in the processing of complex self- and other-related auditory information.

A38

THE INFLUENCE OF SELF-AWARENESS ON EMOTIONAL MEMORY FORMATION: AN FMRI STUDY

Carla Pais-Vieira[1], Erik Wing[2], Roberto Cabeza[2]; [1]University of Aveiro, [2]Duke University — Previous neuroimaging studies have shown a strong influence of orienting tasks on activity associated with processing emotional stimuli. While limbic structures are widely believed to support emotional processing and emotional memory enhancements under tasks that encourage an externally orientated evaluation of emotion, studies on embodied affect have shown that encouraging an internally orientated evaluation of one's emotional state recruits additional subcortical and cortical regions linked to interoceptive awareness. However, it is unclear how the self-awareness of emotion influences emotional

memory formation. In the present experiment, we explored how different levels of emotional awareness during an episodic encoding task influenced subsequent memory. In an event-related functional neuroimaging study, participants were scanned while viewing emotional and neutral pictures in two orienting tasks: Self-awareness (SA) and Perceptual (PE). Memories for items were tested 2-3 days later. Behavioral results showed that SA-encoded pictures were better remembered than the PE-encoding pictures, with emotional memory enhancements greatest for pictures with negative valence. Functional neuroimaging results showed that, in contrast to PE, emotional memory enhancements for the SA condition were associated with engagement of the anterior insula/inferior frontal gyrus, the midbrain and the basal ganglia. These findings suggest that Self-awareness influenced episodic emotional memory formation by recruiting brain regions that are typically involved in detecting salience and homeostatic regulation of emotional states. More generally, these results indicate that the neural mechanisms mediating emotional memory formation may depend on how affective information is initially processed.

A39

LISTENING TO OWN HEARTBEAT SOUNDS MODULATES SELF-FACE RECOGNITION Jane Elizabeth Aspell[1], David Kaneria[1], James Pamment[1]; [1]Anglia Ruskin University, Cambridge, UK — The multisensory basis of bodily self-consciousness has typically been studied by inducing multisensory conflicts, most commonly between "exteroceptive" modalities, e.g. vision and touch. Attention has lately turned to the contribution of interoceptive signals to self-consciousness, since these are also likely to play a crucial role. Here we investigated whether self-related cardiac information (the sound of one's heartbeat) would affect performance on a self-face recognition task and whether this effect would depend on interoceptive sensitivity. Subjects (n=39) were fitted with digital stethoscopes connected to loudspeakers and during different blocks, would either hear their real-time heartbeat sounds or a recording of another person's heartbeat. To measure self-face recognition we presented subjects with movies (100/50 sec duration) of their own face morphing into that of another person (or vice versa). They pressed a button when the face looked "more like other than self" (or vice-versa). Interoceptive sensitivity was measured by recording subjects' electrocardiograms and using a heartbeat discrimination task in which auditory beeps were either synchronous or asynchronous with respect to their heartbeats. We found the predicted bias in self-recognition (more movie frames assigned to self) in the "own heartbeat sound" condition, but only for subjects with low interoceptive sensitivity, and only for the "self to other" morphing direction. We speculate that listening to own heartbeat sounds promotes activation of self processing networks in the brain, which facilitates self-recognition These results are consistent with growing evidence that self-representation in the brain is a multisensory process and involves both interoceptive and exteroceptive modalities.

A40

SUBJECTIVE MEMORY COMPLAINTS ARE ASSOCIATED WITH ALTERED DEFAULT MODE NETWORK IN COGNITIVELY NORMAL OLDER ADULTS Patrizia Vannini[1,2,4], Andrew Ward[1,3], Sarah Wigman[1,2], Willem Huijbers[1,3,4], Koene R.A Van Dijk[1,3,4], Aaron P Schultz[1,3,4], Rebecca Amariglio[1,2,4], Tamy-Fee Meneide[1,3,4], Trey Hedden[1,3,4], Dorene Rentz[1,2,3,4], Keith A Johnson[1,3,4], Reisa A Sperling[1,2,3,4]; [1]Harvard Medical School, [2]Brigham and Women's Hospital, [3]Massachusetts General Hospital, [4]Athinoula A. Martinos Center for Biomedical Imaging — Subjective memory complaints are common among older adults and frequently seen in preclinical Alzheimer's disease (AD), but very little is known about their neural correlates. Recent fMRI studies show that a specific set of brain regions, collectively called the default mode network (DMN), is important for intact self-awareness and episodic memory. In this study we used resting state functional connectivity magnetic resonance imaging (RS-fcMRI) to investigate the association between intrinsic activity correlations in the default mode network (DMN) and subjective measures of memory functioning. Clinically normal older adults (n=205, mean age = 74.2, mean mmse = 29.1, Logical memory immediate recall mean= 14.9, Logical memory delayed recall mean = 13.6) were administered the General frequency of forgetting subscale of the Memory functioning questionnaire to measure subjective memory. The integrity of the DMN was estimated by correlating RS-fcMRI time courses extracted from a priori regions including the posterior cingulate, lateral parietal, and medial prefrontal cortices. A relationship between subjective memory complaints and functional correlations within the DMN, specifically the correlation between medial prefrontal cortex and the posterior cingulate, was found to be significant even after controlling for age, logical memory score, structural changes and subclinical depressive symptoms (rp=0.14, p=0.02). These results provide further evidence that increased memory complaints are related to DMN integrity in clinically normal older adults. This suggests that subjective memory complaints may offer insight into early behavioral and pathological changes in AD. More research is needed to ascribe a pathological source for this network disruption.

EXECUTIVE PROCESSES: Goal maintenance & switching

A41

GRAPH THEORETIC MEASURES OF FRONTAL CORTEX CONNECTIVITY AT REST ARE SENSITIVE TO INDIVIDUAL DIFFERENCES IN EXECUTIVE FUNCTION Andrew Reineberg[1], Jessica Andrews-Hanna[1], Marie Banich[1]; [1]University of Colorado Boulder — Maintenance and adaptive control of task sets requires brain circuitry with both efficient local processing capability and broad connectivity across the brain. Graph theoretic measures of clustering coefficient and strength are proxy measures for such characteristics. While these measures have been applied to task-induced activations, how the connectivity profile of frontal cortex at rest relates to executive function performance at later time points is still an open question. In the current study, we analyze resting-state fMRI data from ninety-one college undergraduates that completed a battery of tasks measuring important aspects of executive function: inhibition of a prepotent response (antisaccade task), task set shifting (category switching task), and working memory updating (keep track task). We found that the connectivity profile of a number of lateral prefrontal nodes (including middle and inferior frontal gyrus), as assessed by graph theoretic measures of strength (average connectivity across all of that region's connections) and clustering coefficient (a measure of local interconnectivity), was significantly associated with common executive function (z-score average of the three tasks) but not specific aspects of executive function (e.g., residualized set shifting and updating). The results of the current study have important implications for our understanding of individual differences in the brain at rest, particularly the functional role of lateral frontal regions that have previously been implicated as sources of adaptive online control.

A42

BOLD-SIGNAL VARIABILITY DURING COGNITIVE FLEXIBILITY AND STABILITY: EFFECTS ON TASK PERFORMANCE AND TASK-SPECIFIC FUNCTIONAL EMBEDDING OF A REGION Diana J.N. Armbruster-Genc[1,2], Kai Ueltzhöfer[1,2], Matthias Ekman[3], Christian J. Fiebach[1,2,3,4]; [1]Department of Psychology, Goethe University Frankfurt am Main, Germany, [2]Bernstein Center for Computational Neuroscience Heidelberg / Mannheim and Department of Neuroradiology, University of Heidelberg, Germany, [3]Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, The Netherlands, [4]IDeA Center for Individual Development and Adaptive Education, Frankfurt am Main, Germany — This study investigates - using a novel analysis approach - the relation between BOLD-signal variability and behavioral performance in an fMRI-paradigm assessing both cognitive flexibility (i.e., task switching) and cognitive stability (i.e., distractor inhibition; Armbruster et al., 2012), in a large sample of healthy human subjects (n = 77). Results show that higher brain signal variability is beneficial for response times in both conditions. Task switching performance, in terms of error rates, is improved in people with higher levels of brain signal variability, while brain signal variability has a detrimental effect on distractor inhibition performance. We hypothesized that the task-specific functional embedding of a brain region may be a potential underpinning of brain signal variability. Using graph theoretical network analysis, we show consistently positive correlations between task-specific BOLD-signal variability and degree, efficiency as well as betweenness in several prefrontal regions of interest. Importantly, this holds only for the task-specific measures. Specifically, degree, efficiency and betweenness where analyzed separately for the two task conditions, and no significant correlations

were found between signal variability in one condition and the functional embedding of the respective region in the other condition. Taken together, these findings show a differential effect of BOLD-signal variability on task performance depending on the specific task demands. Our results replicate and extend findings from a previous study using EEG during rest (Misic et al., 2011), by demonstrating a positive relationship between BOLD-signal variability and a region's task-specific functional embedding.

A43

THE EFFECTS OF SACCADE TRIAL TYPE PROBABILITY ON RESIDUAL INHIBITION AND TASK SWITCHING COSTS Jordan Pierce[1], Brett McCardel[1], Jennifer McDowell[1]; [1]University of Georgia — Cognitive control processes are implemented to manage incoming sensory information and the allocation of neural resources to appropriate functions. Eye movement circuitry involved in saccade production offers an excellent model for studying cognitive control: basic visually-guided prosaccades are reflex-like glances towards a stimulus. Goal-directed antisaccades invoke cognitive control processes to generate a saccade to the mirror location of a stimulus. Thus, a correct antisaccade requires inhibition of a prepotent saccade towards a cue and the generation of a response in the opposite direction, but the same distance away from the center as a newly appearing stimulus. By manipulating the proportion of prosaccade and antisaccade trials across multiple runs, this study evaluated the corresponding differences in behavioral patterns. Fifty-four participants (n=41 females, mean age=19.3 years (SD=1.3)) were recruited from an undergraduate student research pool. Results indicated that the percentage of correct responses on prosaccade trials decreased when there was a lower probability of prosaccades in the run, yet the percentage of correct antisaccade responses was constant across runs. Furthermore, increasing the probability of antisaccades in a run led to slower reaction times for both saccade types, particularly following a previous antisaccade trial. This finding suggests that residual inhibition from antisaccades slows performance of all subsequent trials, that this effect is modulated by the overall probability of the occurrence of an antisaccade, and that this slowing may or may not lead to differences in the percentage of directionally correct responses depending on trial type.

A44

PHARMACEUTICAL MANIPULATION OF THE EFFECTS OF DOPAMINE AND NOREPINEPHRINE ON COGNITIVE CONTROL Marlies Van Bochove[1], Kees Van Heeringen[2], Massimo Silvetti[1], Lorenza Colzato[3], Wim Notebaert[1], Tom Verguts[1]; [1]Ghent University, [2]Ghent University Hospital, [3]Leiden University — In daily life we constantly need to adapt our behavior. In situations that evoke multiple response options, we must overcome our urge to execute the obvious but incorrect response and select the appropriate although less obvious action. This is referred to as cognitive control. Which resources are needed to enable us to adapt our behavior to the environment, highly depends on the complexity of the situation. In highly familiar situations, strengthening of existing knowledge might be sufficient. In unpredicted situations new connections between situational and response representations need to be formed. Both dopamine (DA) and norepinephrine (NE) are known to influence cognitive control, although it remains unclear which aspects are driven by DA or NE respectively. In the current study we investigated two versions of the flanker task. In the arrow flanker task we investigated adaptation to a familiar environment, and in the novelty flanker task the adaptation to novel situations. To investigate mechanisms that might mediate adaptation, we added a binding task and a probabilistic reward task. All tasks were executed (N = 20) under 3 pharmaceutical conditions, using Reboxetine to enhance NE-ergic function, Amisulpride to enhance DA-ergic function and a placebo. The order of tasks and pharmaceutical conditions were counterbalanced over participants and the medication administration was double blind. We found that both DA en NE modulate behavioral outcomes, but they modulate them in opposite directions. We further report the effects on novelty, binding and reward prediction.

A45

CONTEXT ORIENTED PERFORMANCE BIASES IN COGNITIVE CONTROL Christopher Walker[1,2], Nicola Polizzotto[1], Raymond Cho[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition — Cognitive control, the ability to guide goal-directed behavior, is comprised of a variety of cognitive components that are dynamically adaptive to variable environmental contexts. In experimental settings, one important contextual parameter is the distribution of trial type proportions. Long time course performance biases can emerge as a function of event predictability, and control must be exerted to overcome such biases. In a proactive control task, we tested three task contexts as defined by trial type proportions in a between-subjects design while collecting electroencephalographic (EEG) recordings from 60 participants. High and low control demand trials were presented in tasks where either 30, 50, or 70 percent (%) of trials were high control trials. Behavioral analyses revealed task condition does not drive behavioral differences per se. Across all trial proportions, response latencies were slower for high control compared to low control trials. However, participants in the least predictable context (i.e. 50% high control) exhibited a trend toward slower responding overall. By contrast, we observed the highest error rates in the least likely trial types, and condition related differences were absent with even proportions. Analyses of induced power demonstrated decreased tonic theta-band (4-8 Hz) rhythms in the 30% high control group, while the 70% high control group exhibited increased tonic gamma-band (30-80 Hz) rhythms. Taken together, these results provide behavioral and electrophysiologic evidence that cognitive control mechanisms may produce differential biases that are sensitive to uncertainty and the aggregate control demands in one's environment.

A46

STIMULATION OF FRONTAL POLAR CORTEX DISRUPTS HIERARCHICAL CONTROL OF TASK SEQUENCES Theresa M. Desrochers[1], Christopher H. Chatham[1], David Badre[1,2]; [1]Brown University, [2]Brown Institute for Brain Science — In our daily lives, we perform sequences of tasks that involve not only monitoring for the final end goal, but the intervening subgoals. Often, one proceeds through a task sequence despite limited cues in the environment marking progress. In such situations, one must internally monitor progress through the sequence. In a previous fMRI study, we showed that such sequential control involves the same rostral fronto-parietal networks that have been shown to participate in non-sequential hierarchical tasks based on contingent rule structures. Specifically, while participants repeatedly performed a sequence of four simple categorization tasks (e.g.: color, shape, shape, color), we observed ramping activation in the frontal polar cortex (FPC) within a sequence that reset at each initiation of the next sequence. This activity pattern suggested that FPC plays a unique role in the hierarchical control of task sequences. However, the necessary and specific contribution of this ramping activity to sequential task control remains unclear. Here, we disrupted FPC during performance of the same sequential task using transcranial magnetic stimulation (TMS). We delivered single TMS pulses (d" 0.2 Hz) after the stimulus onset at one or no positions of each repetition of the 4-task sequence. We found that not only does stimulation reliably lengthen reaction times (RTs) on the sequence position that the stimulation was delivered, but also increases RTs at subsequent positions until the next sequence initiates. At the next sequence initiation, RT returns to baseline. This suggests that the FPC plays a necessary role in hierarchical control over task sequences.

EXECUTIVE PROCESSES: Monitoring & inhibitory control

A47

INJURED BRAIN REGIONS ASSOCIATED WITH DISINHIBITION Kris Knutson[1], Olga Dal Monte[2], Selene Schintu[3,4], Eric Wassermann[1], Jordan Grafman[5], Frank Krueger[6]; [1]National Institute of Neurological Disorders and Stroke, National Institutes of Health, [2]University of Turin, [3]Lyon Neuroscience Research Center, [4]University UCBL Lyon, [5]Rehabilitation Institute of Chicago, [6]George Mason University — Disinhibition is an inability to inhibit behavior, which is often seen in frontal-temporal degeneration, Alzheimer's disease, stroke and other types of brain damage. Behavioral disinhibition leads to social and emotional impairments including impulsive behavior and disregard for social conventions. We used voxel-based lesion-symptom mapping (VLSM) on Vietnam veterans with penetrating traumatic brain injury (pTBI) to identify the effects of brain lesions on behavioral disinhibition measured by the Neuropsychiatric Inventory (NPI), a structured caregiver-based interview. Additionally, we compared uninjured veterans and the

pTBI veterans on demographic information and neuropsychological variables. Our results revealed that lesions in the frontal and temporal lobes, gyrus rectus and insula were associated with greater disinhibition. Our findings provide further evidence of the right frontal lobe's involvement, not only in motor and cognitive inhibition, but also in behavioral inhibition.

A48

MOTIVATED TO WIN: INFLUENCE OF MONETARY REWARD ON NEURAL TEMPORAL DYNAMICS OF ACTION MONITORING

Narun Pornpattananangkul[1], Robin Nusslock[1]; [1]Northwestern University — We examined the extent to which reward modulates neural-cognitive activity at discrete action monitoring stages across time. A time estimation task was employed while EEG data were recorded. Participants were instructed to button-press 3.5 s after Cue onset and were later provided with feedback on their performance. They received monetary reward for accurate performance on the Reward trials, but not on No-Reward trials. At the cue-evaluation stage, the reward cue led to a smaller N2 and larger P3 compared to the no-reward Cue, suggesting that the reward cue affected positive-valance evaluation and boosted attention to the cue. Next, at the motor-preparation stage, the reward cue enhanced the Readiness Potential component (RP) starting approximately 1 s before movement, indicating that the reward cue enhanced motor-movement initiation processes. Later, at the subsequent feedback-anticipation stage, the reward cue elevated Stimulus Preceding Negativity (SPN), signifying that the reward cue elevated anticipation of performance feedback. Following, at the feedback-reactivity stage, we found a selective modulation of reward on a feedback-locked stimuli in a reduction of Feedback-Related Negativity (FRN) during accurate-performance feedback, illustrating that the reward cue modified appraisal of positive-valence information. Later, elevated feedback-locked P3 was associated with the reward-cue, but not the accuracy, feedback, demonstrating that the reward cue influences an evaluative system sensitive to magnitude, rather than valance, information. Lastly, we established parallel roles for both reward and accuracy information on the Late-Positive Potential (LPP), revealing a sustained processing of reward outcome and inaccurate performance information.

A49

INCREASED ERROR-RELATED BRAIN ACTIVITY IN OBSESSIVE-COMPULSIVE DISORDER BEFORE AND AFTER COGNITIVE-BEHAVIORAL THERAPY

Anja Riesel[1], Tanja Endrass[2], Lea Auerbach[1], Norbert Kathmann[1]; [1]Humboldt-Universität zu Berlin, [2]Otto-von-Guericke-Universität Magdeburg — Objective: Enhanced neural correlates of performance monitoring represent one of the most robust findings to date in research concerning obsessive-compulsive disorder (OCD). Therefore, they are considered as a promising endophenotype for OCD. In line with that it has been shown that the ERN is heritable, enhanced in unaffected family members of OCD patients and state-independent in pediatric OCD patients. The purpose of the present study was to examine performance-monitoring in adult OCD patients before and after cognitive-behavioral therapy (CBT) to further elucidate whether enhanced error-monitoring qualifies as endophenotype for OCD. Method: Amplitudes of the error-related and correct-related negativity as electrophysiological indicators of performance monitoring were recorded from 60 patients and 60 matched healthy comparison subjects while performing a flanker task. Of these patients 45 returned for a second testing session after CBT; 39 comparison subjects participated a second time after a comparable time interval. Results: At pretreatment, patients with OCD were characterized by enhanced error-related negativity and correct-related negativity amplitudes compared to healthy subjects. This difference remained after treatment. Further, responders and nonresponders did not differ in performance monitoring activity and both groups showed enhanced indices of performance monitoring. No correlation to symptom severity and changes in symptom severity were observed. Conclusion: These results provide evidence for state-independent performance-monitoring alterations in OCD. Even after successful treatment OCD patients remain characterized by increased performance-monitoring. This supports that overactive performance-monitoring could represent a candidate endophenotype that indicates vulnerability for OCD.

A50

COGNITIVE CONTROL AND OBJECT RECOGNITION IN HIGHLIGHTING

Matthew Weber[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania — Highlighting, also known as the inverse base rate effect, is a systematic distortion of association strengths arising from learning cue-response associations distributed unevenly in time. Behavioral and computational evidence indicates that highlighting arises from a redistribution of attention over the cues. We investigated the neural underpinnings of this effect using functional MRI; cues were pictures drawn from semantic categories known to engage object-selective regions of the ventral visual stream (bodies, chairs, faces, locations). We find that the right dorsolateral prefrontal cortex is more engaged by the processing of highlighted cue-response associations relative to associations learned without preconditioning, a result evocative of previous neuroimaging studies on associative learning. In addition, both fusiform gyri are less active for the newer associations, potentially a signature of the reduced association between old cues and new responses characteristic of highlighting. Our work adds to the evidence that cognitive control shapes object-recognition operations even in simple associative paradigms.

A51

NEUROCOMPUTATIONAL MECHANISMS OF FLEXIBLE COGNITIVE CONTROL

Jiefeng Jiang[1], Tobias Egner[1]; [1]Duke University — The brain adjusts cognitive control settings on-the-fly to suit changing task-demands, but how such flexible control is achieved is presently unknown. One possibility is that the brain predicts future task-demand (such as the likelihood of conflict in a Stroop task) on the basis of prior experience, and adapts top-down control accordingly. We developed a Bayesian computational model that achieves optimal conflict prediction by integrating temporally recent and remote information about conflict occurrence as a function of environmental volatility: when the incidence of conflict (i.e., the proportion of congruent trials) remains stable, control adjustments rely more on remote than recent conflict density to discount short-term noise. In a volatile scenario, where the occurrence of conflict varies frequently, adjustments rely more on recent than on remote conflict density to discount outdated information. Based on successful model fits to behavior, we hypothesized that the brain tracks volatility to predict conflict and guide control. We acquired fMRI scans while participants (N=21) performed a face-word Stroop task with varying conflict volatility. Trial sequences were processed by the Bayesian model to generate trial-by-trial estimates of volatility and predicted conflict, and then regressed against fMRI signal. We found that activity in the posterior parietal cortex and the caudate tracked volatility and predicted conflict level estimates, respectively. Furthermore, we found that the fMRI signal in the fusiform face area covaried with "conflict prediction error". These results support our hypothesis and shed light on the specific roles of different brain regions in the flexible adjustment of cognitive control.

A52

VENTRAL STRIATAL AND DORSAL ANTERIOR CINGULATE CORTEX ACTIVATION REFLECT SUBJECTIVE CERTAINTY IN A DIFFICULT VISUAL DISCRIMINATION TASK

George A. Buzzell[1,2], John R. Fedota[1,2], Jessica Braymiller[3], James C. Thompson[1,2], Raja Parasuraman[1,2], Craig G. McDonald[1,2]; [1]George Mason University, [2]Center of Excellence in Neuroergonomics, Technology, and Cognition (CENTEC), [3]Mercyhurst University — While the role of the ventral striatum in reward-based reinforcement learning has been well characterized, its role in intrinsic motivation is less clear. Correctly performing a difficult task may be intrinsically rewarding and therefore may elicit striatal activation. Furthermore, such behavior is consistent with the predictions of reward prediction error models of learning. However, the relationship between trial-to-trial fluctuations in subjective certainty and striatal activation is unknown. In addition, although the role of the dorsal anterior cingulate cortex (dACC) in performance monitoring is well established, its relationship to subjective certainty remains understudied. In the present experiment, participants performed a difficult forced-choice stimulus discrimination task in which they reported the certainty of their response on each trial. In line with previous research, event-related fMRI revealed that correct responses were associated with increased ventral striatal activation, whereas incorrect responses were associated with increased dACC activation. This suggests that intrinsically motivated tasks

can indeed elicit striatal activation in the absence of external rewards and that the performance monitoring system was engaged on incorrect trials. In addition, analysis of only correct responses as a function of subjectively reported certainty showed that correct-sure responses were associated with increased striatal activations, whereas correct-unsure responses were associated with increased dACC activations. This suggests that the double dissociation between striatal-reward and dACC-performance-monitoring extends beyond the binary correct-incorrect classification and reflects the subjective certainty of the individual.

A53

THE IMPACT OF INDUCED ANXIETY ON GO/NO-GO RESPONDING ACROSS MOOD AND ANXIETY DISORDERS. Marissa Krimsky[1], Lynne Lieberman[2], Oliver Robinson[3], Christian Grillon[4]; [1]University of Miami, [2]University of Illinois at Chicago, [3]University College London, [4]National Institute of Mental Health — The impact of anxiety is wide-ranging. It can be an adaptive response, promoting harm avoidance, but it can also negatively impact certain cognitive functions, such as learning and concentration. The present study examined the effect of induced anxiety on performance of a "go/no-go" or "sustained attention to response task" (SART), designed to probe distraction. Subjects were presented with frequent "go" stimuli, to which they had to respond, and infrequent "no-go" stimuli, to which they have to withhold responses. Errors of commission (missed no-go) are thought to measure lapses of attention, such as off-task thinking, whereas go responses are thought to measure habitual responding. Subjects performed this task under two conditions: threat (unpredictable electric shock at any time) and safe (no shock). A total of 40 subjects were tested in this experiment, n= 20 healthy controls, n = 14 individuals diagnosed with a current anxiety disorder, and n = 6 individuals diagnosed with major depressive disorder. Across all groups, we noted a significant negative correlation between anxiety potentiated startle and anxiety potentiated 'go' speed on the SART task. Individuals exhibiting a larger startle response during threatening conditions also responded faster during threat conditions. These results suggest that threat of shock during SART promotes habitual responding along a continuum across levels of anxiety. Critically, this effect was seen as a continuous index irrespective of categorical diagnoses, supporting contemporary approaches towards the classification and treatment of anxiety disorders.

A54

EYE-TRACKING MEASURES OF ATTENTIONAL BIAS IN COCAINE-DEPENDENT SUBJECTS Nadeeka R. Dias[1], Joy M. Schmitz[1], Nuvan Rathnayaka[1], Stuart Red[1], Anne B. Sereno[1], F. Gerard Moeller[2], Scott D. Lane[1]; [1]The University of Texas Health Science Center at Houston, [2]Virginia Commonwealth University School of Medicine — Cocaine-dependent subjects (CDS) show evidence of attentional bias toward cocaine-related cues, and this measure of cue-reactivity may be predictive of craving and relapse. Studies show a competition between the higher-order cortical processes (DLPFC, frontal eye fields) in voluntary eye control {i.e., anti-saccades (AS)} and more reflexive saccades driven by involuntary midbrain (superior colliculus, supplementary eye fields) perceptual input {i.e., pro-saccades (PS)}. Neuroimaging in CDS revealed activation in frontal regions during craving, in which reaction time (RT) was a key index of cognitive and motivational processing. We developed a novel attentional-bias task in which CDS and healthy controls (CTL) were tested using eye-tracking technology to measure saccadic performance on counterbalanced blocks of AS and PS trials featuring cocaine-related and neutral images. Analyses of 87 subjects (46 CDS, 41 CTL) indicate higher attentional bias in CDS vs. CTLs as measured by AS errors (looking toward the stimulus), both across all stimuli (35% vs. 19% AS errors), and specifically in the presence of cocaine stimuli (41% vs. 20% AS errors). Ex-Gaussian analysis of RTs revealed CDS display longer RT latencies than CTLs ($p<0.00$, Kolmogorov-Smirnov test) during AS trials featuring cocaine cues. These data demonstrate deficiencies in inhibitory control, exacerbation of attentional bias, and loss of focus evoked by cocaine cues, and additionally indicate CNS (visual processing) deficits in CDS. These factors are strong predictors of relapse in addiction. This saccade-based measure of attentional bias is expected to provide a unique method by which to assess reactivity to drug cues and screen relapse-prevention interventions.

EXECUTIVE PROCESSES: Working memory

A55

THE ORGANIZATION OF PREFRONTAL CORTEX BY CONTENT AND CONTROL: CONVERGENT DORSAL AND VENTRAL ROSTRAL-CAUDAL GRADIENTS Derek Nee[1], Mark D'Esposito[1]; [1]University of California, Berkeley — The prefrontal cortex (PFC) is essential for higher-level cognition. Our mechanistic understanding of how the PFC contributes to higher-level cognition has been aided by identifying organizational principles that explain PFC function. On the one hand, recent proposals suggest that the PFC is hierarchically organized along its rostral-caudal axis such that more rostral areas exert control over more caudal areas. On the other hand, long-standing hypotheses suggest that the PFC is organized by content with dorsal areas processing spatial information and ventral areas processing identity information. How the rostral-caudal axis of control and dorsal-ventral axis of content interact remains unclear. Here, we examined the rostral-caudal and dorsal-ventral organization of the PFC by orthogonally varying demands on control and content while scanning participants with fMRI. Distinct demands on control elicited dissociable caudal, mid, and rostral activations in the PFC. Control over spatial content produced preferentially dorsal activations in caudal and mid-PFC, while control over verbal content produced preferentially ventral activation in caudal and mid-PFC. However, the rostral PFC was insensitive to content. These results indicate that the PFC has both dorsal and ventral rostral-caudal gradients that converge in the rostral PFC. These data further suggest that the rostral PFC is the locus of domain-general cognitive control, while caudal and mid-level areas of the PFC are more content-specific.

A56

A COMPUTATIONAL MODEL OF DORSOLATERAL PREFRONTAL CORTEX William Alexander[1,2], Joshua W. Brown[2]; [1]Universiteit Gent, [2]Indiana University, Bloomington — Coactivation of anterior cingulate cortex (ACC) and dorsolateral prefrontal cortex (dlPFC) is commonly observed in neuroimaging studies of cognitive control. Although the regions are thought to interact to support top-down control of behavior, the nature of this interaction remains a topic of debate. It has previously been suggested that ACC may signal the need for control which is then deployed by dlPFC, that ACC indicates the need for shifts in attention to external stimuli or task-sets associated with behavior which are then implemented by dlPFC, or that dlPFC and ACC contribute independently to different forms of control. One potential reason for the lack of clarity regarding interactions between ACC/dlPFC may be due to the absence of a consensus regarding the computational function of either region independent of its involvement in a larger control network; a complete computational account for the function of one would provide critical constraints on the possible functions of the other. Building on a recent model of ACC (Alexander & Brown, 2011), we propose a new computational model of dlPFC, the Hierarchical Error Representation (HER) model. The HER model states that dlPFC learns representations of error signals generated by ACC which are then associated with task-related stimuli, while error representations maintained by dlPFC are used to modulate predictive activity in ACC. In a series of simulations, we show that the HER model is able to account for activity observed in dlPFC in fMRI, lesion, and single-unit studies.

A57

ELECTROPHYSIOLOGY AND FUNCTIONAL MAGNETIC RESONANCE IMAGING MEASURES OF BRAIN CONNECTIVITY IN SCHIZOPHRENIA DURING WORKING MEMORY TASK PERFORMANCE Sarah Schipul[1], Alana Campbell[1], Aysenil Belger[1]; [1]University of North Carolina at Chapel Hill — Schizophrenia has been associated with disordered brain connectivity and impaired executive and emotional processing in both functional magnetic resonance imaging (fMRI; e.g., Lynall et al., 2010) and electroencephalography (EEG; e.g., Donkers et al., 2011). These methods reveal different insights into neural patterns, and integrating the two has potential to inform our understanding of brain communication in schizophrenia. The goal of this study is to examine brain connectivity measures in EEG and fMRI data collected during a working memory task

in individuals with schizophrenia and matched control participants. Participants completed separate fMRI and EEG sessions, during which they performed a visual 1-back task with neutral and emotional images. Neural synchrony was assessed by time-frequency analyses of the EEG data using a complex Morlet wavelet transform. Functional connectivity was assessed by correlation analyses of the fMRI activation timecourse in distinct regions of interest. Preliminary analyses with 10 participants per group revealed aberrant connectivity patterns in patients with schizophrenia. Neural synchrony analyses revealed diminished low (theta) and high (beta) frequency power in the schizophrenia group, particularly for targets in emotional conditions. Functional connectivity analyses similarly revealed weaker correlations between brain regions in the schizophrenia group, particularly in pairs involving social perception regions (fusiform gyrus and amygdala). These findings suggest aberrant brain connectivity in schizophrenia in networks involved in working memory. Impaired connectivity may be exacerbated under emotional conditions. Future analyses will include the full set of participants and will directly examine the relation between EEG and fMRI measures of connectivity.

A58

PREDICTING WORKING MEMORY CAPACITY USING SPECTRO-TEMPORAL CHARACTERISTICS OF THE OSCILLATORY EEG Pouya Bashivan[1], Gavin M. Bidelman[2,3], Mohammed Yeasin[1]; [1]Electrical and Computer Engineering, University of Memphis, [2]Institute for Intelligent Systems, University of Memphis, [3]School of Communication Sciences & Disorders, University of Memphis — The aims of this study were to examine possible relationships between spectro-temporal characteristics of brain activity (EEG) and individual working memory (WM) capacity. Event-related desynchronization (ERD) responses within Î±, and Î² frequency bands were examined while participants performed a modified version of the Sternberg memory task. Memory load was modulated by changing the number of visually presented characters from 2 to 8 items. Independent Component Analysis (ICA) was applied to isolate source activity within the brain signals during the visual WM task. Source activity common across different load conditions was identified using cluster-based analysis of the ICA components. This allowed us to isolate similar brain regions that were uniquely modulated by memory load. Results showed robust changes in duration of Î± and Î² band activity with increasing size of the memory set. Empirical results also displayed a strong correlation ($r = 0.82$, $p < 0.002$) between duration of Î² activity in postero-central networks and individual memory capacity. These associations were generally stronger than other response metrics (e.g., evoked potential amplitude) that have been previously described as neural correlates of WM. Furthermore, it was observed that the correlations among Î± and Î² band activities were stronger in their differences (e.g., set sizes 2 and 4) as compared to individual conditions. We infer that the timecourse of Î² activity plays a critical role in WM operations. These results may help in characterizing personalized online load as well as individual memory capacity.

A59

IGNORANCE IS BLISS: THE EFFECT OF TASK-RELEVANCE ON PROACTIVE INTERFERENCE Kimberly Craig[1], Saqib Rana[2], Cindy Lustig[2]; [1]Mary Baldwin College, [2]University of Michigan — How do we forget? Even after a few seconds, forgetting can have a significant impact on information processing. Proactive interference (PI), or the ability of previously-processed information to disrupt current information processing, is often to blame (Berman, Jonides & Lewis, 2009; Monsell, 1978). However, the factors which influence PI remain unclear. Theories of activation-strength and similarity-based competition, while popular, do not fully explain this interference effect. We hypothesize that in addition to similarity, task-relevance is an important factor in the creation of PI (Craig, Berman, Jonides & Lustig, 2013). To investigate this question, we used a one-back task and manipulated the task relevance of different features (number, color, shape) of lure items that preceded the target. Participants viewed a series of items presented one at a time, indicating by button press whether the current item matched the item one-back. In Experiment 1, participants were either instructed to respond based on the color or the number identity of the stimulus. In key trials, similar color and/or number identity information appeared in the two-back position, potentially creating similarity-based interference. However, each of these stimulus features (color and number identity) only created interference when participants were told to attend to that feature; when it was irrelevant it did not affect performance. In Experiment 2, we found the same pattern of results when comparing color and shape information. These results are consistent with the hypothesis that item similarity should create interference only when relevant to the task being performed.

A60

CONTEXTUALLY RELEVANT DEFAULT NETWORK ACTIVITY FACILITATES WORKING MEMORY PERFORMANCE R. Nathan Spreng[1], Elizabeth DuPre[1], Dhawal Selarka[2], Juliana Garcia[1], Stefan Gojkovic[2], Judith Mildner[1], Kyle Kurkela[1], Gary Turner[2]; [1]Cornell University, [2]York University — Substantial neuroimaging evidence suggests that spontaneous engagement of the default network impairs performance on tasks requiring executive control. Here we investigate whether this impairment is context specific. We hypothesized that activation of the default network might enhance performance on an executive control task if control processes are supported by long-term memory representations. Using fMRI, we scanned 36 healthy young adults on a novel 2-back task requiring working memory for famous and anonymous faces. The task was designed to enhance and suppress the default network during working memory for familiar and unfamiliar faces, respectively. Behaviorally, we observed a facilitation effect, with improved working memory performance on "enhancement" trials that required online maintenance of famous face stimuli in the presence of anonymous face distractors. Critically, we also observed greater activation of the default network during these enhancement trials. As predicted, we observed reduced activity in the default network during "suppression" trials that required maintenance of anonymous faces in the presence of famous face distractors. These data suggest that both enhancement and suppression of the default network contribute to performance on a working memory task with high executive control demands. Our findings provide the first evidence that successful activation of the default network, as well as suppression, may be critical for goal-directed cognition.

LANGUAGE: Development & aging

A61

ELECTROPHYSIOLOGICAL EVIDENCE FOR THE FOURTH-GRADE SHIFT? Gabriela Meade[1], Donna Coch[1]; [1]Dartmouth College — According to a classic reading theory, one of the underlying contributors to the so-called fourth-grade shift from "learning to read" to "reading to learn" is automaticity in word recognition (Chall, 1983; Chall, Jacobs, & Baldwin, 1990). Here, we used the N400 component of the event-related potential (ERP) waveform as an index of automaticity in word processing. We recorded ERPs to familiar real words, pseudowords, unpronounceable letter strings, and false font strings in groups of third-, fourth-, and fifth-graders and college students. Stimuli were presented singly, in list form, and participants were asked to perform a semantic categorization task (press a button to animal names). A shift in automatic word processing in fourth grade should be reflected in a shift toward the adult pattern of "legal" stimuli (words and pseudowords) eliciting a marked N400, while "illegal" stimuli (letter and false font strings) do not. Instead, we found that all types of stimuli elicited a marked N400 in the third-, fourth-, and fifth-grade groups. These data do not support the theory of a fourth-grade shift in reading characterized by the development of automaticity in word processing. Rather, the ERP evidence suggests a long developmental time course, beyond elementary school, for efficient single word processing.

A62

NEURAL INDICES OF PHONETIC ENCODING IN MONOLINGUAL INFANTS AND CHILDREN: T-COMPLEX Valerie L. Shafer[1], Yan H. Yu[2], Monica Wagner[3]; [1]The Graduate Center, CUNY, [2]William Patterson University, [3]St. John's University — Infants are faced with the difficult task of identifying acoustic correlates of speech that will allow them to segment the speech signal, and identify lexical units. Selective perception of the relevant cues for speech perception begins to develop in the first year of life, and continues into grade school. The goal of the current analysis was to examine the maturation of the T-complex sequence of peaks (Na, Ta, Tb) to a speech sound in children from three months of age to seven years of age. The

results show that a clear negative peak, consistent with Na, at the left and right temporal sites in most children between 100 and 200 ms differed from the pattern found for the P1 obligatory peak. The Na peak showed a linear shift earlier in time with increasing age. A clear positive peak (Ta), following Na and peaking between 120 and 200 ms was not consistently found in most age groups of children. The Tb peak was only clearly present in the adult groups at T8. Linear mixed-effect model revealed that age, latency, and site have an effect on the T-complex (Na peak) amplitude, but sex and hemisphere were not significant predictors for the T-complex amplitude. Considering that poor T-complex responses have been observed in children with language impairment (Shafer, et al., 2011), our finding suggests further investigation of the T-complex in infants and toddlers at risk for language impairment will be of great interest.

A63

KINDERGARTEN PRE-READING SKILLS AND ERP MISMATCH NEGATIVITY MEASURES PREDICT 1ST GRADE CONNECTED TEXT READING FLUENCY

Elizabeth S. Norton[1], Sara D. Beach[1], Abigail B. Cyr[1], Ola Ozernov-Palchik[2,3], Kelly K. Halverson[1], Nadine Gaab[2,4], John D. E. Gabrieli[1,5]; [1]Massachusetts Institute of Technology, [2]Boston Children's Hospital, [3]Tufts University, [4]Harvard Graduate School of Education and Harvard Medical School, [5]Harvard-MIT Division of Health Sciences and Technology — Early identification of reading difficulties is associated with better academic outcomes; thus, efforts have been made to identify children at-risk for reading difficulties in kindergarten. Previous predictive models have shown that addition of neuroimaging measures can be more accurate in predicting single-word reading than models that include only behavioral pre-reading skills. Here, we examined how pre-reading skills, IQ, socio-economic status (SES), and measures of the ERP mismatch negativity (MMN) response predict connected text reading fluency in 1st grade. In the fall of kindergarten, children (n=40) completed measures of letter knowledge (LK), phonological awareness (PA), and rapid automatized naming (RAN), as well as an ERP MMN paradigm with speech syllables. The same children returned at the end of 1st grade for follow-up assessment, including the Gray Oral Reading Test (GORT-5). We employed regression models predicting 1st grade GORT-5 reading fluency scores. Model 1 was based on behavioral scores. IQ and SES were not significant; however, RAN, PA, and LK, and accounted for 59% of variance in fluency. Model 2 added measures of MMN onset latency and mean amplitude and significantly improved prediction over behavioral Model 1 (p=.02). Predicted scores derived from Model 2 beta weights allowed 96% correct classification of children as above or below the 25th percentile for reading fluency in 1st grade. These findings suggest that kindergarten pre-reading skills and ERP MMN measures can yield a highly accurate model of 1st grade reading, and could potentially be used to predict reading difficulties in children before formal reading instruction begins.

A64

CROSSMODAL-RELATED ARCUATE FASCICULUS COHERENCE PREDICTS LONGITUDINAL READING GROWTH

Margaret M. Gullick[1], James Booth[1]; [1]Northwestern University — Crossmodal integration of auditory and visual information (e.g., phonemes and graphemes) is a critical skill for reading; the arcuate fasciculus may be particularly supportive of reading generally and crossmodal processing specifically. We recently demonstrated that arcuate fractional anisotropy (FA) was significantly related to performance on a crossmodal word rhyme-judgment task in a large sample of children, moreso than for unimodal auditory-only or visual-only performances. Here, we examine longitudinal data collected two to three years after this initial visit from 17 of these children to determine whether connectivity at Time 1 was predictive of reading outcome. Stepwise regressions revealed that Time 2 real-word reading score (identification and fluency raw score average) was significantly predicted by both initial score (p<.001) and initial FA in crossmodal-related arcuate voxels (p=.014); this FA relationship was significant even after hierarchically partialling for variance accounted for by reading score and related skills (pseudoword reading, phonological awareness) . Participants with greater initial crossmodal-related arcuate FAs demonstrated higher Time 2 reading scores. This relationship was crossmodal specific; neither unimodal auditory nor visual FA were predictive of Time 2 reading. Further, change in real-word reading was predicted only by crossmodal FA, even after partialling for other measures (p=.002): participants with lower Time 1 FA demonstrated greater reading score changes, potentially because there was more room for improvement. As such, crossmodal-related arcuate coherence is significantly predictive of reading outcomes even beyond that of standardized test measures. Arcuate fasciculus connectivity thus appears to support crossmodal reading-related integration both initially and longitudinally.

A65

FUNCTIONAL NEUROANATOMICAL DIFFERENCES BETWEEN EARLY READERS WITH AND WITHOUT DEVELOPMENTAL DYSLEXIA

Joanna Christodoulou[1,2,3], Jack Murtagh[1], Tyler Perrachione[1,4], Abigail Cyr[1], Kelly Halverson[1], Patricia Chang[1], Pamela Hook[2], John Gabrieli[1,3,5]; [1]Massachusetts Institute of Technology, [2]MGH Institute of Health Professions, [3]Harvard Graduate School of Education, [4]Boston University, [5]Athinoula A. Martinos Imaging Center — We examined the functional neuroanatomy of early reading development in children ages 6-9 with developmental dyslexia (n=31) and typically developing readers (n=25) using functional magnetic resonance imaging (fMRI). Groups did not differ on age, gender, or nonverbal cognitive abilities, and the group with dyslexia was significantly lower performing on reading tasks. For the fMRI task, participants were shown a sequence of words one after another and were asked to respond whenever two consecutive words began with the same first sound. Children with dyslexia exhibited significantly reduced activations in left-lateralized regions associated with reading and language, extending from left fusiform gyrus, an area of the brain important for word recognition, to left-lateralized frontal cortex (superior, middle, and inferior gyri), temporal cortex (superior, middle, and inferior gyri), and occipital cortex (superior, middle, and inferior gyri; lingual gyrus, parahippocampal gyrus). This finding highlights the importance of the left fusiform gyrus in the context of the reading brain network for single word processing in young readers.

A66

WHITE MATTER INTEGRITY DIFFERENCES IN EARLY READERS WITH AND WITHOUT DEVELOPMENTAL DYSLEXIA

Jack Murtagh[1], Joanna Christodoulou[1,2,4], Abigail Cyr[1], Tyler K. Perrachione[1,3], Patricia Chang[1], Kelly Halverson[1], Pamela E. Hook[2], Satrajit S. Ghosh[1], John D. E. Gabrieli[1,4,5]; [1]Massachusetts Institute of Technology, [2]MGH Institute of Health Professions, [3]Boston University, [4]Harvard Graduate School of Education, [5]Athinoula A. Martinos Imaging Center, McGovern Institute for Brain Research, Massachusetts Institute of Technology — We examined white matter integrity associated with early reading development in children ages 6-9 with developmental dyslexia (n=26) and typically developing readers (n=26) using diffusion-weighted imaging. Groups did not differ significantly on non-verbal cognitive abilities, age, or gender; the group with dyslexia performed significantly lower on standardized reading assessments. DWI analyses of the superior longitudinal fasciculus in two regions indicated significant differences between the typically developing readers and the readers with dyslexia based on fractional anisotropy (FA) values. For both the temporal aspect (arcuate fasciculus) and the parietal aspect of the superior longitudinal fasciculus, typical readers showed significantly higher FA values than readers with dyslexia. This finding provides support for early differences in readers with dyslexia in white matter integrity in regions supporting language processing.

A67

LONGITUDINAL LANGUAGE CHANGES AND MRI ANATOMY IN CHILDREN WITH AUTISM SPECTRUM DISORDER

Tracey A. Knaus[1], Jodi Kamps[2], Anne L. Foundas[3]; [1]Louisiana State University Health Sciences Center - New Orleans, [2]Children's Hospital, New Orleans, [3]University of Missouri, Kansas City School of Medicine — Language ability is one of the strongest predictors of prognosis and developmental course in children with autism spectrum disorder (ASD). Abnormal anatomy and functional organization of language-related cortical regions has been found in children with ASD, although it is unclear whether brain structural differences are related to changes in language abilities during early childhood development. The purpose of this study was to determine whether changes in language ability over time are associated with language cortical anatomy and connectivity. Thirteen boys with ASD, ages 2-6 (mean=4.8, SD=1.2) were evaluated and then re-examined at ages 7-10 (mean=8.9, SD=1.1). During the 2nd

evaluation, volumetric MRI and DTI scans were collected to evaluate gray matter volume of anterior (pars triangularis, PTR; pars opercularis, POP) and posterior (planum temporale, PT) language regions and the integrity of the white matter connection (arcuate fasciculus, AF). All subjects had low language abilities and 6 showed relative improvements in language while 7 had relative language decline. Language changes did not correlate with current age, IQ, or ADOS scores, but were correlated with change in total ADOS score (r=-.667, p=.018), with improved language associated with improved autism symptoms. Language changes were also correlated with right PTR (r=-.567, p=.043), with improved language associated with larger volume. Correlations between change in language and AF microstructure were not significant. Results further implicate atypical anatomy of anterior (but not posterior) language regions in ASD. The association between language improvement and larger right PTR volume, may relate to the ability of these individuals to compensate.

A68

DISTINCT NEUROANATOMICAL REGIONS OF EARLY READING ABILITIES: A LONGITUDINAL VOXEL-BASED MORPHOMETRY STUDY

Ola Ozernov-Palchik[1,2], Nora M Raschle[1,3], Nadine Gaab[1,3,4]; [1]Boston Children's Hospital, [2]Tufts University, [3]Harvard Medical School, [4]Harvard Graduate School of Education — Phonological awareness (PA) and rapid naming (RAN) are among the most reliable predictors of reading achievement in preschool and kindergarten. The relationship between these skills has been debated and several theories have emerged to explain the unique role of each in typical and atypical reading development. However, it remains unclear (a) whether PA and RAN have common and/or distinct neural underpinnings and (b) how these underpinnings vary with reading instruction. In this study, RAN and PA skills were examined in 28 children before (Year 1) and after (Year 2) one year of kindergarten. Using voxel-based morphometry we characterized the relationship between gray matter volume indices (GMVI) and RAN/PA skills in each year and longitudinally. Our results revealed that a higher performance on a RAN task is associated with increased GMVI in bilateral superior temporal as well as precentral regions in both years. In contrast, a higher performance on a PA task was related to increased GMVIs in posterior left hemispheric regions in Year 2 and to a lesser degree in Year 1. Our findings suggest that RAN and PA are associated with distinct neuroanatomical regions of the reading network and that associations with PA but not RAN seem to vary with reading experience. This is in line with previous studies that suggest an independent development of PA and RAN skills with varying developmental trajectories during the time-course of learning to read.

A69

INVESTIGATING THE INFLUENCES OF EARLY LANGUAGE DELAY AND FAMILIAL RISK FOR DYSLEXIA ON BRAIN STRUCTURE IN PRE-SCHOOLERS/KINDERGARTENERS

Nora Raschle[1,2,3], Bryce Becker[1], Sara Smith[1], Nadine Gaab[1,2]; [1]Boston Children's Hospital, Laboratories of Cognitive Neuroscience, Developmental Medicine Center, [2]Harvard Medical School, [3]Universitäre Psychiatrische Kliniken Basel (Switzerland) — Previous research shows that early language abilities in infancy/toddlerhood predict later language/literacy skills and changes in brain structure/function in school-age children with early language delay (ELD) have been reported Here we present behavioral data from 114 pre-schoolers/kindergarteners with (ELD+; N=34) and without (ELD-; N=80) early language delay in infancy/toddlerhood as determined by retrospective parent reports. We further divided these children based on their familial risk of dyslexia (FHD-/FHD+). Behaviorally, ELD+ children scored significantly lower than ELD- children on language and reading-related measures, including expressive and receptive language, phonological processing and rapid automatized naming. The lowest performance was observed in ELD+ children with FHD+. Furthermore, we performed voxel-based morphometry (VBM8) in a subset of 46 children. To investigate the effects of both behavioral (ELD+/ELD-) and genetic (FHD+/FHD-) pre-markers of language-based learning disabilities, a full-factorial design was employed. We demonstrate reduced gray matter volume indices for ELD+>ELD- mainly in left-hemispheric middle temporal areas, but also occipital and frontal regions (p>0.005). Alterations in middle temporal brain regions were observed in ELD+ children regardless of FHD status. FHD+ compared to FHD- children displayed gray matter reductions in temporoparietal and occipitotemporal regions; however the effects were strongest in FHD+ELD+. An interaction effect of ELD and FHD was observed in bilateral temporoparietal and occipitotemporal areas. Our findings support the idea of a cumulative effect of early behavioral and genetic risk factors on later brain structure. These findings may facilitate knowledge of the neuronal basis and etiology of language-based learning disabilities, ultimately informing diagnosis and treatment.

A70

LINGUISTIC DEFICITS DIFFERENTIATE MILD COGNITIVE IMPAIRMENT FROM HEALTHY AGING AND PREDICT DEFAULT NETWORK INTEGRITY

Barbara Lust[1], Janet Cohen Sherman[2], Suzanne Flynn[3], James Gair[1], Charles Henderson[1], Claire Cordella[4], Jordan Whitlock[3], Marc Harrison[1]; [1]Cornell University, [2]Massachusetts General Hospital, [3]MIT, [4]Harvard — This research attempts to identify linguistic deficits that characterize prodromal Alzheimer's Disease (AD), relate these to neuroscientific foundations of linguistic knowledge in prodromal AD, and make predictions for future correlational studies linking behavioral and imaging results in this area. Through inter-institutional collaboration, three pilot populations were compared - Mild Cognitive Impairment (MCI) (mean age 75, N=32), age-matched Healthy Subjects , N=21), and Young Adults (mean age 23, N=10) - on several experiments eliciting language production of complex sentence types varying in specified syntactic and semantic factors. Analyses of results through logistic-linear mixed models indicated that MCI language did not differ from other groups on syntactic factors but was significantly depressed when integration of syntax with ambiguous semantic reference was required, e.g, certain pronoun use or ambiguous reference like "what you have". Working memory tests indicated deficits are not explained by memory restrictions. Review of neuroscientific literature suggests these results cohere both with an autonomous serial auditory language processing model involving late stage syntax-semantics integration and with a recent hypothesis that the neural Default Network (reflecting interaction between spontaneous cognition and sensory controlled external reference) is disrupted in prodromal AD. These processing and structural models converge to implicate early neurodegeneration in integration hubs including the Posterior Cingulate Cortex involving Inferior Parietal Lobe, but sparing anterior Superior Temporal Gyrus (STG) and Inferior Frontal Gyrus (e.g, BA44,45); thus providing predictions for a program of future brain imaging analyses in correlation with linguistically informed behavioral analyses and a potential neurocognitive model for disease progression.

A71

TEMPORAL DYNAMICS OF VISUAL WORD PROCESSING - EFFECTS OF FOREIGN LANGUAGE LEARNING IN CHILDREN AND ADULTS

Aleksandra K. Eberhard-Moscicka[1,2], Lea B. Jost[1,2], Lynn V. Fehlbaum[1], Simone E. Pfenninger[3], Urs Maurer[1,2]; [1]Department of Psychology, Division of Cognitive Neuroscience, University of Zurich, Switzerland, [2]Neuroscience Center Zurich, University of Zurich and ETH Zurich, Switzerland, [3]English Department, University of Zurich, Switzerland — Learning a foreign language implies acquiring expertise for new visual word forms. The N1 component of the event-related potential (ERP) has been shown to reflect visual expertise for print. Moreover, some studies indicated its sensitivity to the familiarity of word forms. Here, we investigated how temporal dynamics of visual word processing change with increasing language proficiency, by testing children longitudinally before (1st grade, mean age: 7.6 years) and after one year of classroom English instruction (3rd grade) and comparing them to more proficient adult foreign language speakers of English. A 128-channel EEG was recorded, while 22 native (Swiss-)German adults and 27 monolingual (Swiss-)German children performed an immediate repetition detection task with German word, English word and pseudoword conditions. We subdivided the N1 segment into thirds and compared the three conditions at left and right occipito-temporal electrodes. Adult participants showed a left-lateralized N1 in all three sub-segments. Differences between conditions occurred only in the third sub-segment where a condition-by-hemisphere interaction modulated the two main effects. No significant effects in any of the three sub-segments were present in children, neither in 1st grade nor in 3rd grade. However, the condition-by-hemisphere interaction in the third sub-segment approached the trend level in 3rd grade and resembled the adult-like N1 pattern. Hence, we propose that learning a new language is reflected in neural changes that occur early in

the course of visual word processing. However, one year of foreign language instruction does not appear to be sufficient to automatize processing of new visual word forms.

LANGUAGE: Other

A72

EFFECTS OF SUBCORTICAL LESIONS ON THE PRODUCTION OF AMERICAN SIGN LANGUAGE

David Corina[1], Svenna Pedersen[2], Cindy Farnady[2], Ursula Bellugi[2], Greg Hickok[3]; [1]Center for Mind and Brain, University of California, Davis CA, [2]The Salk Institute for Biological Studies, [3]University of California, Irvine — Goal: Little is known about the contributions of subcortical systems in mediation of American Sign Language (ASL). Here we present two case studies of deaf signers with left-hemisphere subcortical lesions that provide contrasting impairments in language production. Methods: Two profoundly deaf life-long signers were identified in our aphasia research program. Both subjects were tested with the Salk Institute adaptation of the Boston Diagnostic Aphasia Examination and in-house language and cognitive measures designed to assess ASL comprehension, production and non-linguistic limb movement. Patient LHD 173 is an 86 year old male with a lesion involving corona radiata and centrum semivale. Neuropsychological testing of patient LHD 173 reveals severely impaired language output with difficulty in initiating movements. Performance on sign elicitation tasks resulted in a preponderance of stereotyped highly reduced repetition of sign forms that faded to a soft sign "mumbling" similar to palilalia observed in speech. In contrast, LHD 175 is a 63 year old female with a lesion involving left basal ganglia and corona radiata. LHD 173 shows an exuberance of sign movements often with variable ballistic motion production and an under-damping of movements, prolonged intervals in sequential movements (especially fingerspelling), and difficulty in two-handed coordination. Conclusions: Taken together these two case studies provide evidence for sign language homologues to hypokinetic and hyperkinetic language disturbances occasionally seen in hearing individuals with subcortical white-matter and basal ganglia lesions. These are the first case studies to illustrate these impairments in deaf ASL signers.

A73

REORGANIZATION OF BRAIN ACTIVITY FOLLOWING TREATMENT AND POST-TREATMENT OVERTESTING IN A PERSON WITH ANOMIA

Rhonda B. Friedman[1], William Hayward[1], Sarah F. Snider[1], Kelli L. Sullivan[1], Peter E. Turkeltaub[1]; [1]Georgetown University — This study examined the effects of continued studying vs. continued testing on changes in brain activity following treatment for anomia. YPR presented at three years post-stroke with moderate to severe anomia. 120 pictures that he named consistently incorrectly on three baseline sessions were chosen; 96 as treatment items, and 24 as untrained control items. He participated in treatment sessions semi-weekly for 12.5 weeks. At the end of that time he had successfully "learned" 76 of the 96 items; that is, he named the picture correctly on two successive sessions. Over the course of the 12.5 weeks, as the 76 items were learned they were placed into one of the four additional (over) training conditions (test only, study only, test and study, no overtraining) and continued to be tested and/or studied accordingly to reinforce retention. After a one-month washout period without exposure to the treatment items, items that had been overtested were retained better than those not overtested, but overstudying had no such effect. fMRI scans using a covert naming task were performed before treatment and at retention testing one month after treatment. At the latter time point, greater activity in several brain areas was observed for the overtested items compared to non-overtested items. The reverse comparison revealed no activation. In contrast, comparing activation for items that were overstudied vs. not-overstudied resulted in no difference in activity in either direction. These results suggest that continued testing affects brain re-organization following stroke in a way that leads to better retention.

A74

NEURAL CORRELATES OF COHERENCE MONITORING DURING NARRATIVE COMPREHENSION IN CHILDREN AND YOUNG ADULTS.

Linda Van Leijenhorst[12], Anne Helder[12], Josefine Karlsson[12], Paul van den Broek[12]; [1]Leiden University, the Netherlands, [2]Leiden Institute for Brain and Cognition, the Netherlands — The ability to comprehend texts is crucial to success in everyday life, and the development of reading comprehension skills is an important goal during middle childhood. Despite the efforts of education around 10% of children fail to reach sufficient levels of text comprehension at the end of elementary school. Recently functional MRI studies have begun to identify a network of brain regions that contributes to discourse comprehension (see Ferstl et al., 2008). However, the neural correlates of text comprehension processes in childhood are largely unknown. In this study we investigated the neural correlates of comprehension monitoring during reading in children (N = 6, ages 9-12) and young adults (N = 21, ages 19-27). We collected fMRI data while participants read 32 six-sentence narratives that were presented sentence-by-sentence in a slow self-paced event-related design. Half of the narratives contained a break in coherence. Behaviorally adults demonstrated better text comprehension compared to children, even though both age groups showed increased reading times for incoherent compared to coherent narratives. Preliminary fMRI results show that reading of incoherent narratives was associated with a network of regions in the bilateral Angular Gyri and Temporal Poles, Dorsomedial Prefrontal Cortex, Anterior Cingulate Cortex, and Dorsolateral Prefrontal Cortex (DLPFC) in young adults. Children show a similar pattern of brain activation, but do not seem to recruit DLPFC. These preliminary results suggest that, although similar regions are involved in the comprehension of narratives in middle childhood, the contribution of cognitive control related regions may differ from that in adults.

A75

APHASIA AND AMUSIA FOLLOWING UNILATERAL DAMAGE TO THE LEFT HEMISPHERE

Timothy Justus[1], Barbara Tillmann[2], Aniruddh Patel[3], Nina Dronkers[4,5], Juliana Baldo[4]; [1]Pitzer College, Claremont, CA, [2]Lyon Neuroscience Research Center, Université Lyon 1, [3]Tufts University, Medford, MA, [4]VA Northern California Health Care System, Martinez, [5]University of California, Davis — To what extent are acquired language deficits (i.e., aphasia) associated with acquired music deficits (i.e., amusia)? We tested 22 people with aphasia following unilateral left-hemisphere stroke on the Montréal Battery for the Evaluation of Amusia (MBEA). Here, we focus on the results of the first four subtests. In each test, participants heard 30 pairs of melodies and decided whether they were the same or different. In the first three tests (scale, contour, interval), differences were created by altering the pitch of one tone, whereas in the fourth test (rhythm), differences were created by altering the relative durations of two consecutive tones. Based on the MBEA norms, all aphasic participants in this study could be classified as amusic; however, the degree of amusic impairment did not vary systematically with aphasia subtype. To explore the underlying lesion variability, d-prime scores representing each MBEA subtest were analyzed using voxel-based lesion-symptom mapping (VLSM). Preliminary analyses revealed a network along the left superior temporal cortex, including Heschl's gyrus, that was associated with processing scale and interval, whereas the left inferior frontal cortex was associated with processing contour and rhythm. Although bilateral fronto-temporal regions are frequently implicated in music perception, it is typically the right-hemisphere network that is regarded as more essential for music. Here, we have demonstrated that unilateral left-hemisphere damage alone can result in impaired performance on a standard test of music perception. Supported by the GRAMMY Foundation.

A76

STRUCTURAL MRI REVEALS CORRELATIONS BETWEEN INDIVIDUAL DIFFERENCES IN LANGUAGE-RELATED COGNITIVE ABILITIES AND THICKNESS OF LANGUAGE-RELEVANT CORTICAL AREAS

Clinton L. Johns[1], David Braze[1], Peter J. Molfese[1], Julie A. Van Dyke[1], James S. Magnuson[1,2], Whitney Tabor[1,2], W. Einar Mencl[1], Donald P. Shankweiler[1,2]; [1]Haskins Laboratories, [2]University of Connecticut — This study examined the neuroanatomical correlates of individual differences in cognitive abilities related to language processing and comprehension in typically developing adults. There is increasing evidence for relations between brain structure and variation in linguistic ability; however, most available evidence derives from contrasts between clinical (e.g., dyslexic) and non-clinical groups. In addition, studies investigating individual differences in non-clinical populations have utilized small and homogeneous samples (e.g., college students) and/or have included a narrow range of

indices of language-relevant skills. In contrast, this study incorporates a comprehensive skill battery and a large, community-based sample with a wide range of linguistic ability. A Principal Components Analysis revealed four components that accounted for 76% of the variance in the battery measures. These components correspond to constructs previously correlated with language ability: phonological ability, comprehension ability, processing speed, and working memory capacity. These components were entered into regression analyses of grey matter thickness across the whole brain. Results indicate that individual differences in language-related abilities are associated with differences in cortical architecture across multiple levels of language processing. In the left hemisphere, phonological and comprehension ability were significantly correlated with the thickness of pars opercularis in the inferior frontal gyrus, which has been associated with higher-level language functions; and Heschl's gyrus in the temporal lobe, where auditory processing begins. In addition, the phonological, comprehension, and processing speed components were jointly correlated with the thickness of lingual gyrus in visual cortex, which has been associated with both naming and recognition of words and letters.

A77

THE INFLUENCE OF REFERENTIAL CONTEXT ON THE PROCESSING OF AMBIGUOUS SYNTACTIC STRUCTURES IN SCHIZOPHRENIA: EVIDENCE FROM EVENT-RELATED POTENTIALS

Megan A. Boudewyn[1], Shruti Dave[1], Matthew Traxler[1], Debra Long[1], George R. Mangun[1], Cameron Carter[1], Tamara Swaab[1]; [1]University of California, Davis — Cognitive control deficits in schizophrenia impair spoken language comprehension when the meaning of the discourse context is not supported by the meaning of words in the local sentence context (Swaab et al, 2013). However, it is not known whether referential context in discourse can be used to disambiguate processing of syntactically difficult structures. In the present study, schizophrenia patients and healthy control participants listened to short stories that ended with a sentence containing a preferred syntactic structure (VP-attached phrase: e.g., "cut down the oak with the chainsaw") or with a dis-preferred structure (NP-attached phrase: e.g., "cut down the oak with the mushroom"). Previous event-related potential studies from our lab have shown that attachment preference can be modulated by referential context in healthy adults, such that processing of NP-attachment is facilitated when prior context contains more than one plausible referent (e.g. two oaks; Dave et al, 2013). For healthy control participants, our results showed significant modulation of processing for both NP- and VP-attached sentence types as a function of referential context. In contrast, schizophrenia patients only showed significant effects of referential context on the preferred VP-attached structure ($p<.05$). This suggests that cognitive control deficits in schizophrenia result in impaired suppression of contextually-inappropriate syntactic structures when the to-be-rejected structure is preferred, but not when it is dis-preferred.

A78

LOCATION-SPECIFIC EFFECTS OF CEREBELLAR TDCS ON ARTICULATION AND VERBAL FLUENCY

Catherine Stoodley[1], Mary Swears[1], Alexa Desko[2], Peter Turkeltaub[2,3]; [1]American University, Washington, DC, [2]Georgetown University, Washington, DC, [3]MedStar National Rehabilitation Hospital, Washington, DC — The cerebellum is thought to be involved in both motor and cognitive aspects of language. Depending on the location of damage, cerebellar lesions can lead to dysarthria or to difficulties on naming and fluency measures. In neuroimaging studies, articulation engages the representation of the articulatory muscles in the anterior lobe of the cerebellum (lobule V-medial lobule VI), and verb generation and fluency tasks engage lateral parts of right lobule VII, which connects with left frontal and parietal networks. We examined this topography for language function using anodal transcranial direct current stimulation (tDCS) applied to two different locations: the "motor" position (3 cm lateral to the inion) over the right anterior lobe, and the "cognitive" position (4 cm lateral to the inion and 1 cm down) over the right posterolateral cerebellum. The reference electrode was on the deltoid. Participants (17 females, 14 males; mean age 23.4 ± 6.3 years) completed articulation and fluency measures pre- and post- 20min of 2mA motor (n=11), cognitive (n=10), or sham tDCS (n=10). After motor tDCS, participants produced fewer syllables of "ba" in a 30s period than the cognitive and sham groups. Cerebellar tDCS did not significantly affect phonemic fluency. During semantic fluency, the sham and motor tDCS groups showed practice effects, but the cognitive group showed no improvement. These preliminary findings indicate that, depending on electrode position, cerebellar tDCS can affect articulation or semantic fluency. These findings are consistent with the concept that the cerebellum modulates both motoric and cognitive aspects of language.

A79

AN ERP STUDY OF SENTENTIAL CODESWITCHING IN SPANISH-ENGLISH BILINGUALS: COMPARING HABITUAL AND NON-HABITUAL CODESWITCHERS

Kaitlyn Litcofsky[1], Janet van Hell[1,2]; [1]Pennsylvania State University, [2]Radboud University Nijmegen — A characteristic of bilingual speech is the occurrence of sentences that contain words of both languages. Psycholinguistic and neurocognitive research has shown that switching between isolated items incurs an asymmetrical processing cost where it is harder to switch into the dominant language than into the weaker language. This cost is thought to be related to the inhibition of the dominant language. In contrast, relatively little is known about the processing of codeswitches in a meaningful sentence context. In two experiments, sentential codeswitching was examined using event-related potentials (ERPs) in two groups of Spanish-English bilinguals: those immersed in L2 English who codeswitch frequently in their daily life, and those immersed in L1 Spanish who do not codeswitch. Stimuli were 160 sentences that began in Spanish or English and either contained a codeswitch into the other language or not. Both groups of bilinguals showed late positivity effects in response to codeswitched words as compared to non-codeswitched words, but only when switching from the dominant to the weaker language. No effect of codeswitching occurred when switching into the dominant language. These results are in contrast to the language switching studies, and indicate that codeswitching in a sentential context requires different processing mechanisms. Given the appearance of the late positivity, it appears that sentential codeswitching may rely on sentence-level integration mechanisms related to activation of the weaker language.

LANGUAGE: Semantic

A80

EFFECTS OF DISTANCE BETWEEN MEANINGS ON THE NEURAL CORRELATES OF SEMANTIC AMBIGUITY

Christopher M. Grindrod[1], Emily O. Garnett[2], Svetlana Malyutina[2], Dirk B. den Ouden[2]; [1]University of Illinois at Urbana-Champaign, [2]University of South Carolina — Many words are globally ambiguous, in that the same written or spoken form can have multiple senses, and often completely different meanings. Recent studies have shown that recognition of ambiguous words is influenced by the distance between meanings. For example, words with meanings from the same grammatical class (e.g., organ) are recognized more slowly than words with meanings from different grammatical classes (e.g., bark). These findings argue that meanings that are closer in semantic space exhibit greater competition, slowing word recognition. While there is a behavioral cost in processing meanings that are close in semantic space, how this is reflected in the neural systems underlying ambiguity processing remains unanswered. The goal of the present study was to investigate whether the neural correlates of ambiguity are modulated by semantic distance. In an event-related fMRI study, thirteen young adults performed a lexical decision experiment that included balanced and unbalanced noun-noun and noun-verb homonyms, unambiguous words, and nonwords. We hypothesized that neural activation would be graded based on the distance between meanings in anterior and posterior brain regions involved in the storage, retrieval and computation of word meaning. Consistent with this prediction, balanced homonyms produced increased activation in bilateral middle and superior temporal gyri, left prefrontal cortex and right anterior cingulate. In addition, noun-verb homonyms exhibited greater activation in bilateral inferior frontal gyrus, right anterior cingulate, and right middle and superior temporal gyri. These findings provide evidence that the brain regions underlying semantic ambiguity are modulated by the distance between meanings.

A81

KNOWLEDGE ABOUT FOOD IN PATIENTS WITH PRIMARY DEMENTIA. Raffaella Rumiati[1], Giulio Pergola[1], Maria Caterina Silveri[2], Paola Rossi[2], Emanuela Liaci[1], Francesco Foroni[1]; [1]SISSA, [2]Università Cattolica — Previous studies demonstrated that patients with neurodegenerative diseases may show altered eating habits which, in turn, have been associated with deficits in olfactory processing. However, patients' visual recognition of food items has never been tested in detail. Thirteen patients (age: 71.7 ± 6.1 yrs.; education: 10.3 ± 5.4 yrs.) and 18 healthy controls (age: 68.6 ±5.5 yrs.; education: 8.7 ±2.4yrs.) took part in the study. Seven patients received a presumptive diagnosis of fronto-temporal dementia (FTD) or Semantic Dementia (SD), and 6 of dementia of Alzheimer type (DAT). All participants were administered with 3 tests tapping lexical-semantic knowledge about food and non-food items: confrontation naming (Task 1), categorization (Task 2), and word-to-picture matching (Task 3). Overall, patients performed poorer than controls on Tasks 1 and 3, with FTD-SD patients being more impaired than DAT patients. When we compared performance on food versus nonfood items, we observed that patients performed better on naming food than nonfood items (Task 1). Specifically, FTD-SD patients displayed a significant difference between food and nonfood items, while DAT patients showed no difference. On Task 3 the same pattern was observed. These preliminarily findings suggest that FTD-SD impacts lexical-semantic processes more severely than DAT, particularly with respect to nonfood items. Visual identification may yield a different time course of impairment in these patients.

A82

PREFERENTIAL INVOLVEMENT OF THE RIGHT HEMISPHERE IN METAPHOR COMPREHENSION: EVIDENCE FROM TMS Natalie A. Kacinik[1], Rita W. El-Haddad[1], Tony Ro[2]; [1]Brooklyn College and Graduate Center, City University of New York, [2]City College and Graduate Center, City University of New York — Early research on the neural basis of metaphor processing, particularly studies of brain-injured patients, suggested that the right hemisphere (RH) was preferentially involved in understanding metaphors. However, most recent divided visual field, fMRI, and ERP studies of normal individuals have generally not supported the RH metaphor hypothesis. We used rTMS to investigate whether disrupting RH vs. LH processes in normal individuals would show preferential involvement of the RH in metaphor comprehension. Participants were presented with literal and metaphoric sentences, of moderate familiarity on average, followed by a related or unrelated word. Participants made a relatedness judgment while undergoing counterbalanced blocks of TMS to their left or right posterior superior temporal cortex or vertex (control). Three TMS pulses were applied 100ms apart coinciding with offset of the sentence, during, and soon after onset of the target word to maximally disrupt the activation and integration of the sentence and word meaning. Reaction time data revealed a TMS by stimulus type interaction with TMS to the RH resulting in significantly longer RTs for metaphoric compared to literal items. Responses to literal stimuli were slower after TMS to the LH rather than the RH, although the difference was not significant. These findings concur with Pobric et al.'s (2008) study of word pair stimuli that appears to be the only metaphor TMS study done to date, and extends the importance of right posterior temporal cortex for metaphor comprehension to moderately familiar metaphoric sentences whose processing was significantly hindered by disrupting the functioning of that region.

A83

SEMANTIC ACCESS AND ERROR MONITORING DURING SENTENCE COMPREHENSION: EFFECTS OF PRESENTATION SPEED ON THE N400 Darren Tanner[1], Sarah Grey[2], Janet G. Van Hell[2]; [1]University of Illinois at Urbana-Champaign, [2]Pennsylvania State University — In research on language comprehension using event-related potentials (ERPs), studies consistently report that the amplitude of the N400 component is reliably larger for words that are anomalous versus those that are congruent with a preceding semantic context, and some studies additionally report a posterior late positive complex (LPC). Recent theoretical accounts of this biphasic response suggest that N400 amplitude modulations reflect facilitation of a supportive context in accessing semantic features from memory, whereas the LPC reflects attempts to reprocess or repair the preceding context (Kolk & Chwilla, 2007; Van Petten & Luka, 2012). Here we investigated the effects of language presentation speed on the N400 and LPC during semantic processing. Participants read semantically congruent and incongruent sentences (e.g., "John wanted to bake/*read a book in his spare time"; ERPs time-locked to "book") while performing a binary acceptability judgment task in one of three stimulus-onset asynchrony (SOA) conditions: 225ms, 450ms, and 650ms. The semantic congruence effect on N400 amplitude was modulated by SOA: N400 effects were largest in the 650ms condition, smaller in the 450ms condition, and non-existent in the 225ms condition, In contrast, the LPC was present in all three conditions. This dissociation in the effects of SOA on the N400 and LPC suggests that the use of semantic context for lexical integration may break down in highly speeded processing scenarios, though the ability to detect and categorize anomalous sentences remains intact. We discuss our findings as they relate to theories of semantic access and error monitoring during language comprehension.

A84

QUANTIFICATION, ATTENTION AND THE P300 EFFECT Veena Dwivedi[1], Raechelle Gibson[2], Kaitlin Curtiss[1]; [1]Brock University, [2]Western University — We used event-related brain potentials (ERPs) in a dual task study to investigate how comprehenders interpret number in different semantic contexts. Borrowing from recent behavioural work (Patson & Warren, 2010), 10 participants made judgments on the number of words appearing on a computer screen. Equal numbers of one- vs. two-word chunks were presented throughout the experiment. Participants indicated their decision on whether one or two words appeared by pressing "1" or "2". We hypothesized that the appearance of a single noun marked as morphologically plural, e.g., trees, would result in interference with the (correct) "1" response on the number judgment task. We employed a 3 X 2 design. The subject noun was either universally quantified or referential, e.g., (i) Every kid climbed a tree vs. (ii) The kid climbed a tree. The direct object was either indefinite singular, see (i), (ii) above, or definite singular/plural, as in (iii)/(iv) Every/The kid climbed the tree and (v)/(vi) Every/The kid climbed the trees. Number judgments were required at tree(s), which was always presented alone (and never final). ERPs at tree(s) showed different neurophysiological responses to plural trees when it was contained in conditions starting with Every vs. The; a P300 effect was found, where this effect was attenuated in referential contexts. Thus, sentences beginning with "the" are given more attention than those beginning with "every;" the latter are underspecified. Therefore, more resources are available for the secondary task of counting words on the screen (Donchin, 1981), resulting in the observed P300 amplitude difference.

A85

NEURAL CONNECTIVITY DURING SEMANTIC PROCESSING OF PICTURES AND SPOKEN WORDS IN AUTISM SPECTRUM DISORDERS Emily Coderre[1], Barry Gordon[1,2], Kerry Ledoux[1]; [1]Department of Neurology, The Johns Hopkins University School of Medicine, [2]Department of Cognitive Science, The Johns Hopkins University — One of the core deficits of autism spectrum disorders (ASD) is language processing, with abnormalities documented in semantic integration and higher-level linguistic cognition. For example, in ERP research, the N400 effect for language (a late negativity indexing semantic integration) is often reduced or even absent in ASD individuals compared to normal controls. These language deficits may be related to findings of abnormal brain connectivity in ASD, specifically hyperconnectivity in local networks and hypoconnectivity in long-range networks, both at rest and during language processing. The current study uses electroencephalographic (EEG) coherence analysis, which provides a measure of neural connectivity on a millisecond time scale, to investigate differences in connectivity during the N400 window that might explain the linguistic deficits observed in ASD. Preliminary data are presented from seven high-functioning individuals with ASD (HFAs) and age-matched normal controls (NCs) performing an N400 congruency paradigm in which a picture and auditory word either matched (congruent condition) or mismatched (incongruent condition). The ERP data showed a larger and earlier N400 effect (i.e., larger N400 for incongruent than congruent trials) for HFAs than NCs, contrary to previous research. EEG coherence analysis of the incongruent > congruent difference waves within the N400 window showed increased short-range cross-hemisphere coherence for HFAs compared to NCs. In contrast, NCs showed greater within-hemisphere coherence than HFAs, especially for fronto-parietal connections in the left hemi-

sphere. These results replicate previous findings of abnormal connectivity in ASD and suggest that HFAs may employ a different functional strategy of semantic integration processing than NCs.

A86

SHARED NEURAL SYSTEMS FOR LANGUAGE AND GESTURE COMPREHENSION Elizabeth Redcay[1], Kayla Velnoskey[1], Meredith Rowe[1]; [1]University of Maryland — Behavioral evidence and theory suggest that comprehension and production of gestures and words may be part of a shared cognitive system. The goal of the current study is to identify the extent to which the neural bases for language and gesture comprehension are shared and/or distinct in adults. To address this question, functional MRI data were collected from 15 college students while they watched video clips of an experimenter producing communicative, participant-directed gesture strings (e.g., gesturing "Hello, come here") and "grooming gestures", which were hand and body actions that did not convey communicative intent (e.g. scratching her face and smoothing her hair). To identify amodal brain regions supporting communicative and semantic processes, we presented participants with 3 language conditions. These included 1) communicative, participant-directed sentences, matched in content to the communicative gestures, 2) 3rd-person sentences that describe a character's actions, but not mental states, and 3) jabberwocky sentences. Comparison of communicative to grooming gestures (CG vs GG) elicited activation bilaterally along the full anterior-posterior extent of the superior temporal sulcus (STS). Conjunction analyses between CG vs GG and participant-directed vs 3rd-person sentences revealed shared engagement of left posterior STS for processing communicative intent whereas conjunction between CG vs GG and 3rd-person vs jabberwocky sentences revealed shared engagement of left anterior STS for semantic representations. These data suggest the STS provides a common neural substrate for both language and gesture processing but components of this shared system are represented differentially along the posterior to anterior extent of the STS.

LONG-TERM MEMORY: Episodic

A87

MANIPULATING PERCEPTUAL FLUENCY ALTERS THE MERE EXPOSURE EFFECT AND REVERSES OLD/NEW ERP EFFECTS P. Andrew Leynes[1], Richard J. Addante[2]; [1]The College of New Jersey, [2]The University of Texas at Dallas — Prior studies have shown that recognition memory judgments of words can be differentially supported by perceptual fluency or familiarity, which are associated with distinct event-related potentials (ERPs) (Leynes & Zish, 2012: Neuropsychologia, 50, 3240-3249). However, it remains unclear how pervasive these effects are. The current study extended these finding by manipulating the perceptual fluency at test (i.e., visual clarity) of novel commercial product images (e.g., toy, cereal box, etc.) to determine how memory of novel objects and product-liking ratings would be influenced by fluency. All products were encoded under full perceptual clarity, whereas perceptual fluency (clear or blurry) of test items varied across blocks or randomly across individual trials. ERPs were recorded during the recognition test (old/new judgments) that also required subjects to provide a liking judgment for each probe. Behaviorally, old products were liked more than new products (i.e., the mere exposure effect) when visual clarity remained constant from trial to trial (blocked condition). However, this pattern was altered when visual clarity varied randomly, such that perceptually clear products were liked more than blurred products (old and new product liking ratings did not differ). These results support the claim that perceptual fluency drives the mere exposure effect. The ERP analyses did not uncover any evidence of traditional old/new ERP effects in either condition (i.e., FN400 or LPC). Instead, we observed a reversed effect (new > old) during the 900-1100ms time window in right parietal regions. We consider several possible cognitive mechanisms that may underlie this unusual memory-related ERP difference.

A88

DOPAMINERGIC MODULATION OF HIPPOCAMPAL AND STRIATAL ASPECTS OF SPATIAL LEARNING AND MEMORY IN PARKINSONISM Franka Thurm[1], Nicolas W. Schuck[2], Mareike Fauser[3], Ulrike Lueken[4], Alexander Storch[3], Shu-Chen Li[1]; [1]Chair of Lifespan Developmental Neuroscience, Department of Psychology, TU Dresden, Germany, [2]Princeton Neuroscience Institute, Green Hall, Princeton University, Princeton, NJ, USA, [3]Deparment of Neurology, Faculty of Medicine Carl Gustav Carus, TU Dresden, Germany, [4]Institute of Clinical Psychology and Psychotherapy, Department of Psychology, TU Dresden, Germany — In light of the involvement of the frontal-striatal pathway in reward processing and adaptive behavioral control, research on non-motor symptoms of Parkinson's disease (PD) and effects of PD medication has mostly focused on cognitive impairments that can be attributed to dopamine deficiency of the frontal-striatal loop. A rarely investigated, if not entirely overlooked, aspect in current research on cognitive dysfunctions of PD is the potential interactions between striatal dopamine degeneration and hippocampal-dependent functions. Of specific interest, the hippocampus and striatum play different roles in spatial learning and memory (e.g., Doeller & Burgess, 2008, PNAS; Parkard, Hirsh, & White, 1989, J Neurosci). Midbrain dopamine degeneration may thus affect the relative contributions of the hippocampus and striatum on spatial learning in PD patients. Using a virtual reality (VR) spatial navigation task, a recent study showed impaired performance of older compared to younger adults, particularly in hippocampus-dependent boundary processing (Schuck et al., 2013, Hippocampus). Normal aging is accompanied by a global but less severe dopaminergic loss compared to PD, these results hint towards navigation deficits in PD patients as well. Here we used a VR-spatial navigation task to investigate PD patients' spatial navigation performance and effects of dopamine treatment by assessing PD patients' navigation performance ON and OFF medication. Preliminary analysis revealed an apparent effect of medication, with patients performing better under medication. Further analyses will be conducted to explore whether medication may enhance the striatal- and hippocampal-dependent aspects of spatial learning differentially.

A89

USE OF EXPLICIT MEMORY CUES IN PATIENTS WITH AMNESTIC MILD COGNITIVE IMPAIRMENT (AMCI) Kara T. Kleber[1,2], Rebecca G. Deason[3], Maureen K. O'Connor[1,2,4], Xiaoyan Sun[1,2], Sean Flannery[1,2], Michael J. Tat[1,2], Andrew E. Budson[1,2]; [1]VA Boston Healthcare System, [2]Boston University School of Medicine, [3]Texas State University, [4]Bedford VA Hospital, Bedford MA — Patients diagnosed with amnestic Mild Cognitive Impairment (aMCI) and Alzheimer's Disease (AD) are known to have significant impairments in episodic memory, but also exhibit increases in false memory. Increases in false memory errors in aMCI and AD patients may be associated with a more liberal response criterion in tests of recognition memory. Examining how AD and aMCI patients set recognition criteria could be important in understanding their high rate of false recognitions. Investigators have suggested that the parietal lobe may play a role in setting memorial response criteria. It has been demonstrated that, relative to healthy controls, patients with parietal lobe lesions fail to use explicit memory cues that were designed to shift their response criterion in recognition memory tests (Dobbins et al., 2012). Because AD-related pathophysiologic processes involve the parietal lobes, our objective was to examine how aMCI patients would use external memory cues. Patients and healthy controls were administered a recognition memory test with both valid and invalid cues that appeared before most test words. Participants were informed of cue accuracy and asked to incorporate cues to maximize performance. Subject performance with no cue (baseline) was compared to cued performance to determine whether the two groups incorporated the cues differently. Group differences were observed in a shallow encoding condition, but not in a deep encoding condition. The results suggest that aMCI patients can actively use external cues to help them make memory decisions under some memory encoding conditions, but not in others.

A90

DECODING THE AGE AND REHEARSAL HISTORY OF REAL-WORLD MEMORIES Melina Uncapher[1], J Tyler Boyd-Meredith[1], Jesse Rissman[3], Anthony Wagner[1,2]; [1]Dept of Psychology, Stanford University, [2]Neurosciences Program, Stanford University, [3]Dept of Psychology, University of California Los Angeles — Using fMRI and multivoxel pattern analyses (MVPA), we recently demonstrated that individual lab-based memories can be detected from distributed patterns of brain activity. However, it is currently unclear whether these methods would be similarly effective in decoding more ecologically valid factors such as memory for real-world events, memories

that have been rehearsed, and the remoteness (age) of memories. Here we scanned participants as they retrieved memories of autobiographical events. Participants wore cameras for two-week sessions to capture images of life events, 8mo, 5mo, and 2mo prior to scanning. They returned to the lab at the end of each session to rehearse 40 of 80 event photo sequences selected from the prior session. Subsequently, using MVPA, we reliably decoded participants' identification of events from their own camera relative to those from others' cameras. We were also able to decode the remoteness of memories, as well as whether memories had been practiced during the prior rehearsal stages. Interestingly, dorsal parietal activity informed classification of practiced relative to unpracticed events, and recent relative to remote memories, whereas ventral parietal activity contributed to classification of unpracticed events and more remote memories. This dissociation in parietal cortex, along with behavioral data, suggests that qualitative changes may occur in neural signatures of retrieval of real-world memories that have been rehearsed or are more remote in time. These findings have implications when outcomes hinge on real-world memories that have been repeatedly rehearsed or are temporally remote, as may be the case in eyewitness identification or testimony.

A91

INDIVIDUAL DIFFERENCES IN OLDER ADULTS' FORCED-CHOICE RECOGNITION MEMORY: PARTITIONING CONTRIBUTIONS OF RECOLLECTION AND FAMILIARITY.

Joel Quamme[1], Ellen Migo[2], Selina Homes[3,4], Andrew Bendell[3], Kenneth Norman[5], Andrew Mayes[3], Daniela Montaldi[3]; [1]Grand Valley State University, [2]King's College London, [3]University of Manchester, [4]Shropshire Enablement Team, [5]Princeton University — The Complementary Learning Systems (CLS) model (Norman & O'Reilly, 2003) predicts the manner in which forced-choice recognition memory decisions are made should be sensitive to differences in test format under conditions of high target-foil similarity. When previously encountered target items are tested alongside corresponding similar foils (forced-choice corresponding; FCC), judgments can be supported by a familiarity comparison. However, when target items appear alongside foils that correspond to different targets (Forced-choice non-corresponding; FCNC), familiarity comparisons should be unhelpful and decisions should depend instead on recollection of specific details about original studied items. In the current study, we used an individual differences approach to test this prediction. We examined relationships among older adults' performance on measures of FCC and FCNC for object pictures and standardized measures of recall and recognition commonly used in neuropsychological practice. Drawing on prior individual differences work, we tested for separate variance partitions in FCC and FCNC attributable to recollection (shared with recall) and familiarity (shared with recognition after the common influence of recall was removed). Consistent with CLS predictions, a significant familiarity-related variance partition was found in FCC, but not FCNC, and a recollection-related variance partition was found in FCNC but not FCC. Latent variable simulations confirm that the probability of this result occurring under the particular dual-process assumptions of CLS is at least ten times that of each of several alternative models. The results have implications for both recognition memory theory and test design in neuropsychological practice.

A92

IMPAIRED PERCEPTION OF MNEMONIC OLDNESS, BUT NOT MNEMONIC NEWNESS, AFTER PARIETAL LOBE DAMAGE

Marian Berryhill[1], Kylie Hower[2], John Wixted[3], Ingrid Olson[2]; [1]University of Nevada, [2]Temple University, [3]University of California, San Diego — In studies of episodic memory retrieval, recognition paradigms are known to elicit robust activations in the inferior parietal lobe. However, damage to this region does not produce severe deficits in episodic memory performance as indexed by typical accuracy measures. Rather, because problems with memory confidence are frequently reported, the observed deficits may be best described as subjective memory deficits. Here, we further investigated the inferior parietal lobe's role in recognition memory as well as in subjective memory. We tested the hypothesis that the inferior parietal lobe gauges the perceived oldness of items, given several neuroimaging findings suggesting that a portion of the left inferior parietal lobe is sensitive to perceived oldness. We tested two patients with bilateral parietal lobe lesions and matched controls on an old/new recognition task. From these data, we constructed receiver operating characteristic (ROC) curves by fitting the data with the unequal-variance signal-detection model. No impairment was observed in terms of patients' recognition accuracy. However, patients exhibited lower hit rates and false alarms rates at high confidence levels. Further, patients and controls differed in how they set decision criteria for making recognition responses. Patients' decision criteria for "old" responses were shifted in a conservative fashion such that they were unwilling to endorse recognized target items with high levels of confidence. Thus, damage to the inferior parietal lobe seems to produce a unique problem in metamemory that cannot be indexed via traditional performance measures and that is selective to the "perception of oldness".

A93

THE ROLE OF HIPPOCAMPUS AND ENTORHINAL CORTEX IN MEMORY INTEGRATION AND INFERENCE

Dagmar (Dasa) Zeithamova[1], Amelia M. Wattenberger[1], Alison R. Preston[1]; [1]University of Texas at Austin — Everyday judgments often draw on multiple prior experiences. They may require retrieval and logical inference from multiple separated memories. Alternatively, they rely on integrated memories resulting from reactivation of prior related memories and their integration with current events during encoding. We hypothesized that reliance on one or the other process depends on the degree of prior knowledge reactivation during encoding of related events. To test this hypothesis, participants were overtrained on a set of AB associations (house-object or face-object). During functional MRI the next day, subjects learned in a single exposure overlapping BC associations between familiar (B) and novel (C) objects. Multivoxel pattern analysis within ventral temporal cortex indexed trial-by-trial reactivation of related A content (face/house) during BC learning. To test whether such reactivation promotes memory integration, a surprise AC inference test assessing memory for indirect associations was also scanned. During BC encoding, hippocampal and entorhinal activation tracked trial-by-trial reactivation of prior memories. During AC inference, these regions were more active during successful than unsuccessful inference. We conclude that reactivation of prior memories enables hippocampal-mediated memory integration to anticipate novel judgments. Activation in lateral prefrontal regions was also greater during successful than unsuccessful AC inference, especially when corresponding BC trials showed minimal evidence for A reactivation. We speculate that when prior memories are not reactivated during encoding, separate memory traces are formed and recombined during inference through lateral prefrontal processing. These findings demonstrate how reactivation modulates the respective engagement of two complementary encoding-retrieval mechanisms that support novel judgments.

A94

AEROBIC CAPACITY AND RECOGNITION MEMORY ARE POSITIVELY ASSOCIATED WITH GRAY MATTER VOLUME IN THE MEDIAL TEMPORAL LOBE IN HEALTHY YOUNG ADULTS

Andrew Whiteman[1], Chantal Stern[1], Karin Schon[1,2]; [1]Boston University College of Arts and Sciences, [2]Boston University School of Medicine — Convergent evidence from human and non-human animal studies suggests aerobic exercise may improve brain health and cognition. Rodent studies have consistently demonstrated an augmentative effect of running on hippocampal memory and structural plasticity mechanisms in the hippocampus. Similarly, recent human studies indicate exercise may lessen age-related decline in hippocampal volume. Here, we explored whether additional structures in the human medial temporal lobes are impacted by aerobic fitness. We used modulated voxel-based morphometry to assess regional differences in gray matter volume associated with aerobic capacity and recognition memory. Thirty-four healthy young adults (mean age = 20.8 ±2.4 years) underwent cardio-respiratory fitness testing (VO2 peak), and MR imaging to acquire high-resolution structural T1-weighted MP-RAGE images (1.0 mm3 isotropic voxels; 3T Philips Achieva). Participants also viewed a series of 144 trial unique complex outdoor scenes in the context of a working memory paradigm. Approximately 15 minutes later, participants performed a surprise subsequent recognition memory test (SMT) for these scenes. Results from a hierarchical regression analysis showed that VO2 peak positively predicted gray matter volume in the entorhinal cortex, the "gateway" to the hippocampus. Moreover, volume in both the hippocampus and the entorhinal cortex positively correlated with performance on the SMT, a task we have previously shown recruits these same anatomical structures functionally

(Schon et al., 2004). Our results extend previous work by suggesting aerobic capacity may be associated with both structure and function of the medial temporal lobe memory system.

A95

THE NEURAL CORRELATES OF ENCODING PROCESSES ASSOCIATED WITH THE CONFIDENCE AND ACCURACY OF SOURCE RETRIEVAL

Preston P Thakral[1], Michael D Rugg[1]; [1]University of Texas at Dallas — Previous studies have demonstrated that the neural correlates of successful source encoding (subsequent source memory effects) overlap regions selectively engaged during the online processing of the source features. The aim of the present experiment was to determine whether feature-selective subsequent memory effects predict the accuracy and confidence of subsequent source memory judgments. At study, participants viewed a series of pictures of colored objects. Each object was accompanied by a visually- or an auditorily-presented word. The study task was to judge whether the word was congruent or incongruent with the picture. At test, participants viewed studied and unstudied pictures and were required to respond "old" if confident they had seen the picture before and otherwise to respond "new". After each "old" response, participants went on to judge whether the picture had been paired with a visual or an auditory word, using a 6-point confidence scale. As expected, source accuracy increased with confidence. Modality-independent subsequent source memory effects were identified in inferior frontal cortex and fusiform gyrus. Modality-selective effects overlapped regions preferentially involved in the online processing of visual and auditory information. Both classes of subsequent memory effects were associated primarily with highly confident source judgments, and did not track source confidence in a graded manner. Together with previous findings that subsequent memory effects do track subsequent source confidence in a continuous fashion, the present findings suggest that the relationship between subsequent source memory effects and subsequent source confidence and accuracy is variable, likely depending on the details of the experimental procedure.

A96

ELECTROPHYSIOLOGICAL INSIGHTS INTO INVOLUNTARY MEMORY RETRIEVAL

Lisa H. Evans[1], Jane E. Herron[1], Edward L. Wilding[1]; [1]Cardiff University Brain Imaging Centre (CUBRIC), School of Psychology, Cardiff University, UK — There are many instances where we would prefer memories did not come to mind, perhaps because they are distressing or embarrassing. Research indicates that people can sometimes exert control over memory and prevent involuntary retrieval. In this study we used event-related potentials (ERPs) to examine some circumstances under which individuals can do this. In particular, whether people continue to retrieve information from memory when it is no longer required, and if so, how long this persists. In an initial study phase words were shown individually on the left or right side of fixation. In a test phase these words were shown again, interspersed with unstudied words, in one of three locations: above, at, or below fixation. Participants were cued trial-by-trial to complete one of two tasks: indicate the current screen location of the word (perceptual task), or indicate if the word was new or where it was displayed in the study phase (memory task). Two trials of each task were completed before a switch to the alternate task was required. An ERP index of successful memory retrieval was reliable on the first trial of the perceptual task, after switching from the memory task, but not on the subsequent trial. These findings indicate that there was involuntary retrieval of irrelevant memory information immediately after switching from the memory task but this was not sustained. This could be due to memory control mechanisms taking time to engage or the dissipation of a task set that assists memory retrieval.

A97

DRAWING ON THE PAST TO SIMULATE THE FUTURE: MEDIAL PREFRONTAL CORTEX AND THE FACILITATION OF PRIOR KNOWLEDGE

Roland G Benoit[1], Szpunar Karl K[1], Schacter Daniel L[1]; [1]Harvard University — The human ability to simulate possible future episodes seems to be supported by the same core network that also supports recollections of the past. This study scrutinized the functions mediated by a specific node of this network, the anterior medial prefrontal cortex (mPFC). We hypothesized that this region supports simulations by accessing prior knowledge structures related to the elements of a simulation. Prior to the scanning session, participants generated 200 people and locations that they personally know, and indicated the familiarity and pleasantness of each person and location. In the fMRI scanner, they then simulated interacting with a given person at a specific location. Consistent with our hypothesis, mPFC activation was tightly coupled with the degree to which the constituting elements of the episode were familiar. Thus, this region was more strongly engaged when the simulations could be based on richer prior knowledge. Moreover, preliminary analyses indicate that activation in a part of this region also reflects the combined pleasantness of the episode's elements, suggesting that mPFC processes the anticipated affective quality of the event. Taken together, mPFC may effectively facilitate prior affective knowledge to simulate what it might be like to experience a potential future episode.

A98

HIPPOCAMPAL DAMAGE IMPAIRS THE ON-LINE REPRESENTATION OF VISUAL INFORMATION

David Warren[1], Melissa Duff[1], Daniel Tranel[1]; [1]University of Iowa — The hippocampus plays a necessary role in the formation of new declarative memories, but is not generally thought to participate in on-line representation of information during short delays (i.e., on the scale of short-term or working memory). However, recent findings suggest that the hippocampus contributes to memory representations even during very short delays. We used neuropsychological methodology to evaluate hippocampal contributions to on-line representation of visual information by adapting a paradigm previously used to study visual working memory capacity (Zhang & Luck, 2008) and applying it to patients with hippocampal damage. Participants studied 1, 3, or 6 briefly-presented (100 msec) colored squares, and after a short blank interval (1 s) indicated the color of a randomly selected square using a graded color wheel. Maximum likelihood estimation was used to determine whether responses were memory-guided or guesses, yielding estimates of representation accuracy and guessing rate. Using this approach, we studied the performance of patients with bilateral hippocampal damage (N=5), neurological comparison patients without hippocampal damage (N=14), and healthy normal comparison participants (N=16). We found that patients with hippocampal damage were impaired when performing this task despite the very short study-test interval (1 s). Specifically, hippocampal patients showed increased guessing rates [$F(2,35)=4.043$, $p<0.05$] suggesting more frequent loss of the studied stimulus representations. Meanwhile, estimates of representational accuracy were similar for all groups [$F(2,35)=0.246$, $p>0.75$]. This intriguing finding suggests that the hippocampus normally supports maintenance of recently-experienced visual information across very short intervals, but does not contribute to the accuracy of those representations.

A99

HIPPOCAMPAL ACTIVITY AND MEMORY PERFORMANCE PREDICT CLASSIFICATION ACCURACY FOR STIMULI RECALLED FROM LONG-TERM MEMORY

Marie St-Laurent[1], Hervé Abdi[2], Bradley R. Buchsbaum[1,3]; [1]Rotman Research Institute at Baycrest, [2]University of Texas at Dallas, [3]University of Toronto — According to the Principle of Reactivation, faithful recollection evokes patterns of neural activity that resemble those instantiated when an event was first perceived. In the current study, we investigated the link between specific neural reactivation, memory performance, and hippocampal activity. We used functional magnetic resonance imaging (fMRI) to quantify brain activity as participants viewed and mentally replayed a set of 11 short videos, each of which was viewed and recalled multiple times. We then trained a classifier to identify specific videos based on brain activity at perception, and tested how accurately the classifier could distinguish videos during mental replay. Classification accuracy correlated significantly with subjective in-scan ratings of memory vividness, and with performance on a post-scan memory test of the videos' content. The magnitude of hippocampal activation during mental replay also correlated significantly with trial-to-trial variation in classifier performance. Our results indicate a link between neural specificity and both subjective and objective measures of memory performance, and demonstrate how classifiers can be used to quantify the quality of recollection objectively. In addition, we observe that activity in the hippocampus, a structure known to play a central role in the retrieval of vivid and detailed memories for past events, is linked to the reactivation of stimulus-specific patterns of brain activity, which is consistent with its hypothetical role as an index of long-term memory content.

A100

RESTING STATE CONNECTIVITY IS RELATED TO INDIVIDUAL DIFFERENCES IN SUBJECTIVELY-RATED MEMORY ABILITY. Signy Sheldon[1,2], Norman Farb[2], Brian Levine[1,2]; [1]Rotman Research Institute, Baycrest Centre for Geriatric Care, [2]Department of Psychology, University of Toronto — Individual differences in memory are well accepted, yet the neural basis of these differences is largely unknown. Resting state connectivity analysis is a useful method to determine if such individual differences are reflected in how the brain is intrinsically functionally organized. In this study, we sought to determine if Default Model Network (DMN) connectivity, a network that has strong links to memory function, is influenced by individual differences in two types of memory retrieval: episodic (the recall of past personal events) and semantic (the recall of general facts and information) memory. Participants' self-reported ability to recall episodic and semantic memories was measured with a validated questionnaire, the Survey of Autobiographical Memory (SAM; Palombo et al., 2013). These scores were used as covariates to analyze participants' resting state scan. Seed connectivity analyses using an anatomically defined parahippocampal gyrus seed revealed that self-reported episodic memory ability was anchored in a medial temporal lobe network that predominately included posterior aspects of the brain, notably regions in the visual cortex. Self-reported semantic memory ability, however, was anchored in a medial temporal lobe network that was predominately connected to anterior brain regions, notably the prefrontal cortex. Similar differences were found using other seed regions of the DMN. These differences suggest mnemonic traits are selectively related to specific neurocognitive processes. High episodic memory ability is related to enhanced medial temporal/posterior connectivity that may support imagery-based processes, which underlie rich recollection. Those with subjectively-rated high semantic ability have enhanced medial temporal/anterior connectivity supporting organized retrieval of information.

A101

TASK-RELATED CHANGES IN CONNECTIVITY WITH ANGULAR GYRUS PREDICT RECOLLECTION PERFORMANCE ACROSS THREE EPISODIC MEMORY TASKS Danielle King[1], Marianne de Chastelaine[1], Rachael Elward[1], Tracy Wang[1], Michael Rugg[1]; [1]University of Texas at Dallas — Prior research has demonstrated that neural activity in the angular gyrus (AnG) is enhanced during successful recollection. This region appears to be functionally heterogeneous, contributing to a wide range of experimental tasks that rely on various cognitive processes. The AnG has also been shown to be highly flexible, changing allegiance with different brain networks frequently over time. In the present study, we examined whether there are brain regions that exhibit task-related changes in functional connectivity with the AnG during successful recollection and whether the magnitude of these changes can predict recollection performance. Data from three fMRI experiments, each of which assessed the neural correlates of successful recollection using a different test procedure (remember/know, associative memory, and source memory) were analyzed using psychophysiological interaction (PPI) analysis. The results demonstrated that across all three experiments, a consistent set of regions demonstrated recollection-related increases in connectivity with the left AnG. These included extrastriate cortex, ventral temporal cortex, bilateral posterior parietal cortex, posterior cingulate/retrosplenial cortex, and striatum. In addition, the average increase in connectivity across these different regions correlated positively across subjects with recollection performance in all three experiments. Thus, the extent to which the AnG increases connectivity with a distributed set of brain regions during successful retrieval reliably predicts recollection performance. Possible mechanisms underlying this relationship will be discussed.

LONG-TERM MEMORY: Semantic

A102

RETRIEVAL OF ESTABLISHED SEMANTIC NARRATIVES: CONTRIBUTIONS OF MTL AND TEMPORAL NEOCORTEX Mieke Verfaellie[1], Kathryn Bousquet[1], Aubrey Wank[1], Margaret Keane[2,1]; [1]VA Boston Healthcare System and Boston University School of Medicine, [2]Wellesley College — Many reports suggest that lesions of the medial temporal lobes (MTL) spare memory for semantic facts or concepts, or at most affect retrieval of recently acquired knowledge only. Such findings have led to the notion that once consolidated, semantic memories are represented neocortically and are no longer MTL-dependent. Here, we examined whether well-established semantic memories with a narrative structure are also independent of the MTL. Seven amnesic patients, five with lesions restricted to the MTL and two with lesions extending into lateral temporal cortex (MTL+), were asked to recount fairy tales and bible stories that they rated as familiar. Narratives were scored for number and type of details, number of main steps, and order in which the main steps were recounted. In comparison to controls, patients with MTL lesions produced fewer details, but the number and order of main steps generated was intact. By contrast, patients with MTL+ lesions showed a pervasive impairment, affecting not only the generation of details, but also the generation and ordering of main steps. These findings suggest (1) that retrieval of detailed semantic memories acquired pre-morbidly remains MTL dependent; and (2) that neocortically mediated semantic memories are schematic in nature, preserving only the essential elements and their sequence. These findings are inconsistent with standard consolidation theory, but can be accommodated by a memory transformation view (Winocur et al., 2011), if it is assumed that consolidation involves a loss of detail not only for episodic, but also for semantic memories.

A103

DEFINING NOVEL CONCEPTS: IMPAIRED CREATIVITY IN AMNESIA Margaret Keane[1,2], Kathryn Bousquet[1], Mieke Verfaellie[1]; [1]VA Boston Healthcare System and Boston University School of Medicine, [2]Wellesley College — Recent work from our laboratory has demonstrated that individuals with amnesia following medial temporal lobe (MTL) damage show impaired performance in a semantic imagination task in which they are asked to generate and elaborate upon issues that might arise in the future (e.g., "What will be the most important national defense issues debated in the 2032 election?"). Interpretation of this deficit is complicated by the fact that control participants may draw upon autobiographical memory to answer such questions (e.g., recalling comments from a recent presidential debate about the role of the military in foreign conflicts). To evaluate semantic imagination in a task that is unlikely to tap autobiographical memory, we tested 9 amnesic participants in a paradigm that required them to generate definitions for novel noun-noun combinations (e.g., "cactus carpet"), and to list features for each concept. A control condition required participants to define familiar noun-noun compounds (e.g., "ceiling fan"). Compared to a matched control group, amnesic participants showed impaired generation of acceptable definitions and impaired generation of features for novel compounds. By contrast, the amnesic group showed intact generation of acceptable definitions for familiar compounds. These results suggest a role for the MTL in semantic creativity under conditions that are unlikely to tap autobiographical memory in control participants. Our findings add to a growing body of literature implicating the MTL in the creative use of existing knowledge in the service of problem solving and discourse.

A104

IMPLICIT TRANSITIVE INFERENCE USING AUDITORY STIMULI Anthony Greene[1], Rea Aazcueta[1], Jared Blommel[1], Brendan Semph[1], Chloe Ries[1], Joseph Nimm[1], Patrick Heffernan[1]; [1]University of Wisconsin-Milwaukee — Transitive inference (TI), a form of inferential reasoning, refers to the ability to make correct judgments about relationships indirectly, by their relations to common items. While transitive inference has been extensively examined in humans, to date, only visual stimulus items have been used. One major question is whether successful TI for visual items is an aspect of spatial cognition. In order to examine the generalizability of TI in humans, we introduce auditory stimuli, presented in pairs, (A>B, B>C, C>D, D>E) which an organized into a single hierarchy (A>B>C>D>E) to support correct inference (B>D) among novel pairings. Participants were randomly divided into a named condition (names were given to the tones e.g., flute or horn) or unnamed condition and were either informed or uninformed about the existence of the hierarchy prior to the stimulus presentation. Some uninformed participants become aware, while some informed participants do not discover the hierarchy. Awareness was assessed through a post experimental questionnaire. Results show no significant differences between any of these groups at study or test, suggesting little or no effect of verbal strategies or conscious awareness. Test performance was strongly

predicted by performance on the inner pairs during training (r = 0.444 p < 0.001) and awareness was modestly correlated with BD performance (r = 0.225 p < 0.015) yet not required, as there were performers with low awareness. Overall our results demonstrate that visual and auditory TI performance profiles are nearly identical suggesting similar processes despite distinct perceptual modalities.

A105

AMBIGUITY TYPE AND GRAMMATICAL CLASS AFFECT SEMANTIC SELECTION

Fan-pei Yang[1], Daniel C. Krawczyk[2,3], Navid Khodaparast[2], Kailyn Bradley[2], Min-chieh Fang[1], K. C. Chiu[1]; [1]National Tsing Hua University. Taiwan, [2]Center for Brain Health, University of Texas at Dallas, Dallas, TX, USA, [3]Department of Psychiatry, University of Texas Southwestern Medical Center at Dallas, TX, USA — Research to-date has not successfully demonstrated consistent neural distinctions for different types of ambiguity or explored the effect of grammatical class on semantic selection. We conducted a relatedness judgment task using event-related functional magnetic resonance imaging (fMRI) to further explore these topics. Participants judged relatedness within word pairs. Consistent and inconsistent conditions were included along with □ller items. Imaging results revealed a main effect of ambiguity in the dorsolateral prefrontal cortex (DLPFC) and parietal cortices. A main effect of grammatical class was observed in the parahippocampal and lingual gyri, and a main effect of consistency was found in the DLPFC, ventrolateral prefrontal cortex (VLPFC) and occipital cortices. Interactions among these factors were observed in the cingulate gyrus and motor cortices in addition to the DLPFC. These results suggest that both ambiguity type and grammatical class modulate semantic selection through different neural regions.

A106

SENSATION SEEKING IS MORE INFLUENTIAL FOR AUTOMATIC THAN CONSCIOUS CONTROLLED MEMORY SYSTEMS

Adam Lawson[1], Amanda Renfro[1]; [1]Eastern Kentucky University — Substantial evidence shows that high and low sensation seekers differ in brain activation related to the memory of emotionally salient events. In this poster, three experiments using an old-new recognition memory task are presented. All three experiments consistently show sensation seeking differences in brain mechanisms reflective of automatic memory mechanisms as opposed to more conscious-controlled recollection memory mechanisms. One study (Lawson, Liu, Joseph, Vagnini, Kelly, & Jiang, 2012) utilizing event-related potentials (ERPs) and functional magnetic resonance imaging (fMRI) found sensation seeking differences in early N2-orbitofrontal and FN400-caudate nucleus activation reflecting automatic processes. Two subsequent studies using skin conductance response and heart rate (beats per minute) data have further substantiated automatic memory mechanisms as the primary mechanism for sensation seeking differences. Two experiments, one utilizing negative valance images (N = 80) and the second utilizing positive valance images (N = 40), were conducted using an old-new task that required both automatic familiarity judgments and more conscious controlled recollection judgments. In both experiments, sensation seeking differences for both behavioral and psychophysiological data were found in relation to the familiarity of images rather than recollection of memories. Collectively, the results suggest that individual differences in sensation seeking reflect cortical processes involved in non-conscious familiarity as opposed to conscious-controlled recollection memory systems.

A107

CATEGORY-SPECIFIC ACTIVATION PATTERNS ARISE FROM BASE CONNECTIVITY: CONVERGING EVIDENCE FROM FUNCTIONAL NEUROIMAGING, PROBABILISTIC TRACTOGRAPHY, AND A NEURAL NETWORK MODEL

Lang Chen[1], Matthew A. Lambon Ralph[2], Lauren Cloutman[2], Ryo Ishibashi[3], Timothy T. Rogers[1]; [1]University of Wisconsin-Madison, [2]University of Manchester, [3]Kyoto University — Functional neuroimaging studies have reported differential activation for different conceptual categories including animals, actions, tools etc. Accounts diverge on whether this phenomenon reflects (a) the existence of functional/anatomical modules for conceptual categories or (b) systematic differences in perceptual experience that covary with knowledge domains. We consider a third hypothesis: that category-specificity arises from the underlying connectivity of the cortical semantic network. In an Activation Likelihood Estimate (ALE) meta-analysis of 48 studies, we found that animal concepts elicited greater activation in lateral posterior fusiform gyrus (pFG), superior temporal gyrus/sulcus (STG/STS) and lateral occipital cortex (LOC) bilaterally whereas artifact concepts elicited greater activation in bilateral medial pFG, left posterior middle temporal gyrus (pMTG) and left inferior parietal lobe (IPL). We then conducted a probabilistic tractography analysis of diffusion-weighted images from 24 subjects to investigate white-matter pathways connecting these brain regions. All temporal lobe regions streamed to the ventral anterior temporal lobe (vATL), hypothesized as a multimodal hub for concept processing. Artifact-specific regions were also connected in a specialized white-matter sub-network: pMTG streamed to both the IPL and pFG artifact regions, while the medial pFG stream merged with the inferior occipeto-frontal fasciculus (IFOF) projecting caudally into the dorsal parietal cortex. In a neurocomputational model adopting this connectivity, we demonstrated that animal-specific and artifact-specific brain activation patterns, both in the sighted and congenitally blind, emerge spontaneously after environmental structures that exist across multiple modalities are acquired. Thus we propose that category-specificity in brain imaging studies arises from the base connectivity of the underlying network.

A108

FAST MAPPING RAPIDLY INTEGRATES INFORMATION INTO EXISTING MEMORY NETWORKS

Marc N Coutanche[1], Sharon L Thompson-Schill[1]; [1]University of Pennsylvania — Successful learning involves consolidating and integrating new material into existing memory networks. There is some evidence that a learning procedure, known as fast mapping (FM), simulates the early word-learning environment of children. Recent results have suggested that learning by FM can proceed independently of hippocampally-mediated learning systems in adults, leading to claims that FM procedures promote rapid and direct incorporation into memory networks. Yet, integration of newly learned information has not been tested following a FM procedure. We report an investigation of whether FM integrates new words and meanings more rapidly than explicit encoding (EE). We introduced fifty participants to sixteen unfamiliar animals and names through either FM or EE. Participants exposed to the words through an EE paradigm showed strong declarative memory performance, but little lexical competition or semantic priming of related known words. In contrast, although FM produced weaker declarative memories, the FM group demonstrated evidence of lexical integration immediately after training (creating a double dissociation). This integration was still present the next day. The learned animals became semantically integrated by the day after FM, but not after EE. This is evidence that FM can prompt rapid lexical and semantic integration with existing knowledge.

A109

CONVERGING EVIDENCE FOR THE NEUROANATOMIC BASIS OF COMBINATORIAL SEMANTICS

Amy Price[1], Michael Bonner[1], Jonathan Peelle[2], Murray Grossman[1]; [1]University of Pennsylvania, [2]Washington University in St. Louis — Human thought and language rely on the brain's ability to flexibly combine concepts. This fundamental process supports the construction of complex concepts from basic constituents. For example, both "jacket" and "plaid" can be represented as individual concepts, but can also be combined to form the more complex concept, "plaid jacket". Although this process is central to the expression and comprehension of meaning, little is known about its neural basis. Here we present evidence for a neuroanatomic model of conceptual combination from three experiments. We predicted that the highly integrative region of heteromodal association cortex in the angular gyrus would be critical for conceptual combination, given its anatomic connectivity and its strong association with semantic memory in functional neuroimaging studies. Consistent with this hypothesis, we found that the process of combining concepts to form meaningful representations specifically modulated neural activity in the angular gyrus of healthy adults in an fMRI study (N=22; p<0.05, whole-brain corrected), independent of the modality of the conceptual information. We also found in healthy adults that individual differences in the structure of the angular gyrus were related to individual differences in behavioral performance on the conceptual combination task. Finally, in a population of patients with neurodegenerative disease (N=22), we found that the degree of atrophy in the angular gyrus was specifically related to impaired performance on

combinatorial processing ($p<0.05$, whole-brain corrected). These converging anatomic findings implicate the angular gyrus in a high-level integrative function in semantic memory that underlies conceptual combination.

A110

PARCELLATION OF LEFT PARIETAL TOOL REPRESENTATIONS BY FUNCTIONAL CONNECTIVITY Frank Garcea[1,2], Bradford Mahon[1,2,3]; [1]Department of Brain and Cognitive Sciences, University of Rochester, USA, [2]Center for Visual Science, University of Rochester, USA, [3]Department of Neurosurgery, University of Rochester, USA — Manipulating a tool according to its function requires the integration of visual, conceptual, and motor information, a process subserved in part by the left parietal cortex (LPC). How these different types of information are integrated and how their integration is reflected in neural responses in the LPC remains an open question. Here, participants viewed images of tools and animals during a functional magnetic resonance imaging (fMRI) experiment. Functional connectivity and k-means clustering were used to parcellate the LPC into subregions based on functional connectivity to a whole brain network of regions involved in tool use. One cluster, in lateral inferior parietal cortex, expressed privileged functional connectivity to the motor system (left ventral premotor cortex). A second cluster, in the anterior IPS, expressed privileged functional connectivity with the ventral-medial temporal lobe (left medial fusiform gyrus). A third cluster, in the superior parietal lobe, expressed privileged functional connectivity with the dorsal stream (dorsal occipital cortex). Hierarchical clustering was used to formally relate the resulting parcellation scheme of left parietal tool representations to previous work that has parcellated the left parietal lobule on purely anatomical grounds, and control analyses using Monte Carlo style simulations demonstrated that the clustering solutions were outside the range of what would be observed based on chance "lumpiness" in random data or mere anatomical proximity. These findings demonstrate significant heterogeneity in the functional organization of manipulable object representations in the LPC, and outline a framework that generates novel predictions about the causes of some forms of upper limb apraxia.

A111

IMPOVERISHED REMOTE SEMANTIC MEMORY IN HIPPOCAMPAL AMNESIA Nathaniel B. Klooster[1], Melissa C. Duff[1]; [1]University of Iowa — Remote semantic memory, previously acquired knowledge of vocabulary, concepts, and general information about the world, is widely considered intact in hippocampal amnesia. According to the standard view, the hippocampus plays a critical role in the acquisition of new semantic information, but that over time, these representations become independent of the hippocampus through neocortical consolidation. Recent work, however, suggests that the hippocampus contributes to on-line information processing and to reconsolidation of old or updated information. Given these findings suggesting a more extended time course of hippocampal involvement, we re-examine the integrity of remote semantic memory in patients with bilateral hippocampal damage and severe declarative memory impairment using psycholinguistic measures of semantic richness. Participants were presented with a series of words that varied on a continuum of high and low frequency and asked to state as many features (e.g., harpsichord: has keys, has legs, played in Baroque music) and as many senses (e.g., bug: an insect, to annoy, a wiretap) for each word as possible. Relative to a group of demographically matched comparison participants, the patients with hippocampal amnesia produced significantly fewer features and senses of the words. Future work will determine whether this deficit is an impairment in the access and use of the representations, a subtle disruption in the remote semantic representations themselves, or some combination. Regardless of the outcome, these findings suggest that the hippocampus continues to support the maintenance, updating, access, and use of semantic representations after their initial acquisition.

METHODS: Electrophysiology

A112

UNCERTAINTY AND FEEDBACK-RELATED STATES IN A SEMI-STRUCTURED, PARTICIPANT-DRIVEN TASK Laura Mariano[1], Joshua Poore[1], Andrea Webb[1], Amy Kruse[2], Brendan Seagraves[2], Jana Schwartz[1]; [1]The Charles Stark Draper Laboratory, [2]Intific, Inc. — Although electroencephalography (EEG) has become portable and amenable to investigating cognitive processes in realistic environments, inferences of underlying cognitive processes from EEG have largely been predicated on rigid, laboratory-controlled event-related designs. As such, it is unclear whether data from semi-structured, participant-driven tasks will be robust and interpretable. We investigated uncertainty and feedback-related states using a 24-channel, portable EEG (B-Alert X24, ABM) in an interactive, semi-structured probabilistic learning task developed using the RealWorld® (Intific, Inc.) simulation authoring tool. 29 participants freely progressed through a virtual environment and learned which one of six character models, varying by features, was a "threa", by making "shoo" decisions upon encountering them together. In 30% of encounters, all models were "non-threats"; shooting the wrong model (or making no decision) resulted in environment reset. Pre/post-task reaction-time tests indicated participants' opinions of which models were "threats". Repeated measures analyses revealed that participants were largely unsuccessful in "threat" identification (17% correct); however, reaction-times or confidence regarding "threats" changed across the task ($F(1,52)=25.93$, $p<.001$). Modeling "wrong-kill" and "correct-kill" decisions as events, event-related potential (ERP) analyses yielded evidence of characteristic uncertainty (N100) and feedback-related negativity (FRN) deflections, coupled with significant increases in fronto-central alpha and beta band activity in the period immediately following decision feedback. Our findings illustrate how interpretable inferences can be (cautiously) extracted from rich, complex user-driven tasks with limited repetition, suggesting that it is possible to investigate cognitive process with EEG within tasks that more closely approximate realistic environments.

A113

EVALUATION OF A BRIEF NEUROMETRIC BATTERY FOR THE DETECTION OF COGNITIVE DECLINE IN OLDER ADULTS. Emily C. Cunningham[1], Jamie N. Hershaw[2], Paul D. Kieffaber[1]; [1]College of William and Mary, [2]Uniformed Services University of the Health Sciences — With the prevalence of Alzheimer's disease (AD) projected to increase by 40% over the next decade, the urgency surrounding development of reliable methods of early detection is intensifying. Electroencephalography (EEG) holds promise in this area, and the primary aim of this research is to develop and evaluate a brief battery of EEG-based neurometrics for use in the detection of subtle changes in sensory/perceptual function. Kappenman and Luck (2011) demonstrated the feasibility of assessing multiple visual event-related potential (ERP) components in parallel within a single task. Our first aim, therefore, was to extend these findings to the auditory domain, using nested stimuli within a single procedure to elicit multiple auditory ERP components (MMN, P50, N2, P300). Waveforms and scalp topographies of these components were found to be similar to those of components elicited via conventional methods, and exhibited high test-retest reliability (r values ranged from 0.6-0.95, excepting an r of 0.13 for P50). In the second portion of this project, we tested a novel EEG-based battery of combined auditory and visual stimuli designed to elicit a broad range of ERPs (MMNf, MMNd, P50, C1, Visual MMN, P300, N2pc, ERN). Data were recorded from younger (ages 18-24) and older (ages 60+) adults while they completed the 20-minute neurometric task. Results indicate that this battery may be used to elicit up to eight distinct ERPs in a short period of time, and preliminary analyses support the potential utility of these ERP profiles for the identification/classification of age-related changes in brain function.

A114

ASSESSING LATERAL INTERACTIONS WITHIN THE EARLY VISUAL AREAS OF ADULTS WITH AUTISM. Sabrina Censi[1,2], Mathieu Simard[3], Laurent Mottron[4,5], Dave Saint-Amour[3,6], Armando Bertone[1,2,5]; [1]Perceptual Neuroscience Laboratory for Autism and Development (PNLab), [2]McGill University, [3]Centre de recherche, CHU Sainte-Justine, [4]Université de Montréal, [5]University of Montreal Center of Excellence for Pervasive Developmental Disorders

(CETEDUM), [6]Université du Québec à Montréal — Atypical performance on visuo-spatial tasks targeting early, non-social perception is a defining characteristic of autism, yet few biologically plausible hypotheses are available to explain them. Some authors have theorized that individuals with autism may have atypical local connectivity resulting in altered response properties of early visual feature detectors. The goal of this study was to assess lateral interactions between neurons within early visual areas in autism by measuring steady-state visual evoked potentials (ssVEPs) elicited by windmill-dartboard and lateral masking paradigms. Nine adults with autism and 9 typically developing adults were asked to passively view visual stimuli during windmill-dartboard and lateral masking paradigms while ssVEPs from four electrodes over the occipital cortex (Oz, POz, O1 and O2) were collected. For the windmill-dartboard paradigm, first- and second-harmonic components of the responses were used to calculate indices reflecting facilitatory (FI) and inhibitory (SI) cortical interactions for all participants. For the lateral masking paradigm, Gabor patches were presented ether in isolation (target), or flanked by collinear Gabors at different contrasts (8, 16, 30%) at target-flanker distances (1.5Î», 3 Î», 6 Î»). There were no group differences for either FI or SI cortical interaction indices, although an expected difference between collinear and orthogonal Gabors (presented at a contrast of 16%) at target-flanker distances of 1.5 Î» was found in the control group, p = 0.018. Importantly, this difference was not evidenced for the autism group, which is consistent with the hypothesis that lateral connectivity within early visual areas is atypical in autism.

A115

PRE-PROCESSING INTER-RATER RELIABILITY IN FACE-NAME MEMORY TASK-RELATED HIGH-DENSITY EEG: ICCS AND IMPACT ON ERP RESULTS Steven Shirk[1,2], Donald McLaren[1,2,3], Jessica Dodd[1], Alex Powers[1], Alec Duffy[2], Meghan Mitchell[1,2,3], Alireza Atri[1,2,3]; [1]Edith Nourse Rogers Memorial Veterans Hospital, [2]Massachusetts General Hospital Department of Neurology, [3]Harvard Medical School — EEG data is a temporally-sensitive measure of brain activity commonly used in cognitive neuroscience studies. Analysis of ERP data is performed, however, on post-processed as opposed to raw data. The pre-processing steps that yield post-processed data from raw data often involve imposing filters, removing sections of data considered artifacts, and mitigating eye blinks. Some pre-processing steps involve subjective processer (i.e. rater) judgments. The aim of this study was to compare results from data pre-processed by three different raters in order to calculate inter-rater reliability and to investigate the possible impact inter-rater discordance may have on the final ERP analysis results. Using data collected from young, cognitively healthy subjects (N=16, age range 18-39) during a face-name paired-associate recognition task, we observed high inter-rater reliability across raters, with interclass correlation coefficients (ICCs) ranging from 0.60 to 0.99 for the 8 regions of interest (ROI) by epoch by memory contrast measurements. Only 7 of 88 ICC measurements were below .80, mostly occurring in the frontal pole. Furthermore, the effects of interest were similar for the results produced by all three raters for the classic old/new ERP effects related to recognition memory performance. These findings support that the inter-rater reliability of ERP pre-processing in this paired-associate memory task is high, that rater-related pre-processing effects do not significantly impact ERP effects of interest, and validate the robustness of this ERP paradigm.

METHODS: Other

A116

LATERALITY AND HEMISPHERIC INTERACTION TO FIXATED DISPLAYS: ENHANCING THE ECOLOGICAL VALIDITY OF BEHAVIOURAL TESTS Jennifer Kluftinger[1], Andrew J. Hughes[2], Barbara J. Rutherford[3]; [1]Simon Fraser University, [2]University of North Dakota, [3]UBC Okanagan — Two experiments use patterns of laterality and hemispheric interaction established from lateralized displays to test a procedure that more closely mimics natural viewing. Displays for a matching task were presented at fixation, either with or without a lateralized distractor to capture the attention of the contralateral hemisphere. Task difficulty varied across display sizes of three or five stimuli, and by the type of match. Experiment 1 presented a target letter that did or did not match the case of the probes. Experiment 2 presented a non-lexical target that did or did not match the orientation of the probes. Both experiments were predicted to provoke a cost from hemispheric interaction when the task was simple and a benefit when the task was difficult. Laterality was predicted to shift from favouring the left hemisphere in Experiment 1 (lexical task) to the right hemisphere in Experiment 2 (mental rotation). Support was found in the accuracy data. Experiment 1 found laterality in favour of the left hemisphere and better performance by the left hemisphere alone than both together to three-item displays; and, a benefit to performance from hemispheric interaction compared to the left hemisphere alone to five-item displays for physical match. Experiment 2 found laterality in favour of the right hemisphere to five-item displays for physical match and better performance by both hemispheres than either one alone to five-item displays for categorical match. The findings reveal that the procedure is effective. It follows that adoption would enhance the ecological validity of behavioural tests.

A117

ENGAGEMENT: PSYCHOPHYSIOLOGICAL APPROACHES TO UNDERSTANDING PSYCHOLOGICAL IMMERSION IN MULTIMEDIA Joshua Poore[1], Andrea Webb[1], Cunha Meredith[1], Schwartz Jana[1]; [1]The Charles Stark Draper Laboratory — Engagement (i.e., presence, immersion) is important in the development of educational media; engaged users are putatively more likely to grasp pedagogical content than disengaged users. Previous psychophysiological approaches to measuring engagement, however, have been largely counterproductive in that they rely on comparisons of physiologic signals outside of the multimedia context (e.g., simple baselines), or experimentally constrain the context in which one hopes users to be engaged. We investigated whether context-dependent approaches to modeling physiological data taken from users during unconstrained media exposure was informative beyond context-independent physiological data in accounting for post-hoc self-reports of engagement. In our experiment, 39 participants were exposed to various genres of interactive (video-games) and passive media (videos), for comparison, while monitored with eye-tracking, electromyography, and autonomic nervous system sensors (i.e., electrocardiogram, photoplethysmograph, electrodermal activity), followed by a self-report battery of published measures of engagement (Brockmeyer, et al., 2009; Procci & Bowers, 2011). For context modeling, events within each media exposure were coded for content and time-stamped from screen-captures. Results indicate that context-dependent ($r = .56$, $p < .01$) and -independent physiological ($r = .31$, $p < .05$) responses were significantly correlated with engagement measures, but context-dependent responses independently accounted for substantially more variance in self-report measures ($\Delta R2 = 23\%$, $p < .001$) as compared to context-independent responses, which were not independently significant predictors. Our findings address shortcomings in current methods for measuring engagement across different media types and genres, and show promise in providing granularity for metrics that may inform the design of engaging media.

A118

COMPARING NATURAL LANGUAGE AND ADAPTIVE QUERYING APPROACHES FOR ESTIMATING SIMILARITY STRUCTURE April Murphy[1], Christopher Cox[1], Kevin Jamieson[1], Robert Nowak[1], Timothy Rogers[1]; [1]University of Wisconsin-Madison — In brain-imaging studies which use advanced statistical approaches for predicting neural representations associated with word meaning, a common tool includes using corpus-based methods from natural language processing (NLP) to estimate the semantic similarity structure among words. However, reviewing several NLP methods reveals that cognitively plausible (i.e., human-like) performance across these models is extremely difficult to compare because the models are trained on different corpora and often evaluated on different semantic tasks. Moreover, reliable performance on representations of abstract (e.g., emotion) words is far poorer than for concrete words. An alternative approach could be to obtain thousands of high-quality individual human judgments, but this process is extremely labor-intensive, and the number of measurements needed increases prodigiously with the number of words used. In the present work, we introduce a new method for more efficiently estimating similarity structure among words. Under the assumption that these relations reside in a relatively low-dimensional space, the model learns d-dimensional embeddings from human subjects by selecting optimal queries in the form of forced-choice triads-allowing human-like representations to be learned from a minimum n of actual observations. We

then compared this method to (a) estimates of similarity from random samples of individual human judgments, and (b) estimates from several leading NLP models. Critically, our method performs just as well as (a) yet with many fewer measurements, and considerably outperforms (b). Given the present results, we suggest that these estimates can be appropriated to better guide multi-voxel pattern analyses of neural semantics in future applications.

PERCEPTION & ACTION: Audition

A119

GRAY MATTER CORRELATES OF PITCH PERCEPTION AND PRODUCTION

Gottfried Schlaug[1], Berit Lindau[1], Ethan Pani[1], Psyche Loui[1,2]; [1]Beth Israel Deaconess Medical Center and Harvard Medical School, [2]Wesleyan University — Tone-deafness (congenital amusia) is a neurodevelopmental disorder of musical ability. Local gray matter volumes were regressed with performances in psychometric tests of tone-deafness (Montreal Battery for Evaluation of Amusia) and psychophysical tests of pitch discrimination (psychophysical staircase threshold-finding procedure) to compare these two derived phenotypical markers of tone-deafness. The voxel-based morphometry study was conducted in 60 subjects with varying levels of pitch discrimination and MBEA performances, controlling for age, gender, nonverbal IQ, and amount of musical training. We initially ran a negative regression of gray matter on pitch discrimination threshold. Results showed a significant cluster (504 voxels, qFDR = 0.015, pFWE = 0.026 at cluster level) overlaying the pars triangularis of the left inferior frontal gyrus (IFG) and the left insula. We then conducted a positive regression of grey matter on performance on the MBEA. This regression showed smaller gray matter clusters in the pars triangularis of the left IFG as well, but did not reach significance. Results of the regressions of gray matter on pitch discrimination threshold and the contour sub-score of the MBEA overlapped in the pars triangularis of the left IFG. Although the two measures yield slightly different results, they also seem to share common features. Taken together, these data suggest that pitch discrimination threshold may serve as a stable phenotype of tone-deafness, with the peak grey matter correlate in the left IFG and anterior insular region.

A120

WHITE MATTER CORRELATES OF PITCH PERCEPTION AND PRODUCTION

Psyche Loui[1], Ethan Pani[2], Berit Lindau[2], Gottfried Schlaug[2]; [1]Wesleyan University, [2]Beth Israel Deaconess Medical Center and Harvard Medical School — Although musical ability is ubiquitous and celebrated across all human cultures, a subset of the population is tone-deaf (also known as congenitally amusic): they show impairments in pitch perception and production. We conducted a diffusion tensor imaging study comparing white matter integrity of a large group of adults (N = 60) along a continuum of pitch discrimination thresholds of performance. We used the whole-brain TBSS approach to define skeleton white matter voxels in each subject, and then regressed the pitch discrimination threshold on FA values for each voxel across all subjects. Results showed a single robustly significant (447 voxels; $p < .05$ TFCE-corrected for whole-brain comparisons) cluster in the right superior longitudinal fasciculus. This negative correlation between FA and pitch discrimination threshold remained significant after controlling for musical training and nonverbal IQ differences, confirming that better pitch perceivers (i.e. people with lower thresholds for pitch discrimination) had higher Fractional Anisotropy (the degree of preferential diffusion of white matter) in the right hemisphere superior longitudinal fasciculus. As the superior longitudinal fasciculus is a collection of white matter fibers that include the arcuate fasciculus - a dominant pathway for language and music - results replicate and extend previous work showing reduced arcuate fasciculus (fronto-temporal) connectivity among tone-deaf individuals, and provide converging evidence for the role of auditory-motor connectivity in fine-grained pitch perception.

A121

PERCEPTION OF AMERICAN ENGLISH VOWELS BY SPANISH-ENGLISH BILINGUAL LISTENERS

Paula Garcia[1], Karen Froud[1]; [1]Columbia University, Teachers College — Adult cross-language studies demonstrate that second language (L2) learning is influenced by native language (L1) phonological systems, with L2 learners assimilating non-native sounds to native phonemes (Best, 1995). Sequential bilingual Spanish-English speakers face perceptual challenges in acquiring American English (AE) vowel contrasts, which are often signaled by multiple acoustic cues not present in L1. Research on English vowel perception in L1-Spanish adults has focused on the English vowel contrast /i/, /j/ (as in sheep, ship) because discrimination errors between these two vowels are common (e.g., Flege, Bohn & Jang, 1997). However, other vowel contrasts such as /Œ/-/Q/ are also known to present perceptual challenges for Spanish listeners (Escudero & Chládková, 2010). nThis study examined neurophysiological responses (ERPs) of adult sequential Spanish-English bilinguals, compared to English-speaking controls, in a task requiring perceptual discrimination of AE vowel contrasts /Œ/-/Q/ and /æ/-/[/ under two listening conditions: (1) natural vowel duration and (2) neutralized vowel duration. MMN / P300 responses were observed for all participants. Behavioral (accuracy-reaction time) and neurophysiological (MMN/P300) differences between groups indicate that Spanish listeners identified vowel pair /æ/-/[/ like English speakers in both conditions, but were less accurate and slower to identify vowel pair /Œ/-/Q/. These results suggest that perceptual differences in vowel pairs are related to Spanish listeners difficulties with relevant spectral/duration features in specific AE vowels (e.g., formant transitions in /Œ/-/Q/), but not in others (e.g., /æ/-/[/). These findings could support development of teaching methods that improve perception of relevant vowel cues during L2 English acquisition.

A122

INDIVIDUAL DIFFERENCES IN CHANGE DEAFNESS: VERBAL COGNITIVE STYLE AIDS DETECTION

Carryl Baldwin[1], Dan Roberts[1], George Buzzell[1], Bum-Sik Sin[1], Matthew Jesso[1], Brian Simpson[2], Nandini Iyer[2]; [1]George Mason University. Fairfax, VA, [2]Air Force Research Laboratory, Dayton, OH — In complex auditory scenes containing more than four objects, humans frequently fail to detect the disappearance of one of the objects unless attention is specifically directed towards that object (Eramudugolla, Irvine, McAnally, Martin, & Mattingley, 2005). This change deafness, or the failure to detect suprathreshold changes to an auditory scene, has been attributed to either a failure of attention (Eramudugolla et al., 2005) or the rate at which listeners can apply verbal labels to the objects, as opposed to a failure of auditory encoding (Gregg & Samuel, 2008). In two experiments that differed only in the specific natural object sounds presented, listeners attempted to detect the disappearance of an object from a complex continuous stream of 2, 4, 6, or 8 natural sounds. In different blocks, the objects were dissociated by their identity, location in space, or both. We reasoned that individuals with a strong visuospatial strategy would perform better when objects dissociated by location, and conversely a verbal cognitive style would benefit from dissociation by identity. As expected, individuals with a strong verbal strategy detected significantly more object changes within the identity task than individuals with a strong visuospatial strategy. However, in the task in which objects were dissociated by location, there were no differences in performance as a function of cognitive strategy. Adding location information by presenting multiple objects from different locations aided performance generally, but verbal strategists maintained their performance advantage. These results provide strong support for the role of verbal strategies in aiding auditory change detection.

A123

REPRESENTATION OF SPECTRO-TEMPORAL FEATURES OF FRICATIVE AND STOP-CONSONANT WORD ONSETS WITHIN THE SENSORY AUDITORY-EVOKED POTENTIALS (AEPS), THE P1-N1-P2 AND T-COMPLEX USING SINGLE TRIAL ANALYSIS

Monica Wagner[1], Arindam RoyChoudhury[2], Valerie L Shafer[3], Brett Martin[3], JungMoon Hyun[3], Mitchell Steinschneider[4]; [1]St. John's University, [2]Columbia University, [3]The Graduate Center of the City University of New York, [4]Albert Einstein College of Medicine — The phoneme sequence that constitutes a spoken word consists of a unique set of acoustic features that change over time. The P1-N1-P2 and T-complex of auditory evoked potentials (AEPs) reflect these time-varying features (Wagner et al., 2013) and can be used to index cortical level processing of the spoken word. It is unclear, however, whether spectro-temporal features of words can be consistently identified within the P1-N1-P2 and T-complex signature waveforms in individual subjects having normal language abilities. AEPs were recorded (65 channel net, Electric Geodesic

Inc.) from 48 native-Polish and native-English adults in response to spoken words that began with the syllables "set" and "pet". Each word type consists of 70 natural productions, which approximates the acoustic variation of a single speaker. The onset phonemes /s/ and /p/ are highly contrastive in both spectral and temporal features (Bordon et al., 2003; Rosen, 2013), which facilitates identification of feature processing within the sensory AEPs. Single trial responses were analyzed to assess (1) whether spectral contrasts were reflected within the signature waveforms to natural speech stimuli (2) variation in the signature waveform patterns across healthy adults (3) consistency of single trial brain responses within individual healthy subjects and (4) changes in stability of the brain responses over time between 50 and 600 ms. Results are discussed in terms clinical potential of the P1-N1-P2 and T-complex signature waveforms and the value of single trial analysis.

A124

AUDITORY MEMORY DISTORTIONS CORRESPOND WITH INCREASED ACTIVITY IN SUPERIOR TEMPORAL CORTEX Ryan Brigante[1], Joanna Hutchison[1,2], Kristen Deupree[1], Bart Rypma[1,2]; [1]University of Texas at Dallas, [2]University of Texas Southwestern Medical Center — Auditory working memory, the ability to consciously remember sounds for short time periods, has a limited capacity and is prone to errors. Previous work from our laboratory has shown that people tend to restrict auditory musical information mentally so that they remember music with less content than they initially perceived. The present experiment sought to replicate these memory distortions while measuring corresponding changes in blood oxygenation with functional magnetic resonance imaging (fMRI) of the brain. Eleven healthy young adults listened to excerpts of professional music during fMRI scanning and then made judgments about the relative content of stimuli in a delayed response task. Consistent with previous research, participants tended to remember stimuli with less content than they initially perceived. These distorted memories corresponded with increased signal relative to accurate trials in superior temporal gyrus (STG) but not inferior frontal gyrus (IFG). This finding suggests that STG is crucially involved in representation of sounds in working memory. At a broad theoretical level, this finding suggests that short-term memory representations are grounded in modality-specific sensory cortices prior to frontal and association cortices.

A125

HEMODYNAMIC SIGNATURES OF (MIS-)PERCEIVING TEMPORAL CHANGE Bjoern Herrmann[1], Molly J. Henry[1], Mathias Scharinger[1], Jonas Obleser[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences — Perception of time and temporal change are critical for human cognition. Yet, perception of temporal change is susceptible to contextual influences such as changes in acoustic pitch. Recent magnetoencephalographic brain recordings showed how neural oscillations in auditory cortex code for pitch-induced illusions of temporal rate change. The current fMRI study investigated the neural mechanisms underlying perception of temporal rate change and illusions thereof on a systems level that involves brain regions outside sensory cortices proper. In a 6 × design, human participants (N=19) listened to frequency-modulated sounds (~4 Hz) that varied over time in both modulation rate and pitch. Participants judged the direction of rate change ('speeding up' vs. 'slowing down'), while ignoring changes in pitch. Behaviorally, rate judgments were strongly biased by pitch changes: Participants perceived the rate to slow down when pitch decreased and to speed up when pitch increased ('rate-change illusion'). The current fMRI data show that, for regions classically associated with timing functions (pre-SMA, right IFG/insula, left putamen), activation increased with increasing task difficulty. Importantly, while the right IFG/insula only scaled with task difficulty, activation in pre-SMA additionally correlated with the ability to discriminate rate changes and (negatively) with the magnitude of the rate-change illusion. A further distinction was observed in the left putamen, which was negatively correlated with the degree of illusion, but uncorrelated with rate change discrimination. Thus, the current findings dissociate between regions that only scale with task difficulty and those that are additionally linked to perception of temporal rate change.

A126

SYNCHRONIZATION TO AUDITORY AND VISUAL RHYTHMS IN HEARING AND DEAF INDIVIDUALS Aniruddh Patel[1], John Iversen[2], Brenda Nicodemus[3], Karen Emmorey[4]; [1]Tufts University, [2]UC San Diego, [3]Gallaudet University, [4]San Diego State University — A striking asymmetry in human sensorimotor processing is that humans synchronize movements to rhythmic sound with far greater precision than to temporally equivalent visual stimuli (e.g., to an auditory vs. a flashing visual metronome). Traditionally, this finding is thought to reflect a fundamental difference in auditory vs. visual processing, i.e., superior temporal processing by the auditory system and/or privileged coupling between auditory and motor systems. However, it is unclear whether this asymmetry is an inevitable consequence of brain organization or whether it can be modified (or even eliminated) by experience or by stimulus characteristics. To study the role of experience, we compared synchronization to flashing metronomes in hearing and profoundly deaf individuals. Deaf individuals performed better than hearing individuals when synchronizing with visual flashes, suggesting that cross-modal plasticity enhances the ability to synchronize with temporally discrete visual stimuli. However, synchronization was still not as accurate as when hearing individuals tapped to an auditory metronome, suggesting that there are certain fundamental neural asymmetries in auditory-motor vs. visuo-motor synchronization to discrete metronomic stimuli. To study the role of stimulus characteristics in synchronization, participants tapped to a silent image of a bouncing ball. When this stimulus was used, hearing participants synchronized as well as they did with an auditory metronome, and deaf individuals showed signs of metrical grouping, suggesting that visual timing may access higher-order beat perception mechanisms for deaf individuals. Overall, these results suggest that the auditory advantage in rhythmic synchronization is more experience- and stimulus-dependent than has been previously reported.

PERCEPTION & ACTION: Development & aging

A127

NEURAL ADAPTATION IN INFANTS' PERCEPTION OF AUDIOVISUAL TEMPORAL SYNCHRONY RELATIONS Franziska Kopp[1], Alexandra Jesse[2]; [1]Max Planck Institute for Human Development Berlin, [2]University of Massachusetts Amherst — In this experiment, we tracked the neural dynamics associated with the repeated presentation of an audiovisual asynchrony in 6-month-old infants. One group of infants (n = 22) was repeatedly shown audiovisual stimuli in which the auditory event preceded the visual event by 320 ms (AV320), for another group (n = 20) this asynchrony was only 280 ms (AV280), and a third group (n = 20) received the same stimuli in synchrony (AVsync). Asynchronies of 320 ms are outside of the temporal window of audiovisual integration in infants; asynchronies of 280 ms should be near the boundary of this window. EEG was assessed and evaluated by comparing ERP patterns across blocks and across groups. There was a general tendency of diminished negative (auditory N1, visual Nc) and increased positive (visual Pb) amplitudes between block 1 and block 2 in all groups, indicating general adjustment processes with repeated presentation. As an indicator for the processing of synchrony versus asynchrony, Pb latencies were significantly longer in response to asynchronous than synchronous stimuli, with longer latencies for larger asynchronies. The auditory N1 and P2 were differentially modulated across blocks and groups. N1 amplitude became less negative and P2 amplitude became more positive in the AVsync group across blocks, whereas this pattern was only marginal significant for the AV280 group, and was completely absent in the AV320 group. Results suggest an influence of the audiovisual asynchrony on the perception of temporal synchrony relations, and a change of neural dynamics with repeated asynchrony presentations.

A128

EMERGENCE OF INDIVIDUALITY IN COGNITIVE DEVELOPMENT Ulman Lindenberger[1], Julia Freund[2], Andreas M. Brandmaier[1], Lars Lewejohann[3], Imke Kirste[4], Mareike Kritzler[3], Antonio Krüger[3,5], Norbert Sachser[3], Gerd Kempermann[2,6]; [1]Max Planck Institute for Human Development, [2]Technische Universität Dresden, [3]Westfälische Wilhelms-Universität Münster, [4]Duke

University Medical Center, [5]German Research Center for Artificial Intelligence, [6]German Center for Neurodegenerative Disease (DZNE) — What is the link between individual experience and brain structure? Why do identical twins not resemble each other perfectly even when growing up together? To shed light on these issues, Freund et al. (2013) introduced an animal model for the study of individualization mechanisms. They observed forty genetically identical mice that were kept in an enclosure offering a large variety of activity options. Each animal was equipped with a microchip, allowing for reconstruction of the animals' exploratory behavior. Despite a common environment and identical genes, the mice increasingly diverged in their exploratory behavior. These differences were associated with differences in the generation of new neurons in the hippocampus: Animals that explored the environment to a greater degree also grew more new neurons in the dentate gyrus of the hippocampus than animals that were more passive. We conclude that individual experiences and ensuing behavior contribute to the "individualization of the brain." This process of individualization cannot be reduced to differences in environment or genetic makeup. We will discuss potential mechanisms underlying individualization, the general potential of the paradigm introduced by Freund et al. (2013), including future questions and plans. Freund, Brandmaier, Lewejohann, Kirste, Kritzler, Krüger, Sachser, Lindenberger, & Kempermann (2013). Emergence of individuality in genetically identical mice. Science, 340(6133), 756-759.

A129

RESTING INTERHEMISPHERIC INHIBITION IN ELDERLY: FUNCTIONAL AND STRUCTURAL MRI CORRELATES

Allyson Rosen[1,2], Jeffrey Stephens[1,2], Gary Glover[2], Maxwell Boakye[3], Paige Fraser[1,2], Keith Main[1,2], Jean Charles Lamy[4]; [1]Palo Alto Veterans Affairs Health Care System, Palo Alto, CA, [2]Stanford University, [3]University of Louisville, KY, [4]CESEM, CNRS UMR8194, Université Paris Descartes, Sorbonne Paris Cité — Change in transcallosal inhibition has been invoked as a mechanism by which older adults show less lateralized frontal fMRI activation. The aim of the study is to compare three measures of interhemispheric connectivity in motor cortex in older adults: resting state functional connectivity, interhemispheric inhibition (IHI as measured by transcranial magnetic stimulation), and DTI tractography. Previous work showed that the changes were selective for long IHI (40 ms interpulse interval) and related to active, fMRI in motor cortex. We hypothesized that we would also find a relationship in older adults between long IHI and resting state connectivity fMRI in the motor cortices. Fifteen young (ages 21-35) and sixteen elderly (ages 61-86) underwent paired pulse TMS (interpulse intervals 10 ms and 40 ms) and resting state fMRI. Functional connectivity of the primary motor cortex was derived based on regions of interest (ROI) in right and left M1. The ROI's were based on separate structural and active fMRI data. We found a significant correlation in elderly (R2=-0.27, p=0.035) and not young (R2=0.11, p=0.24) between motor cortex fMRI and resting long IHI. Previous studies have also demonstrated that stronger IHI was related to more corpus callosum integrity since it is believed to mediate IHI. We performed diffusion tensor imaging and used tractography to measure the integrity (fractional anisotropy) of the hand area in the corpus callosum and again found the same long interval resting IHI data in elderly to be correlated with FA of the hand area in the corpus callosum (R2=-0.20, p=0.048).

A130

BRAIN STRUCTURE AND FUNCTION IN CHILDREN WITH NONVERBAL LEARNING DISABILITIES

Ian DeVolder[1], Thomasin McCoy[1], Vincent Magnotta[1], Peg Nopoulos[1]; [1]University of Iowa — Nonverbal learning disability (NLD) refers to a constellation of neuropsychological deficits specific to nonverbal cognitive processes, including tactile and visual perception, complex psychomotor activity, processing of novel stimuli, sustained attention, executive function, academic areas such as mathematical reasoning, and problems with socioemotional cognition. It has been hypothesized that NLD constitutes a right-hemisphere neurodevelopmental disorder, with particular problems in white matter development and right hemisphere connectivity. The purpose of the current study was to examine brain structure, white matter integrity, and functional connectivity in children with NLD using structural MRI, diffusion tensor imaging (DTI), and resting-state functional connectivity MRI (rs-fMRI). 11 children with NLD (9 males, 2 females; age range = 7-12) were compared to 33 age and sex-matched healthy control children. Intracranial volume was found to be decreased in children with NLD. When looking regionally, only the hippocampus appeared abnormal in NLD, with a reduction in right hippocampal volumes. DTI revealed a decrease in fractional anisotropy (FA) within several white matter tracts that connect different lobes in both the right and left hemispheres for children with NLD. Resting-state fMRI data indicated a decrease in functional connectivity within right hemisphere regions, accompanied by an increase in connectivity to left hemisphere regions in children with NLD. The results provide support for a right-hemisphere neurodevelopmental component to NLD. Resting state data indicated a decrease in right hemisphere functional connectivity, with a potentially compensatory increase in connectivity to left hemisphere brain regions, possibly explaining the intact verbal abilities in these children.

A131

AGE-RELATED COMPENSATION DURING MOTOR IMAGERY: A MULTIMODAL STUDY

Hana Burianova[1], Lars Marstaller[2], Anina Rich[2], Mark Williams[2], Greg Savage[2]; [1]University of Queensland, Australia, [2]Macquarie University, Australia — Motor imagery (MI) is an active process during which the representation of simple or complex motor movements is internally reproduced without any overt physical action. The neural correlates of MI overlap greatly with those of motor execution, and thus MI has been utilized in rehabilitative settings to optimize motor function after stroke or injury. As older adults are more prone to impairments in motor function, understanding age-related effects on MI is important. In a multimodal study, young and older adults took part in the Finger Configuration Task (FCT), either executing or imagining sequences of finger movements, whilst their brain activity was measured by magnetoencephalography (MEG) and functional magnetic resonance imaging (fMRI). The results show that MI ability does not diminish with age; however, the quality of the underlying neural signal changes. In contrast to young adults, during MI older adults show increased activity in somatosensory areas and in additional areas outside of the motor network. This activity correlates positively with both vividness and FCT accuracy scores, and is also associated with stronger beta desynchronization. In contrast to older adults, young adults show increased activity in areas implicated in executive control of attention. Activity in these areas does not correlate with either vividness or accuracy scores. The converging fMRI, MEG, and behavioural results yield evidence of age-related compensation in areas involved in bottom-up processing of somatosensory information, and weaker top-down control of attention. Our findings have important implications for the utilization of MI as a rehabilitative strategy in older adults.

A132

DISCRIMINATION OF NUMEROSITIES IN CHILDREN STUDIED BY MEANS OF FAST PERIODIC VISUAL STIMULATION

Sandrine Mejias[1], Bruno Rossion[2], Christine Schiltz[1]; [1]University of Luxembourg, [2]University of Louvain — We are constantly dealing with quantities in our environment. This ability to process numerical magnitude is present in infants (Izard et al., 2009), a variety of animal species (Flombaum et al., 2005) and in tribes with small number words lexicon (Pica et al., 2004). It implies that our brain is able to extract the total number of items in a scene, regardless of perceptual interference (non-numerical properties of the stimuli). However, this ability seems to be refined through development (Halberda et al., 2012), due to visual-perception maturation and/or educational environment, e.g. when learning arithmetic. Here, we measured rapidly and objectively 6-to-12-y.o. children's sensitivity to (non-)symbolic numerical stimuli (dots or Arabic numbers), using fast periodic visual stimulation (FVPS) as implemented in a repetition-suppression paradigm (Rossion & Boremanse, 2011). Children were presented with stimuli appearing at 3.5 items/second (fundamental frequency=3.5 Hz), for 60 seconds. Half of the sequences consisted of different stimuli at every cycle of stimulation (e.g., "10", "18", "12",...), the other half of sequences were composed of same stimuli ("10") repeated throughout the whole sequence. We observed a large increase of the EEG response at the fundamental frequency (a steady-state visual evoked potential; Regan, 1966) over the lateral parieto-occipital electrodes sites. This response was reduced when the same stimulus was repeated, especially for symbolic stimuli. These results are correlated to children's age, their visual-perception, arithmetic and non-symbolic numerical abilities (L-POST, KRT, Panamath). They indicate that FPVS of (non-)symbolic numerosities is a promising tool to study children's sensitivity to numerical magnitude.

A133

EVENT-RELATED POTENTIALS OF RESPONSE SELECTION AND INHIBITION MODULATED BY COMPLEXITY OF OBJECT CATEGORIZATION IN NORMAL AGING Erin Venza[1], Athula Pudhiyidath[1], Hsueh-Sheng Chiang[1], Raksha A. Mudar[1,2], Audette Rackley[1], Jeffrey Spence[1], John Hart, Jr.[1]; [1]University of Texas at Dallas, [2]University of Illinois at Urbana Champaign — The study aims to investigate how event-related potential (ERP) markers of response selection and inhibition in normal aging population are modulated when categorization increases in perceptual and semantic complexity. Ten normal aging adults were included and assessed by neuropsychological tests (9F, age = 63 ±4.9, education = 17.8 ±1.8, MMSE = 28.6 ±1.2). In the Single Car (SC) task, subjects pressed a button upon seeing a car (Go) but not a dog (NoGo). In the Object Animal (OA) task, they pressed for non-animal items (Go) but not for animals (NoGo). We found that reaction time (RT) for Go was longer in OA than in SC ($p < .001$). Accuracy showed no significant difference between conditions or tasks. ERPs were analyzed using a multi-variate statistical technique (STAT-PCA, threshold at FDR=.05). An interaction effect was found in frontal areas, where Go elicited more negative N2 than NoGo in SC but no difference in OA. Two components associated with the main effect of condition were found corresponding to a centro-parietal P3 and to an occipital N1. The main effect of task was found with OA having more negative potentials than SC centro-parietally around 300 ms post-stimulus. The findings suggest response inhibition recruits increased level of attention and motor monitoring compared to response selection. Top down control may be less sufficient during inhibition than during selection when categorization involves less semantic information. It suggests normal aging adults may benefit from deeper semantic processing in inhibiting responses during categorization.

A134

BEHAVIORAL AND NEURAL CHARACTERIZATION OF DISTRACTION ACROSS THE ADULT LIFESPAN Joaquin A. Anguera[1], Camarin E. Rolle[1], Adam Gazzaley[1]; [1]University of California San Francisco — Our recent work demonstrated that performance during one type of interference, interruption (or multitasking) declines with advancing age (Anguera et al., 2013). Using the same paradigm (NeuroRacer), we evaluated another type of interference, distractibility, during a perceptual discrimination task under the settings of distraction (completion of a task against a visually noisy background) & no distraction. 174 individuals between the ages 20-79 (~30 individuals per decade of life) participated in a 1st experiment: here we observed a correlation between age and an index of distractibility ($r=.38$, $p<.001$) indicating that with increasing age, adults become more distractible. In a 2nd experiment, we collected EEG data on 20 young (24.1 ± 2.9), 19 middle-aged (39 ± 4.2), and 20 older adults (70.5 ± 5.9) while playing each NeuroRacer condition. Attentional processing was assessed using posterior alpha desynchronization time-locked to sign onset for targets and non-targets. An age group (YA; OA; MA) X condition (Distracted; Not-Distracted) X stimulus (Target; Non-Target) interaction was present, with main effects of stimulus and condition as well. Follow-up tests revealed that only young adults showed a differential patterns of alpha desynchronization for targets and non-targets during the distraction condition, unlike the other condition or groups. These findings suggest that while middle-aged and older adults still show similar extents of alpha desynchronization as younger adults, they do not effectively modulate this activity for different target types in a distracting environment. This lack of neural differentiation between target types informs the increase in distractibility with age across the lifespan.

A135

AN ERP-STUDY ON THE PROCESSING OF SOCIAL INFORMATION - MAKING A CASE FOR POINTING GESTURES Manuela Stets[1], Bennett Bertenthal[1]; [1]Indiana University, Dept. of Psychological and Brain Sciences — The importance of communicating information using social cues has been studied extensively. For instance, Senju et al. (2006) showed differential ERPs to gaze cues that were congruent or incongruent with the appearance of a lateralized target. Using fMRI-methodology, Materna et al. (2008) reported that adults showed similar responses to gaze-shifts and pointing gestures. However, neuro-cognitive results remain inconclusive as to whether pointing is also represented similarly to changes in eye-gaze direction in infants as seen in adults. This study investigates cortical responses to pointing in 10-month-old infants and adults. Participants saw a fixation cross followed by 4 conditions: pointing gestures that were congruent or incongruent with a target's location (a checkerboard appearing left or right for 500ms), only a pointing hand, or only the target. Based on behavioral findings (Bertenthal et al., under review), we used a stimulus-target onset asynchrony (SOA) of 100 or 600ms. Preliminary adult results suggest that a pointing hand elicits neural activation similar to a face including a gaze-shift as indicated by a pronounced N170 (slightly delayed) for all pointing-conditions. This component was not modulated by the SOA. In infants, all conditions including the pointing gesture elicited a component complex resembling the N290-P400-complex known to reflect face-processing in this age-group. The condition with only the target did not. As such, this study presents evidence that patterns of neural activity in response to a pointing hand are similar to those observed in response to gaze-shift.

PERCEPTION & ACTION: Vision

A136

PERCEIVED SIMILARITY DEPENDS ON CONTEXT Alexander N. Sokolov[1], Joachim F. Eicher[1,2], Marina A. Pavlova[1]; [1]University of Tübingen, [2]University of Freiburg — In daily life, we used to rely upon apparent similarity when missing specific knowledge about things or recalling people and places. However, if similarity is context-dependent is largely unknown. Statistical context (i.e., overall base rates and initial encounters of distinct stimuli) can modulate perceived magnitudes of single stimuli: For instance, the same speed appears slower with fast rather than slow speeds possessing higher overall base rates or dominating the series outset (the frequency and primacy effects; Sokolov et al., 2000). When judging similarity of stimulus pairs, physically small differences between stimuli are typically more common than large differences. Here, we examined whether the overall frequency (i.e., base rate) and initial encounters of distinct stimulus pairs affect perceived similarity. Six Gabor patches (spatial frequency, 1-10 cycle deg-1 in 0.2 log-steps) were presented in pairs to four separate groups of participants who had to judge their similarity using a 3-point scale (hardly, moderately, and very similar). In the groups, patch pairs with either large or small differences possessed higher overall base rates and/or dominated the initial trials. The results showed that regardless of which (small or large) differences mainly occurred on the initial trials, judgments of similarity were considerably higher in groups with on overall frequent pairs of large rather than small differences (the frequency effect). We conclude that apparent similarity largely depends on the statistical context of stimuli. The outcome suggests important implications for computational models of sensory representations that should take proper account of variable base rates of stimulus pairs.

A137

ABSTRACTION OF NUMBER CONCEPTS FROM VISUAL PERCEPTS IN THE HUMAN BRAIN Joonkoo Park[1], Nicholas DeWind[1], Marty Woldorff[1], Elizabeth Brannon[1]; [1]Duke University, USA — Humans are endowed with an intuitive sense of number that allows us to perceive and estimate numerosity without relying on language. It is controversial, however, as to whether the brain is capable of representing number itself or is only capable of encoding number based on other perceptual cues that are necessarily confounded with number, such as the total surface area or density of a dot array. In this study, we developed a novel analytic method which allows an assessment of the unique contributions of number and other visual properties. In essence, when dot-array stimuli are systematically constructed to cover a range of perceptual properties, all of these properties can be represented as a linear combination of three orthogonal dimensions. Thus, a linear model can be used to quantitatively assess the unique contribution of each dimension, including number, in explaining neural responses to the dot arrays. We then used this approach to a passive-viewing event-related-potential experiment to investigate the temporal dynamics of neural sensitivity to number and to other visual properties. The results demonstrate that the human brain is uniquely sensitive to number from very early in the visual stream - 75 ms at the medial occipital site and 180 ms at the bilateral occipito-parietal sites. These findings provide strong evidence for the existence of a neural mechanism for rapidly and directly extracting numerosity information in the human visual pathway.

A138

STRUCTURAL AND FUNCTIONAL CONNECTIVITY FINGERPRINTS FOR FACE PERCEPTION Zeynep Saygin[1], Nancy Kanwisher[1]; [1]Massachusetts Institute of Technology — A fundamental hypothesis in neuroscience is that connectivity mirrors function at a fine spatial grain across the cortex. Previous research supports this hypothesis for the human brain, by demonstrating that the degree of voxelwise face-selectivity in the fusiform gyrus of individual subjects can be predicted from that voxel's connections to the rest of the brain (its unique connectivity fingerprint), measured through diffusion-weighted imaging (DWI; Saygin et al. 2012). Here we asked whether resting-state functional connectivity (fcMRI) can also predict face-selectivity in the fusiform gyrus, and whether structural or functional connectivity fingerprints also predict face selectivity in the superior temporal sulcus (STS). We found that both fcMRI and DWI connectivity predicted face selectivity in the fusiform and STS more accurately than did a group analysis of face selectivity from other subjects. Prediction accuracies from DWI connectivity were slightly but significantly better than predictions from fcMRI connectivity for the fusiform gyrus, but the two predictors performed similarly for the STS. A direct comparison of the subset of connections that best predicted face-selectivity revealed that DWI and fcMRI connectivity fingerprints for function were generally quite similar, especially for the top predictors, although differences existed among weaker predictors. Overall, these data provide converging evidence from both DWI and fcMRI that i) connectivity and function are tightly linked at a voxelwise scale in face-selective cortex in humans, and ii) face-selective voxels can be predicted from either diffusion or resting functional data alone.

A139

FAST CONNECTIVITY DYNAMICS OF CONSCIOUS AND UNCONSCIOUS VISUAL EXPERIENCE Nicolas Bedo[1], Lawrence M. Ward[1,2]; [1]University of British Columbia, [2]UBC Brain Research Centre — In spite of many insights into the neural correlates of consciousness, we still don't know much about the moment-to-moment changes in brain connectivity associated with conscious experience. Oscillatory dynamics likely play an important role in conscious processing by facilitating rapid engagement and disengagement of widely distributed neural assemblies. We exploited a visual illusion, in which a small contrast decrement of a fuzzy annulus often, but not always, resulted in the experience of the annulus vanishing, to study differing (conscious versus unconscious) visual experiences in response to the same physical stimulus. Using high-density EEG, independent component analysis, and dipole fitting, we identified common neural sources at frontal (anterior cingulate) and parietal (precuneus/posterior cingulate) sites. Consistent with previous studies, pre-stimulus alpha-band (8-13 Hz) functional connectivity (phase synchronization) between independent components localized to these sites was larger on trials on which the annulus appeared to vanish (unconscious) than when it remained consciously visible. When the annulus remained consciously visible, however, early (<100ms) gamma- (38-42 Hz) and theta-band (3-7 Hz) phase synchronization was larger than when it vanished. Further, pre-stimulus effective connectivity (directed information flow from transfer entropy) was greater from parietal to frontal sources in theta- and alpha-bands, and greater following stimulus onset in alpha- and gamma-bands, when the annulus remained consciously visible. These results highlight the importance of anterior-posterior interactions in consciousness by elucidating the timing and directionality of information flow, and also confirm that rapid changes in synchronized oscillatory activity are associated with drastic alterations in one's moment-to-moment conscious perception.

A140

DECODING ACTION CONCEPTS AT DIFFERENT LEVELS OF ABSTRACTION - AN MVPA STUDY Moritz F. Wurm[1], Angelika Lingnau[1]; [1]University of Trento, Italy — Action concepts are abstractions of concrete action. It is assumed that abstraction occurs on several distinct levels. For example, "opening a bottle" is an abstraction of concrete instantiations of that action (e.g., "opening a particular wine bottle"). On a higher level of abstraction, "opening" describes the action concept independent of the object class. The neural substrates of abstraction from concrete actions to abstract action concepts are debated: Motor versions of embodied theories claim that action concepts are grounded in the motor system. By contrast, classical cognitive theories propose that action concepts consist of amodal representations in networks distinct from the motor system. Here we used cross-conditional multivoxel pattern analysis (MVPA) of fMRI data to decode observed actions on three levels of abstraction: a concrete level (opening vs. closing a specific bottle), an intermediate level (opening vs. closing across different bottle exemplars), and an abstract level (opening vs. closing across object classes, i.e., bottles and boxes). A ROI analysis revealed significant decoding accuracies for the concrete level in left ventral premotor, and bilateral inferior parietal and occipitotemporal cortex (OTC). Intermediate and abstract concept levels, however, could be decoded bilaterally in the anterior intraparietal sulcus (aIPS) and in the posterior middle temporal gyrus (pMTG) only, an area that has also been implicated to play a role in conceptual processing of action verbs. These results were corroborated by a surface-based searchlight analysis. In contrast to embodied theories, our findings suggest that action concepts are represented outside premotor and motor regions.

A141

TIME-SCALE OF PERCEPTUAL GROUPING FORMATION Daniel D. Kurylo[1]; [1]Brooklyn College, CUNY — Neural processes that mediate perceptual grouping serve to bind individual components of a stimulus. Binding develops over time in the form of intrinsic lateral connections, feed-forward convergence, and dynamic modifications from feedback signals. In order to determine the time-scale over which binding forms among stimulus components, perceived grouping was measured for briefly presented dot patterns that were followed by a stimulus mask. Grids of dots, organized in terms of common luminance, appeared for 12 ms on a computer monitor. Grids were followed by a mask that overlaid either grid elements, or the spaces among elements in which binding would occur. A gap of varying duration occurred between grid offset and mask onset in which no stimulus was present. Observers reported the perceived pattern of grouping of the grids. Results indicated that grouping can proceed uninterrupted with as little as 12 ms access to primary stimulus signals, whereas masking spatial locations among elements disrupts processing for the first 35 ms of grouping formation. In addition, feedback of partially constructed grouping patterns appears to occur during a 12 ms window that exists 47 ms after stimulus presentation. These results may be accounted for by reciprocal interactions at early stages of processing in which grouping patterns are identified, after which constructed patterns are passed to subsequent levels of processing. These results support a model of progressive element binding that cascades over time through multiple levels of processing.

THINKING: Decision making

A142

NEURAL DYNAMICS OF DECISION-MAKING IN A FINANCIAL TRADING TASK Alison Harris[1], Cary Frydman[2], Tom Chang[2]; [1]Claremont McKenna College, [2]University of Southern California — Although economic models of decision-making often assume that choice behavior is rational, deviations from optimality have been repeatedly documented in financial trading. One robust finding is the disposition effect : the tendency of investors to hold on to losing stocks while selling winners prematurely. Recent neuroimaging data suggests that this behavior is associated with differential activity in neural reward circuits for realization of capital gains (price cost), compared to paper gains. However, less is known about how individuals overcome these biases to implement appropriate trading actions: selling losers (realized losses) and holding winners (paper gains). Here we hypothesize that optimal trading behavior is associated with increased cognitive regulation, similar to that observed in dietary self-control. We examined this question using event-related potentials (ERP) to measure subjects brain activity while trading in an experimental stock market to obtain real monetary outcomes. For each stock, optimality of choice on a given trial was defined mathematically based on the stock s expected return and the participant s decision to hold or sell. Consistent with previous ERP data, where successful self-control is associated with early attentional gating of perceptual activity, the earliest neural correlates of optimal choice occurred from approximately 100-150 ms after stimulus onset. This early peak was enhanced for both realized losses and paper gains, despite behavioral differences in the action being implemented, and highly significant differences

in RT. In line with a growing literature on attentional fluctuation, these data suggest that early differences in attentional modulation can be associated with far-reaching behavioral effects.

A143

ECONOMIC DECISION-MAKING IN THE ULTIMATUM BARGAINING GAME: BEHAVIORAL AND ERP EVIDENCE FOR EFFORTFUL OPERANT CONDITIONING STRATEGIES

Courtney Stevens[1], Neal Rusk[1], Ami Snur[1]; [1]Willamette University, Salem Oregon — The present study examined the neural correlates of economic decision-making. Participants (n=15) played a multiple-shot version of the Ultimatum Bargaining Game (UBG) while event-related brain potentials were recorded. Participant played the UBG in two conditions. In the Perceived Fixed (PF) condition, participants believed the proposer did not see their decision and only entered computer-generated offers. In the Perceived Alterable (PA) condition, participants believed the proposer could see their decision before selecting a next offer, such that decisions could potentially influence future offers. In reality, all offers were randomly generated. We predicted that the effects of offer type (fair/mid-value/unfair) would be affected by the manipulation of perceived offer alterability (PF/PA). Data were analyzed using a 2x3 ANOVA with factors of Condition (PF/PA) and Offer Type (fair/mid-value/unfair). Consistent with previous literature, participants accepted unfair offers less frequently. However, this effect was stronger in the PA condition, which also showed lower overall acceptance rates. The N350 showed increased amplitude to mid-value offers in the PA versus PF condition, suggesting greater mental effort for mid-value decisions in the PA condition. In addition, the P300 showed a main effect of offer type (largest for fair offers) and condition (larger in the PF condition), suggesting greater reward satisfaction for fair offers and larger overall monetary gains in the PF condition. Taken together, these data suggest that participants may use effortful operant conditioning strategies in the UBG when they believe they can influence a proposer's future offers, providing a potential explanation for participants' behavior in the UBG.

A144

THE INFORMATION-THEORETIC SURPRISE OF ECONOMIC DECISIONS DIFFERENTIALLY MODULATES BOLD SIGNAL IN ANTERIOR AND POSTERIOR BRAIN REGIONS

Michael J. Tobia[1], Tobias Sommer[2]; [1]PSU Center for NMR Research, Hershey Medical Center, [2]University Medical Center, Hamburg-Eppendorf — The Bayesian brain learns the statistical distribution of sensory events for perceptual inference and decision-making based on sensory consequences. It is not known if the brain also stores information about the distribution of its own response history when learning complicated contingencies with multifarious consequences. This experiment investigated whether behavioral surprise, an information-theoretic measure of response predictability that implies memory for a distribution of response history, modulates neural activity. Thirty participants (ages 18-30) completed 240 trials of an inter-temporal choice task in which they selected an amount to wager from four possible values on each trial, followed by two independent consequences: a probabilistic gain/loss, and a response-contingent state transition. Behavioral surprise for each trial was calculated as the [-log2 p(x)], where p(x) is the probability of the categorical value (1-4) of the selected wager at the current state. FMRI data were analyzed for activation at the onset of stimulus events, and trial-by-trial parametric modulation by behavioral surprise, nominal wager value, and reward/loss value. Two sets of clusters ($p < .005$; cluster > 156 voxels) were differentially modulated by behavioral surprise. An anterior system comprised of the inferior frontal gyrus and anterior cingulate (each bilaterally), and left caudate, was positively modulated. A posterior system comprised of the posterior cingulate, parahippocampal gyrus and posterior hippocampus (each bilaterally), and left angular gyrus, was negatively modulated. These results provide evidence that the brain stores information about its own response history, not just sensory information. This information could be important when learning complicated multifarious response-consequence relations.

A145

WHEN REINFORCEMENT LEARNING IS NOT ENOUGH: EXAMINING THE ROLE OF MIDBRAIN REWARD PROCESSING IN NON-STATIONARY ENVIRONMENTS

Cameron Hassall[1], Olave Krigolson[1]; [1]Dalhousie University — Real-world decision making is challenging due, in part, to changes in the underlying reward structure: the best option last week may be less rewarding today. Determining the best response is even more challenging when feedback validity is low. Presented here are the results of two experiments designed to determine the degree to which midbrain reward processing is responsible for detecting reward contingency changes when feedback validity is low. In particular, we recorded electroencephalographic data while participants learned optimal stimulus-response rules that were either changing or static. We observed an enhancement of the feedback error-related negativity (fERN) - a component of the event-related potential (ERP) related to reward processing - in non-stationary environments compared to stationary environments, but only when participants were cued as to which environment they were in. Our results suggest that while midbrain reward systems may be involved in detecting unexpected uncertainty in non-stationary environments, other systems are likely involved when feedback validity is low - namely, the locus-coeruleus-norepinephrine system. Finally, a computational model that combines these systems is described and tested. Taken together, these results downplay the role of the midbrain reward system when feedback validity is low, and highlight the importance of the locus-coeruleus-norepinephrine system in detecting reward contingency changes.

A146

WIN, LOSE OR BUST: ERP CHANGES ASSOCIATED WITH FEEDBACK IN A GAMBLING TASK

Nikki Honzel[1], Jary Larsen[1], Felix Bacigalupo[2], Diane Swick[1,2]; [1]Veterans Affairs Northern California Health Care System, [2]University of California, Davis — The current study examined the neural activity associated with evaluating feedback in a realistic gambling task. Event-related potentials (ERPs) were recorded while participants played a modified Blackjack game against a dealer. We wished to see whether the feedback-related negativity (FRN) and P300 components were sensitive to the type of loss. Participants drew up to five cards to sum as close to 21 without going over. Participants started with $10.00 and were awarded $0.25 if they scored higher than the dealer. If the participant lost (scored lower than dealer) or busted (score > 21), $0.25 was deducted. ERPs were time-locked to the feedback screen to examine neural responses on "Win", "Lose" or "Bust" trials. The FRN to "Lose" was significantly more negative than either "Win" or "Bust". Interestingly, the ERP response to "Bust" was driven by an extreme positive wave, with "Bust" feedback producing a significantly larger P300 compared to either "Win" or "Lose" feedback. These findings replicate previous results that demonstrate the FRN is more negative to losses compared to wins. However, in the current task, FRN was not selective to just good versus bad outcomes. Both "Lose" and "Bust" feedback resulted in a loss of $0.25, yet the neurophysiological responses were significantly different. The prominent P300 suggests that "Bust" feedback resulted in a greater violation of reward expectations. The results also suggest a difference between evaluation of negative feedback contingent on the participant's choice to risk taking an additional card, compared to a loss when competing against an opponent.

A147

RISK-SEEKING ATTITUDE MANIFESTED VIA OVERVALUATION OF REWARDS RATHER THAN BIASED WEIGHTING OF PROBABILITY IN SENSORIMOTOR TASKS

Erik Chang[1], Jyh-Jong Hsieh[1,2], Shih-Wei Wu[3]; [1]National Central University, [2]National Chiao-Tung University, [3]National Yang-Ming University — Our daily decisions are seldom made in vacuum but heavily rely on explicit and implicit uncertainties. Previous decision-making studies have demonstrated that explicit uncertainty leads to risk-averse tendency, while implicit sensorimotor uncertainty results in risk-seeking tendency. A hypothetical account for this discrepancy is that the overconfidence on one's own motor performance inflates the subjective estimate of success. Here we compared participants' decisions for a traditional lottery versus two novel sensorimotor lotteries of which reward probability was calibrated from individual's performance on the corresponding sensorimotor task: The keyboard task required the participant to intercept a

moving object by pressing a keyboard button when it passed a central circular region on a computer display, whereas the touch-screen task required direct reach-to-touch interception at the same region. Participants had to choose between a risky bet and a sure bet. The risk attitude was assessed under the framework of cumulative prospective theory (CPT) which separately estimates parameters for probability weighting and outcome valuation. Intriguingly, and somewhat counter-intuitively, participants showed a significant tendency to overvalue the reward of the touch-screen lottery but undervalue it in the traditional lottery, whereas the bias of valuation for the keyboard lottery was in-between but also significantly different from the other conditions. By contrast, there was no significant difference in the probability parameter was found among conditions. We suggest that personal efforts may alter the subjective valuation of outcome rather than weighting of probability, with a few caveats awaiting future investigations.

A148

RECONCILING NEURAL REPRESENTATIONS OF VALUE AND SALIENCE IN THE HUMAN PARIETAL AND ORBITOFRONTAL CORTEX Thorsten Kahnt[1], Soyoung Park[1], John-Dylan Haynes[2], Philippe Tobler[1]; [1]University of Zurich, [2]Bernstein Center for Computational Neuroscience Berlin — A large body of evidence has implicated the posterior parietal and orbitofrontal cortex in the processing of motivational value. However, value perfectly correlates with motivational salience when appetitive and aversive stimuli are investigated in isolation. Accordingly, uncertainty has remained about the precise nature of the previously identified signals. In particular, recent evidence suggests that neurons in the posterior parietal cortex signal salience instead of value. Here we used multivariate (pattern-based) analyses and human fMRI data to reconcile the neural representations of motivational value and salience. Thirty subjects were scanned during a Pavlovian task which involved visual cues predicting appetitive and aversive outcomes, and provided orthogonal levels of value and salience. We used a searchlight decoding approach in conjunction with support vector regression models to identify neural signatures of value and salience. We find that multivoxel ensemble activity in the superior posterior parietal cortex encodes both value and salience of the predictive cues. In contrast, activity patterns in the inferior posterior parietal cortex encode salience only. Thus, by using an unbiased whole-brain approach, we demonstrate that both value and salience signals are present in the posterior parietal cortex. Moreover, we identify multivoxel patterns in the orbitofrontal cortex that correlate with motivational value. Critically, the positive value of appetitive cues is represented by the same multivoxel pattern as the negative value of aversive cues. Thus, these orbitofrontal activity patterns constitute a common neural scale for appetite and aversive values.

A149

CORTICOSTRIATAL CIRCUIT DYSFUNCTION DRIVES REINFORCEMENT LEARNING DEFICITS IN INCARCERATED ANTISOCIAL OFFENDERS Edward Patzelt[1], Alexander Millner[1], Erik Kastman[1], Hayley Dorfman[1], Arielle Baskin-Sommers[2,3], Kent Kiehl[4,5], Joseph Newman[3], Joshua Buckholtz[1,6,7]; [1]Harvard University, [2]Mclean Hospital, [3]University of Wisconsin-Madison, [4]University of New Mexico, [5]Mind Research Network, [6]Center for Brain Science, [7]Massachusetts General Hospital — Epidemiological studies suggest that the majority of crime is committed by a relatively small number of antisocial individuals. The economic burden imposed by antisocial behavior is profound, with billions spent each year on incarceration. However, antisocial behavior is notoriously difficult to treat, owing largely to our poor understand of the cognitive and neural mechanisms that enable humans to learn and follow social norms. Given that successful norm compliance likely requires adaptive reinforcement learning, some have suggested that antisocial individuals may show domain-general deficits in reward feedback learning. We tested this hypothesis using an instrumental monetary reinforcement-learning task in a sample of 49 incarcerated offenders who were scanned with a mobile 1.5T MR device. In order to more precisely isolate deficits related to "antisociality" from related constructs, we controlled for individual variability in trait aggression. We found temporally specific associations between antisocial behavior and corticostriatal circuit activity during gain learning. In particular, antisocial behavior was linked to decreased striatal activation at choice and diminished ventromedial prefrontal cortex activity in response to reward feedback. Together, these findings provide evidence for corticostriatal hyporeactivity during value-based decision-making in antisocial individuals. Corticostriatal circuit dysfunction may impair the adaptive reward feedback learning required to guide behavior according to social norms.

THINKING: Reasoning

A150

THE EFFECT OF SEMANTIC AND RELATIONAL SIMILARITY ON THE N400 IN VERBAL ANALOGICAL REASONING Ryan J. Brisson[1], Matthew J. Kmiecik[1], Amanda S. Sweis[1], Robert G. Morrison[1]; [1]Loyola University Chicago — We have previously shown that the N400 event-related potential becomes more negative as the semantic distance increases between the source and target of verbal analogies. This result, along with the finding that far analogies increasingly depend on frontopolar cortex (Green et al., 2010, 2012) suggests that near and far verbal analogies may differentially depend on semantic and relational neurocognitive processing. In order to further investigate the role of semantic and relational similarity in verbal analogies we presented the A, B, C and D terms of verbal analogies sequentially. As in our previous study, we varied the semantic distance between the AB and CD terms as measured using Latent Semantic Analysis, matching both valid and invalid near and far analogies for distance. In this study we also counterbalanced stimuli so every word appeared equally in each analogy slot across participants. Participants did not differ in accuracy or RT for near and far analogies. Upon presentation of the C-term, the N400 was less negative for the near valid condition compared to all other conditions. In contrast, upon presentation of the final D-term, the N400 was differentially modulated with respect to both validity and distance with valid analogies showing less negative N400's than invalid, but semantic distance still showing a small but reliable impact on both near and far analogies. Together these results show the combined influence of semantic and relational similarity on the N400 and suggest the increasing importance of the processing of explicit relations late during verbal analogical processing.

A151

COMPONENTS OF BELIEF UPDATING AND THEIR NEURAL CORRELATES Nicole Marinsek[1], Benjamin Turner[1], Michael Miller[1]; [1]University of California, Santa Barbara — In this study, we aimed to 1) model the component processes of hypothesis evaluation during the receipt of new evidence and 2) identify brain regions that support these processes. We recorded subjects' brain activity with fMRI as they attempted to generate appropriate category labels for a series of novel word sets that were designed to either elicit repeated cycles of hypothesis formation and evaluation ("ad hoc" word sets) or minimize these processes ("automatic" word sets). We used a Bayesian framework to model the strength of subjects' category hypotheses as the words in each set were presented. In order to estimate the parameters of the model, we collected behavioral data on a different set of subjects and used the data to generate normed estimates of the posterior probability for the first word in each set, likelihood ratios for subsequent words, and the degree to which each word violated expectations. We created several versions of the Bayesian-based model in order to test different potential psychological strategies. We then ran model-based fMRI analyses of the original data in order to identify the brain regions associated with belief updating, hypothesis strength, and hypothesis acceptance, thus simultaneously validating competing models of psychological strategies and localizing their associated networks. The results of this study provide insight into the psychological and neural processes of hypothesis evaluation and the validity of Bayes' theorem as a model of belief updating in humans. This research was supported by the Institute for Collaborative Biotechnologies under grant W911NF-09-D-0001.

A152

DTI TRACKS CREDULITY TO EXPLICITLY-LABELED FALSE INFORMATION IN PATIENTS WITH SCHIZOPHRENIA Erik Asp[1], Kelsey Warner[1], Daniel Tranel[1], Nancy Andreasen[1]; [1]University of Iowa — We have developed the False Tagging Theory (FTT), which proposes that the link between the association areas of the prefrontal cortex and the temporal-parietal junction (TPJ) are necessary for somatic "false tags" in the psychological concept of doubt. We have shown that damage (via stroke or tumor resection) to these structures or the primary link between them (i.e., supe-

rior longitudinal fasciculus) leads to a disrupted false tagging mechanism and a "doubt deficit" which manifests as increased credulity. The FTT may address longstanding questions in patients with schizophrenia (SZ), such as how fixed false beliefs can form. Here, we put the FTT to a crucial test by giving SZ patients novel beliefs in the laboratory and directly measuring their ability to falsify (or doubt) those beliefs. Subjects were given stories to which a series of explicitly-labeled false statements were embedded. The false statements were designed to sway the dispositional opinion of the protagonist of the story, if mistakenly believed. The results show that SZ patients 1) tend to misremember more explicitly-labeled false information as true than comparisons, and 2) use the misremember false information in subsequent social judgments of the protagonist. Moreover, structural integrity of white matter measured by DTI in the frontal and parietal lobes negatively correlates with "false as true" errors in SZ patients. These findings indicate that a core component of executive dysfunction in schizophrenia may be explained by failures to doubt automatically believed information, a deficit that is associated with a specific disruption of the frontal-parietal circuitry.

Poster Session B

ATTENTION: Multisensory

B1

HAND LOCATION AFFECTS VISUAL PROCESSING UNDER DISTRIBUTED BUT NOT FOCUSED ATTENTION Catherine Reed[1], William Bush[2], Natasha Parikh[3], Niti Nagar[1], John Garza[4], Sean Vecera[2]; [1]Claremont McKenna College, [2]University of Iowa, [3]Harvey Mudd College, [4]University of Nebraska, Lincoln — Hand position can bias attention to locations near the hands and affect the amplitude of both early (e.g., N1) and later ERP components (e.g., P3). The current study used dense-array electroencephalography/event-related potentials (dEEG/ERP) to measure the impact of hand position on visual processing during both focused and distributed spatial attention. To manipulate the distribution of attention we used a modified version of the paradigm developed by Mangun and Hillyard (1993). Stimuli were presented briefly and rapidly on either side of a fixation; participants distinguished infrequent targets (15%) from standards while EEG data were collected. We compared conditions in which a hand or a wood hand-shaped object was placed near a stimulus location. In Experiment 1, attention was broadly distributed across both stimulus locations to determine whether increased amplitudes of P1 or N1 components could be attributed to the position of the hand per se or to any visual anchor. In Experiment 2, a cue directed attention to one location to determine whether attentional focus overrode the hand's contributions. When attention was distributed across two potential stimulus locations, greater N1 amplitudes were observed in response to stimuli at near-hand compared to near-block locations, indicating that the hand had a greater impact on processing than a simple visual anchor. However, when attention was focused on a single location, focal attention and stimulus location overrode hand or anchor effects. These results demonstrate that hand position influences early visual processing, but only when attention is broadly distributed.

B2

DRD4 LONG ALLELE CARRIERS SHOW ENHANCED SELECTIVE ATTENTION TO HIGH-PRIORITY ITEMS IN THE ENVIRONMENT Marissa Gorlick[1], Darrell Worthy[2], Valerie Knopik[3], John McGeary[4], Christopher Beevers[1], W. Todd Maddox[1]; [1]University of Texas at Austin, [2]Texas A&M University, [3]Brown University — Individuals with 7 or more repeats (long allele) in exon III of the DRD4 gene sometimes demonstrate impaired attention, as seen in ADHD, and at other times demonstrate enhanced attention, as seen in addictive behavior. Though the clinical effects of DRD4 are the focus of much work, this gene may not necessarily serve as a "risk" gene for attentional deficits, but as a plasticity gene where selective attention is heightened for priority items in the environment. In the current work we examine the role of DRD4 in two tasks that benefit from selective attention to high-priority information. In Experiment 1, participants perform a category-learning task where performance is supported by selecting features to update verbal rules. Here selective attention to the most salient features is associated with good performance. In Experiment 2, participants perform a working memory task that relies on selective attention to update and maintain items in memory while also performing a secondary task, the Operation Span Task (OSPAN). Long allele carriers show superior performance relative to short in the category learning and OSPAN tasks. These results suggest that DRD4 may serve as a "plasticity" gene where long allele carriers show heightened selective attention to high-priority items in the environment, which can be either beneficial or counterproductive, depending on the context.

B3

DYNAMIC RECRUITMENT OF SENSORY-BIASED ATTENTION NETWORKS IN TEMPORAL AND SPATIAL SHORT-TERM MEMORY TASKS Samantha W Michalka[1], Lingqiang Kong[1], Maya L Rosen[1], Kathryn J Devaney[1], Barbara G Shinn-Cunningham[1], David C Somers[1]; [1]Boston University — While the sensory modalities of audition and vision both can both provide amodal spatial and temporal domain information, the quality and resolution of this amodal information is not equal across the senses. The visual system exhibits high spatial but low temporal resolution; conversely, the auditory system exhibits low spatial but high temporal resolution. We propose that tasks in one sensory modality may dynamically recruit the other modality's attention network when the other modality offers higher resolution in the relevant domain (e.g., visual-temporal or auditory-spatial tasks). We call this the Domain Recruitment Hypothesis. To test this hypothesis, we performed 3 sets of fMRI experiments. First, we employed a sustained attention task with competing auditory and visual stimuli to define sensory-biased cortical regions in both frontal and posterior areas. We then used resting-state functional connectivity to confirm regions with the same sensory-bias belong to visual or auditory attention networks. In the final experiment, we employed 4 short-term memory change detection tasks: visual-temporal, visual-spatial, auditory-temporal, and auditory-spatial. The auditory-spatial task (vs. the auditory-temporal task) significantly recruited the visual network. Similarly, the visual-temporal task (vs. the visual-spatial task) significantly recruited the auditory network. These observations support the Domain Recruitment Hypothesis. Our findings have important implications for understanding the functional organization of human cortex and the neural substrates of cognitive control. This work was supported by CELEST, a National Science Foundation Science of Learning Center, (NSF SMA-0835976) and the National Institutes of Health (NIH R01EY022229, 1F31MH101963-01).

B4

WHAT IS THE SHAPE OF BUBANO? THE SOUND-SHAPE CORRESPONDENCE EFFECT IN 4-MONTH-OLD INFANTS Jovana Pejovic[1], Monika Molnar[1], Clara Martin[1]; [1]Basque Center on Cognition, Brain, and Language, Donostia, Spain — Sound-shape correspondence represents a bias in association between acoustic and visual information, specifically between the name (auditory) and shape (visual) of an object. A well-known example of this bias is to associate the pseudo-word kiki with angular objects, and the pseudo-word bouba with rounded objects. This "bouba-kiki effect" has been observed in adults, toddlers, and recently even in 4-month-old infants. However, it is unclear whether the effect in infants is specific to the combination of the phonemes found in "kiki" and "bouba", or the effect can be extended to other pseudo-words, specific to the participants' native language background. To test this, we asked Spanish-Basque bilinguals to generate new pseudo-words that they associate with rounded or angular object. Another group of participants rated the pseudo-words to verify their association to the objects. From this corpus, we selected two new Spanish-like pseudo-words for the infant experiment: "raceto" for angular objects, and "ubano" for rounded objects. This pair has been presented to 4-month-old Spanish monolingual infants using an audio-visual preference looking paradigm, in which infants were exposed to either congruent trials (raceto paired with angular objects and bubano paired with rounded objects) and incongruent trials (raceto paired with rounded objects, and bubano paired with angular objects). Infants' looking behaviour did not confirm that infants link pseudo-words to objects, although infants showed a significant preference of listening to "raceto" over "bubano". Our results in relation to previous findings on sound-shape correspondence in infancy will be discussed.

B5

THE MECHANISM OF WATCH STEAL: THE EFFECT OF POWER GRIP ON ATTENTION TO TACTILE STIMULUS Masataka Urushihara[1], Goh Matsuda[1,2], Yoshiyuki Tamamiya[1,2], Kazuo Hiraki[1,2]; [1]The University of Tokyo, [2]JST, CREST — This study examined the effect of power grip on attention to tactile stimulus. We focused on magician's techniques to deceive a sense of touch. For example, in watch steal, a magician tells spectators to close their hand tightly and make them look away from their wrist when trying to steal their watch before they realizes it. We conducted two experiments composed of the following three conditions. In a relax condition, participants relaxed their hand. In a power-grip and soft-grip condition, they held a hand-gripper tightly and held a tied hand-gripper softly with their right hand, respectively. In the first experiment, we employed a vibration detec-

tion task (VDT) in which participants pressed a key when they felt a vibration presented on their right wrist. In order to investigate an interaction of visual misdirection and power grip, we employed a dual task paradigm in the second experiment; one is a visual mental counting task and the other is VDT. The correct response ratios of VDT showed no significant effects of power grip in the first experiment. On the contrary, power grip significantly reduced the correct response ratios of VDT in the second experiment. These results suggest that power grip decreased participant's attention to tactile stimuli only when their attentional focuses were divided into two different modalities such as senses of touch and vision. This interpretation is concordant with the magician's watch steal. Our findings indicate the importance to consider muscle condition when investigating mechanism of tactile sense.

B6

WHILE YOU WERE ALMOST SLEEPING: NEURAL CORRELATES OF EYE CLOSURE DURING SLEEP DEPRIVATION Ju Lynn Ong[1], Danyang Kong[1], Tiffany T.Y. Chia[1], Christopher L. Asplund[2], Michael W.L. Chee[1]; [1]Duke-NUS Graduate Medical School, Singapore, [2]Yale-NUS College, Singapore — When deprived of sleep, partial and complete eye closures increase, reflecting wake-sleep transitions. Interestingly, when fully awake and in darkness, voluntary eyes-open and eyes-closed conditions elicit differential brain activation, even in non-visual areas (Marx et al., 2003). Here, we determined whether involuntary eye closure arising from being sleep deprived modulates BOLD signal in a similar fashion. 19 healthy participants who were kept awake for ~24h underwent resting-state scans. Although instructed to keep their eyes open, multiple epochs with partial or complete eye closure were observed on account of increased sleepiness. Continuous eye-tracking video was classified into 4-sec "Eyes Closed" (EC) or "Eyes Open" (EO) epochs. In accordance with prior work, the contrast between EC>EO epochs showed increased activations in the somatosensory, visual extrastriate and auditory regions. This pattern of activation has been attributed to an interoceptive state characterized by imagination and heightened multisensory activity. A novel finding is that the sleep deprived state was associated with addditional changes: increased activation of the more "limbic" nodes of the default-mode network (parahippocampal gyrus, hippocampus, medial prefrontal and posterior cingulate cortex) which could denote a transition from wakefulness to sleep during which an individual becomes free from exteroceptive vigilance. Eye closure was also associated with pronounced deactivation of the thalamus and brainstem, that could reflect transition between wakefulness to sleep and/or dramatic sensory gating. Thus, eye closures, particularly following sleep deprivation are associated with significant shifts in activation and deactivation of multiple brain regions.

B7

WITHIN- AND CROSS-MODAL ATTENTION MODULATE UNATTENDED VISUAL INFORMATION AS REVEALED BY THE STRENGTH OF VISUAL MOTION AFTEREFFECTS ACROSS VISUAL CONTRAST Vivian Ciaramitaro[1], Doris Chow[1], Geoffrey M Boynton[2]; [1]University of Massachusetts Boston, [2]University of Washington — You miss something (e.g. seeing a "gorilla" at a party) when you attend to information of the same modality elsewhere (e.g. staring at a beautiful guest) or a different modality (e.g. listening to a conversation). Here we examined if within- and cross-modal attention affected the processing of unattended visual information. Participants viewed one drifting gratings in each hemifield and heard a binaural auditory tone. On any given trial only one stimulus was attended: the visual stimulus (speed discrimination task) or the auditory stimulus (frequency discrimination task). At the end of each trial, the strength of a visual motion aftereffect (MAE) was quantified, using a nulling paradigm, for the same visual stimulus when it was (a) attended, (b) unattended with attention directed to the contralateral visual stimulus (within-modal attention), or (c) unattended with attention directed to the auditory stimulus (cross-modal attention). Relative to attended visual information: MAE strength was reduced (1) in the within-modal condition, when attention was directed to the contralateral visual stimulus, confirming spatial attention effects on MAE and (2) in the cross-modal condition when attention was directed to the auditory stimulus. Furthermore, MAE strength suggests a larger suppression of unattended information for within-modal versus cross-modal attention. Two additional experiments show MAE strength increases gradually with contrast, with saturation effects in accord with neuronal contrast response functions in earlier visual areas. These results reveal behavioral consequences correlating to differences in the BOLD response to unattended visual information in similar attention tasks (Ciaramitaro, Buracas & Boynton, 2007).

B8

TESTING FOR A SUPRA-MODAL ATTENTIONAL NETWORK MECHANISM Alfredo Spagna[1], Jin Fan[2]; [1]Department of Psychology, Sapienza, Rome, Italy, [2]Department of Psychology, Queens College CUNY, United States — There has been growing knowledge regarding the visual attentional networks which are a set of anatomically distinct and hierarchically organized components whose interaction supports the alerting, orienting and executive control functions of attention. However, the existence of a supra-modal mechanism recruiting resources from the same functional networks, independent of stimulus modality, has not been tested. In this study, we examined the correlation between participants' performance on a visual and an auditory version of the attention network test. For the auditory version, to parallel left and right visual field cues, we used sound cues presented to left and right ears to engage orienting and alerting functions. Further, to involve executive control, a pair of tones (low/low, high/high, low/high, or high/low frequency) was presented sequentially with the first one as the target and the second one as the flanker. Results showed significant positive correlations between visual and auditory conflict scores for both reaction time and efficiency, while inter- modality attentional scores for the alerting and orienting networks were not significantly correlated. Taken together, these results may suggest that there is a common neural mechanism supporting executive control across both modalities, but a relatively greater contribution of modality specific processes to the alerting and orienting functions.

B9

NEURAL BASIS OF CROSSMODAL INFLUENCES ON VISUAL TIME-ORDER PERCEPTION Lavanya Krishnan[1], Antigona Martinez[1,2], Wenfeng Feng[1], John McDonald[3], Steven Hillyard[1]; [1]University of California, San Diego, [2]Nathan Kline Institute, [3]Simon Fraser University — It has recently been reported (McDonald et al. 2013) that task-irrelevant auditory cues reflexively activate visual cortex, eliciting event related brain potentials (ERP) that are larger contralateral to the cue. This neural modulation may underlie the enhanced processing of visual stimuli that occur in close spatial proximity to sudden acoustic changes in the environment. We designed a study to investigate the functional significance of this visual cortex activation in enhancing visual perception, by correlating its amplitude with perceptual judgments, on a trial-by-trial basis. The task involved a spatially non-predictive auditory cue followed by red and green squares on either side of fixation. The squares were either simultaneous, separated by 33 ms, or 66 ms. Participants were required to report the color of the square that they perceived as appearing first. When the red and green squares were presented simultaneously, on 72 % of the trials, participants perceived the square at the cued location as appearing earlier. We found that the cued square would need to lag the uncued square by 56 ms in order to be perceived as appearing simultaneously in accordance with the findings of McDonald et al. (2005). ERP recordings revealed that in response to the auditory cue there was an enhanced contralateral positivity over visual cortex. This contralateral positivity was significantly larger when participants perceived the stimulus at the cued location as appearing earlier compared to when they did not.

EMOTION & SOCIAL: Development & aging

B10

COGNITIVE REGULATION OF NEGATIVE AFFECT ACROSS CHILDHOOD, ADOLESCENCE AND YOUNG ADULTHOOD Jennifer Silvers[1,2], Catherine Insel[3], Alisa Powers[4], Peter Franz[1], Chelsea Helion[2], Theresa Teslovich Woo[2], Gloria Pedersen[2], Danielle Dellarco[2], Jochen Weber[1], B.J. Casey[2], Walter Mischel[1]; [1]Columbia University, [2]Weill Cornell Medical College, [3]Harvard University, [4]Long Island University — Learning to regulate one's emotions is a

critical life skill. One particularly effective means for regulating emotion is cognitive reappraisal, wherein one thinks about a stimulus differently so as to alter its emotional import. While it is commonly accepted that emotional behavior changes dramatically across development, less is known about how the ability to use cognitive strategies like reappraisal differs as a function of age or what neural mechanisms support such changes. The present study sought to address these questions by testing 84 healthy individuals (49 female; aged 6.83-22.3 years) on a fMRI paradigm examining neural responses to aversive and neutral stimuli. On a trial-by-trial basis, participants were instructed to mentally distance themselves from pictured events (reappraise), immerse themselves in them, or respond naturally to the stimulus presented. Overall, participants reported less negative affect when reappraising aversive stimuli than when responding naturally or immersing ($p<.001$). Reappraisal-related reductions in negative affect were paralleled by recruitment of bilateral dorsolateral PFC and posterior parietal cortex ($p<.05$, FWE corrected). An interaction was observed between valence, strategy and age at both the behavioral ($p=.09$) and neural levels ($p<.005$, $k>15$ voxels), such that age predicted less negative affect and less amygdala activity on reappraisal trials but not other trials. Taken together, these data suggest that age predicts enhanced reappraisal success as indexed by both decreases in negative affect and the amygdala response.

B11

VALENCE DIFFERENCES IN NEURAL MARKERS OF IMPLICIT EMOTION REGULATION IN OLDER ADULTS

Jill D. Waring[1,2], Ruth O'Hara[1,2], Amit Etkin[1,2]; [1]Stanford University School of Medicine, [2]VA Palo Alto Healthcare System — There is a well-established positivity bias in older adults, evidenced in greater attention and better memory for positive than negative information. It is thought that older adults engage these emotion regulation strategies automatically, by "default". To better understand the automatic nature of this positivity bias, we investigated behavioral and neural markers of implicit emotion regulation in community-dwelling older adults. Participants completed a face-word emotion conflict task (fear, happy) during functional magnetic resonance imaging. Facilitated regulation of emotion conflict was observed on face-word incongruent trials following another incongruent trial (i.e., emotional conflict adaptation), as reflected in faster reaction times. There were no differences in reaction times for emotion conflict adaptation for fearful versus happy faces, however, there were significant differences in the neural markers of emotion conflict adaptation between face types. There was a set of regions across the prefrontal cortex extending into the temporal lobes and insula that were recruited for fearful greater than happy face-word emotional conflict adaptation, which was not seen for happy greater than fearful adaptation. Anterior cingulate connectivity provides further evidence of the differing mechanisms of implicit emotion regulation between happy and fearful faces. These results suggest that there are neural markers of facilitated emotion regulation for positive information compared to negative in older adults, even on an implicit level. This provides evidence for origins of older adults' "default" emotion regulation strategies that lead to the positivity bias.

B12

DYNAMICS OF SUSTAINED REWARD ACTIVITY ACROSS DEVELOPMENT

Aaron Heller[1], Leah Somerville[2], Todd Hare[3], BJ Casey[1]; [1]Sackler Institute for Developmental Psychobiology; Weill-Cornell Medical College, [2]Department of Psychology, Harvard University, [3]Department of Economics, University of Zurich — Emerging research suggests that the repeatedly engaging reward activity in a sustained manner is relevant for reduced positive affect in depression. However little is known about how the temporal dynamics of reward related activity emerge during adolescent development. Understanding the emergence of such dynamics may be clinically important as mood disorders commonly begin during this period. To that end, sixty-four individuals ranging from the ages of twelve to twenty-four were scanned in an emotional go-no go paradigm in which participants made speeded button responses to emotional faces. To investigate the temporal dynamics of reward activity we examined rates of habituation across the scan to happy faces. Results suggest nonlinear habituation rates across development - young adults demonstrate significantly more sustained activity in reward related circuits including the striatum and prefrontal cortex than children or teens. This effect is best accounted for by a logarithmic function, as opposed to a linear or quadratic function. To test whether this effect could be due to differences in brain morphology we controlled for the Jacobian Determinant used in normalization. This did accounted for differences in parietal but not subcortical regions. These results provide initial evidence that the ability to sustain reward circuitry function in response to appetitive stimuli changes nonlinearly across development. They also demonstrate that controlling for individual differences in brain structure may be important for examining functional brain differences across development.

B13

DIFFERENT NEURAL MECHANISMS IN COORDINATING WITH OTHER'S BEHAVIORAL RHYTHMS BETWEEN NORMAL AND ASD SUBJECTS

Masahiro Kawasaki[1,2], Keiichi Kitajo[2], Kenjiro Fukao[3], Toshiya Murai[3], Yoko Yamaguchi[2], Yasuko Funabiki[3]; [1]University of Tsukuba, [2]RIKEN, [3]Kyoto University — Autism spectrum disorder (ASD) is known to be typically characterized by communication difficulties and stereotyped behaviors. However, there remains open question about what kind of communication is difficult and its neural mechanism. Here we compared the behavioral and electroencephalograph (EEG) rhythms between normal and ASD subjects for alternating tapping task which required subjects to synchronize the tapping intervals with another subject, or a virtual person (PC program) who tapped at a constant or variable interval. Twenty-four normal subjects and twenty-four ASD subjects participate in the tasks. In the task, when one and another subjects tapped key, one sound ("do" or "mi") was presented, respectively. If a difference between time intervals of previous other's tapping and current subject's tapping was small, one-octave high sound was presented. Subjects were asked to tap with equal time interval of previous other's tapping. Each subject completed human condition, constant PC condition (intervals: 600msec) and variable PC condition (intervals: from 400msec to 800msec). Behavioral results of synchronization (i.e. number of presentation of one-octave high sound) showed significant differences between normal and ASD subjects under the human and variable PC conditions but not under the constant PC condition. In EEG results, only the ASD subjects showed the enhancements of frontal theta amplitudes (6-8Hz) just prior to other's tapping. The frontal theta activity is proposed to correlate with cognitive loads. Therefore the ASD subjects might unnecessarily expect the others' behaviors in communication and then might have difficulty in coordinating the sudden changes and fluctuations of other's rhythms.

B14

INFLUENCE OF DAYTIME SLEEP ON EMOTION REACTIVITY IN PRESCHOOL CHILDREN

Dylan Hillsburg[1], Amanda Cremone[1], Ada Fraticelli Torres[2], Rebecca Spencer[1], Jennifer McDermott[1]; [1]University of Massachusetts, Amherst, [2]Universidad de Puerto Rico — Attention biases for affective stimuli are thought to reflect varying degrees of emotion reactivity and can ultimately confer risk for affective disorders (Fox, Ridgewell & Ashwin, 2009). Although sleep is known to have an important role in emotional reactivity and regulation, there is limited work on the influence of sleep during the preschool years and far less work on the specific role of children's daytime sleep. The current study explored the association between preschooler daytime sleep and emotion reactivity using an affective dot probe paradigm that assessed attention toward neutral versus affective faces (i.e. angry or happy). Twenty children between 3-5 years of age (M=3.5-6yrs) completed the dot probe task two times (approximately 1 week apart) under two conditions: 1) after nap promotion and 2) after nap deprivation. Attention bias scores were calculated separately for each emotion by subtracting congruent trial reaction times from incongruent trials. Results revealed a significant bias toward positive emotion ($t(20)=2.09, p=.05$) and a pattern of negative emotion avoidance after nap deprivation. This emotional attention difference was present only after nap deprivation ($t(20)=1.80, p=.086$). No differences in emotion processing emerged for nap promotion. These results reveal that when young children experience sleep deprivation, positive emotion cues may be more easily processed compared to negative ones. As such, nap deprivation may impact emotion regulation in young children via altered attention mechanisms tied to emotion reactivity. These findings extend the attention bias literature to young preschoolers and highlight the major role of sleep in developmental patterns of emotion processing.

B15

INCREASED DIURNAL CORTISOL IS RELATED TO DECREASED FUNCTIONAL CONNECTIVITY BETWEEN THE AMYGDALA AND THE PREFRONTAL CORTEX AMONG HEALTHY OLDER ADULTS Georgina Moreno[1], Joel Bruss[1], Kameko Halfmann[1], Matthew Sutterer[1], Michelle Voss[1], Natalie Denburg[1]; [1]University of Iowa — Previous research indicates that stress may have deleterious effects on the brain. It is well established that the medial temporal lobe, specifically the hippocampus and amygdala, are especially vulnerable to stress. We are now learning that regions in the frontal lobe, an area susceptible to the negative effects of normal aging, may also be vulnerable to stress. To gauge the functional integrity of these brain regions, we investigated whether there is a relationship between diurnal cortisol levels in older adults and differences in resting-state functional connectivity. Resting-state fMRI data and diurnal salivary cortisol levels were collected in healthy older adults (ages 65-90). Following Veer et al. (2012), we used seed-based connectivity analyses to examine coupling between the amygdala and regions in the prefrontal cortex (PFC). Additionally, because a high proportion of regions in the default mode network (DMN) are PFC regions, we investigated connectivity between the amygdala and DMN and its subsystems (Andrews-Hanna et al., 2010). We hypothesized that older adults with higher diurnal cortisol would evidence weaker connectivity between brain regions affected by chronic stress. Consistent with our hypothesis, we found that increased diurnal cortisol was related to weaker coupling between the amygdala and various regions of the PFC. Additionally, diurnal cortisol was a predictor of functional connectivity between the amygdala and DMN (adjusted R-squared=-0.54, p=.02). Our results suggest that elevated diurnal cortisol, which is indicative of increased chronic stress, is a possible mediator of age-related declines in functional connectivity in networks with a large proportion of PFC regions.

B16

AGING AND SUCCESSFUL EMOTION REGULATION: THE ROLE OF VALENCE AND STRATEGY Eric Allard[1], Elizabeth Kensinger[1]; [1]Department of Psychology, Boston College — Several studies have furthered our understanding of the neural correlates of emotion regulation processes in adulthood. However, a preponderance of studies in this area have been limited in terms of the strategies assessed, stimuli employed, and age range of participant samples. In the current study, 34 younger adults and 30 older adults viewed a series of positive and negative video clips during an event-related fMRI scan session. Videos were viewed during three scan runs (passive viewing, selective attention, and reappraisal). When results focused on neural activation during the onset of the emotional peak for the film clip (e.g., the most emotionally salient portion of the film), a significant Age x Valence x Regulation Condition interaction emerged within regions of the anterior cingulate cortex (ACC), left insula, and right dorsolateral prefrontal cortex (DLPFC). Assessments of age differences revealed that older adults had greater ACC, insula, and DLPFC activity in response to negative videos in the passive viewing condition in comparison to younger adults. Older adults also had higher activity within these regions when viewing positive videos in the reappraisal condition as compared to younger adults. Finally, younger adults showed higher activity within these three regions when viewing negative videos in the selective attention condition as compared to younger adults. These results suggest that both age groups engage emotional processing and regulatory regions when processing dynamic, evocative stimuli. However, some age differences in neural activation in response to regulatory strategies do emerge depending on strategy type and stimulus valence.

B17

LONGITUDINAL ASSOCIATIONS BETWEEN NEGATIVE PARENTING DURING EARLY CHILDHOOD AND HIPPOCAMPAL RESTING-STATE STATE NETWORKS THREE YEARS LATER Sarah Blankenship[1], Sandra J.E. Langeslag[1], Victoria C. Smith[1], Tracy Riggins[1], Lea Dougherty[1]; [1]University of Maryland, College Park — It is well-established that severe negative experiences during childhood (e.g., deprivation, abuse) have detrimental effects on cognitive, emotional, and neural development. In particular, chronic stressors, such as psychopathology or abuse, have been shown to adversely impact hippocampal development through glucocorticoid pathways (i.e., cortisol, a stress hormone). Although the effects of stress on hippocampal development are documented in the maltreatment and clinical literature, to date, little research has investigated the relation between typical variations in early life stressors (such as exposure to negative hostile parenting) and hippocampal development during childhood. Understanding how exposure to normative levels of parenting stress affects neurofunctional development provides insight into the complex interactions between stress, brain development, and psychopathology. In the present study we investigated how negative parenting behaviors (i.e., high hostility and intrusiveness, low support) assessed during an observational parent-child interaction task when the children were 3-5 years relates to hippocampal resting-state functional connectivity at 5-8 years. Preliminary results (N=20, 9 female) reveal greater observed negative parenting behaviors during early childhood predict alterations of hippocampal brain networks three years later. Specifically, increases in negative parenting were related to increased connectivity between bilateral hippocampi and left superior frontal gyrus (p=.01, uncorrected), a region implicated in emotional memory, attention, and executive function. This provides some of the first evidence that typical variations in parenting are associated with individual differences in hippocampal functional connectivity, with specific changes in emotional and attentional networks. These results suggest a potential mechanism through which normative negative experiences may affect subsequent behavioral outcomes.

EMOTION & SOCIAL: Emotion-cognition interactions

B18

EFFECTS OF SLEEP ON MEMORY FOR EMOTIONAL AND DISTINCTIVE COMPONENTS OF SCENES Carolina Campanella[1], Stephan Hamann[1]; [1]Emory University — Emotion has selective effects on episodic memory. For example, episodic memory for salient aspects of emotional scenes is often enhanced whereas memory for background, neutral information is impaired, a phenomenon referred to as the emotional memory trade-off effect. This selectivity in memory typically increases after a delay including sleep; suggesting sleep may selectively enhance emotional memory via consolidation. Previously, we demonstrated that distinctive, non-emotional stimuli can elicit similar memory trade-offs, suggesting that similar cognitive processes may underlie trade-offs for salient emotional and neutral information. However, it is unknown whether sleep also selectively enhances memory for distinctive, non-emotional information. We investigated the effect of sleep on memory trade-offs for distinctive and emotional information using a daytime napping paradigm with polysomnography. At encoding, subjects viewed scenes consisting of a central item (either negative, positive, neutral, or visually distinctive but emotionally neutral) against neutral scene backgrounds. After a 2.5 hr delay, during which a sleep group napped and a wake group remained awake, recognition memory was tested for the objects and for the neutral backgrounds. Sleep increased the memory trade-off effect for both emotional and distinctive objects and their associated backgrounds. These findings suggest sleep preferentially consolidates distinctive and emotional information and illustrates the importance of assessing the contribution of distinctiveness when examining cognitive and neural mechanisms underlying memory trade-offs.

B19

EVENT-RELATED POTENTIALS FOR IMPLICIT, EXPLICIT, AND EMPATHIC PROCESSING OF EMOTIONAL FACIAL EXPRESSIONS Jason S. Nomi[1], Stephanie Bastidas[1], Tien T. Tong[1], Taylor J. Groth[1], Lucy J. Troup; [1]Colorado State University — The current study examined how implicit, explicit, and empathic responses to emotional facial expressions influence event-related potentials (ERPs). Non-depressed and non-anxious human participants viewed happy, sad, and neutral emotional facial expressions while attempting to either identify the gender (implicit), identify the emotional expression (explicit), or empathize with the emotional expression (empathic). EEG data were recorded from 19 electrodes set according to the international 10-20 system with analysis focusing on mean amplitudes for midline and bilateral frontal, central, and parietal electrodes. Midline analysis showed that the vertex positive potential (VPP; 140-200ms) amplitude was largest for sad faces across all electrodes regard-

less of condition. Global analysis showed that P3 (200-400ms) amplitudes in the expression recognition condition differed by hemisphere and electrode for sad and happy faces but not for neutral faces. Finally, the global analysis also showed that P3 amplitudes for all three emotional expressions in the empathize condition differed by hemisphere and electrode. The results suggest that the early perception of emotional expression across all manipulations is represented by increased midline amplitude of the VPP while processes such as expression recognition and empathizing with expressions are represented by differences in P3 amplitudes across hemispheres and electrodes.

B20

EMPATHY TO EMOTIONAL PAIN IN SCHIZOPHRENIA Silvia Corbera[12], Kevin Cook[2], Sophy Brocke[1], Sabra Dunn[1], Michal Assaf[1], Bruce Wexler[2]; [1]Olin Neuropsychiatry Research Center, Institute of Living, Hartford, CT, United States, [2]Yale University, New Haven, CT, United States — Social dysfunction is one among the most debilitating aspects of schizophrenia (SZ). Empathy is a multidimensional construct crucial for successful social interactions and is described as having two components: affective (early-automatic) and cognitive (late-controlled). In a previous study, our group examined these components using Event-Related Potentials (ERPs) in an empathy for physical pain paradigm. We found that patients with SZ showed a decreased early-affective response and a deficit modulating the late-cognitive one. In this present study we expand our work and examine these empathic components in a novel context: observing somebody in emotional pain. In this conference I will expand preliminary ERP and behavioral data gathered from 9 SZ and 12 and healthy controls (HC). Participants viewed pictures depicting individuals either in an emotionally painful or neutral situation during two conditions: Pain Judgment Condition (PC): participants decided whether the person was in emotional pain; and Gender Judgment Condition (GC): participants chose the gender of person. SZ had difficulties identifying painful stimuli (stimuli x group= $F(1, 18)=5.22$; $p=0.035$), especially in the PC (stimuli x condition x group: $F(1, 18)=6.25$; $p=0.022$). Groups did not differ in reaction time although both responded slower with painful stimuli in the GC (stimuli x condition: $F(1, 18)=16.50$; $p=0.001$). Groups also differed in a variety of social cognition measures (e.g., quality of life, emotion recognition and regulation and social competence; p values range 0.042 to <0.001). Overall, SZ exhibited deficits processing painful stimuli. A comparison of the paradigms will be presented as well as implications for treatment.

B21

PLACEBO TREATMENT REDUCES SOCIAL REJECTION-RELATED PAIN VIA ACTIVATION OF THE DORSOLATERAL PREFRONTAL CORTEX AND THE PERIAQUEDUCTAL GRAY Leonie Koban[1], Ethan Kross[2], Choong-Wan Woo[1], Luka Ruzic[1], Tor Wager[1]; [1]University of Colorado Boulder, [2]University of Michigan — Placebo analgesia (PA) refers to a reduced experience of pain caused by belief in a medical treatment. PA has been mainly studied in somatic pain, but placebo effects may extend to social "pain" and other forms of distress as well. Placebo effects on somatic pain are thought to involve prefrontal cortex and subcortical regions that contribute to the opioidergic descending pain modulatory system, particularly the periaqueductal gray (PAG). The corresponding mechanisms of placebo effects on social pain are unknown, but several recent studies suggest opioidergic circuits in the PAG and forebrain may be involved. Here, we used fMRI to investigate whether placebo treatment can reduce the social "pain" caused by re-experiencing a recent romantic rejection. N=40 participants were presented with pictures of their ex-partners and of friends (control condition), during a baseline period, as well as after a randomly assigned placebo or control intervention. Behavioral ratings showed a significant reduction in negative affect following the placebo but not the control intervention, indicating that treatment expectations can regulate psychological pain. Further, a multilevel mediation analysis revealed that placebo effects on social pain ratings were mediated by increased BOLD activity in the right dorsolateral prefrontal cortex and PAG. These findings imply that prefrontal-PAG interactions may also be crucial for the relief of affective and social distress, and suggest a possible mechanistic basis for non-specific treatment effects in a wide range of affective disorders.

B22

DISTINCT NEURAL REGULATORS OF EMPATHY FOR PHYSICAL PAIN AND EMOTIONAL SUFFERING Emile Bruneau[1], Rebecca Saxe[1]; [1]Massachusetts Institute of Technology — Brain regions in the "shared pain network", including anterior middle cingulate cortex (AMCC) and bilateral insulae, can be activated by experiencing physical pain, observing another person in physical pain, or even just by reading stories about a character in physical pain. In previous research, we found that reading stories about a character experiencing emotional distress, by contrast, recruits a different group of brain regions mostly associated with thinking about others' minds, including bilateral temporo-parietal junction (TPJ), precuneus (PC) and medial prefrontal cortex (MPFC). An open question remains whether either, or both, of these brain networks is associated with empathic concern - that is, a feeling for another person's suffering, which motivates helping and other pro-social behavior. One way to manipulate empathic concern is through instructions to actively up-regulate empathic feelings, versus to "remain objective". In the current study, participants (n=40) read stories about physically painful and emotionally distressing events, while actively empathizing or trying to remain objective. Using group analyses and individually defined functional and anatomical localizers, we found that activity in the AMCC was associated with up-regulation of empathy for physical pain (but not emotional suffering), while activity in bilateral amygdala was associated with up-regulation of empathy for emotional suffering (but not physical pain). These data provide further evidence for two distinct neural mechanisms, responding to others' physical and emotional pain, respectively, and link these neural mechanisms to empathic concern.

B23

STRESS-MEDIATED ALTERATIONS OF CORTICAL NETWORK COHERENCE ASSOCIATED WITH SEROTONIN TRANSPORTER POLYMORPHISMS John P. Hegarty, II[1], Bradley J. Ferguson[1], Jeffrey D. Johnson[1], Shawn E. Christ[1], David Q. Beversdorf[1]; [1]University of Missouri, Columbia — The brain mediates the physiological response following psychological stress. Cognitive processing is susceptible to stress effects, and genetic contributions affect individual stress susceptibility, such as the serotonin transporter gene (SERT). Impaired cognitive processing is associated with disrupted coherence within neuronal networks and differences across SERT polymorphisms may explain some variability in stress response. Connectivity analyses of functional magnetic resonance imaging (fcMRI) data has been implicated as a potential measure of network coherence. We hypothesized that individuals more susceptible to stress, primarily those possessing the short allele of the SERT gene, would exhibit greater changes in functional connectivity following exposure to a stressor. This was tested utilizing fMRI during resting state, TR=2000ms TE=30ms 4 mm3. Subjects attended counterbalanced sessions and were exposed to the presence/absence of a psychological stressor; the Montreal Imaging Stress Task (MIST) is a modified MRI-compatible Trier Social Stress Test. Presentation of a crosshair, passive fixation, followed presentation of arithmetic problems with/without time constraints and with/without performance feedback. Conservative motion correction techniques were utilized, as motion is a major limitation in this research. Montreal Neurological Institute (MNI) based regions of interest for fMRI signals were assessed to estimate global connectivity patterns. Preliminary results based on repeated measure stress comparisons between genetic groups indicate altered cortical/subcortical connectivity depending on SERT polymorphisms; specifically those genetically more susceptible to stress exhibited the greatest changes in connectivity compared to those less susceptible. These findings reveal that stress may alter cognitive processing based on changes in signal to noise across neuronal networks.

B24

THE BRAIN ACTIVITY IN PROCESSING FACIAL EMOTION AND IDENTITY: AN ANALYSIS OF MEG DATA Shih-tseng T. Huang[1,2], Daisy L. Hung[3,4], Ovid J.-L. Tzeng[4,5], Denise H. Wu[3,6], Pei-Shu Tsai[7], Ming-Chun Lee[1]; [1]Department of Psychology, National Chung-Cheng University, [2]Center for Cognitive Sciences, National Chung-Cheng University, [3]Institute of Cognitive Neuroscience, National Central University, [4]Institute of Neuroscience, National Yang-Ming University, [5]The Institute of Linguistics, Academia Sinica, [6]Laboratories for Cognitive Neuroscience, National Yang-Ming University, [7]Graduate Institute

of Translation and Interpretation, National Changhua University of Education — Haxby, Hoffman & Gobbini (2000) proposed that the core system contains two pathways for the visual analysis of faces, one processes the changeable facial properties(e.g., expression), the other processes the invariant facial properties (e.g., identity). Each pathway involves separate neurological components. Bayle et al. (2007) suggested that the brain activation of emotion task was higher than that of identity task on happy faces. The present study attempted to analyze MEG data in measuring the brain activations in performing tasks of identity of person and emotional expression. Twenty adults (10 males and 10 females, age ranged from 19 to 29) with normal or corrected normal vision and reported no abnormal neurological history participated. In the study, faces of seven basic emotions were tested in separate blocks and presented in pairs. The participants were asked to judge if the two faces in each trial were identical as in the same emotion or as from the same person. The results found the brain activation of person identity task was significant higher than those of the emotion task, and the activations of the second faces were higher than those of the first faces. The difference between the tasks showed a higher activation of the subcortical nuclei especially at the right insula for identity task before 250ms. The findings suggested a non-conscious perception of emotion information which is implemented at early stage of processing.

B25

EMOTION MODULATES BEHAVIOUR MEDIATED BY THE VENTRAL BUT NOT DORSAL VISUAL STREAM. James Kryklywy[1], Derek Mitchell[1]; [1]University of Western Ontario — How a person processes, prioritizes and represents sensory information can be greatly impacted by the emotional nature of a stimulus. This is particularly notable in the ventral visual stream, where emotional content is known to augment stimulus representation and influence the performance of ventral stream-mediated behaviours. However, the impact of emotion within the dorsal visual stream remains unclear. This is a particularly compelling question given evidence that dorsal stream-mediated behaviours are relatively insensitive to attentional manipulations and optical illusions. The present study aimed to investigate whether behaviours mediated predominantly by the ventral versus dorsal stream are differentially susceptible to emotional context. During the presentation of a task-irrelevant sound (negative, positive or neutral), participants localized a visual target stimulus embedded within a background array utilizing either indirect or direct response outputs. These actions are thought to rely differentially on the ventral and dorsal visual streams respectively. In line with predictions, we found that during indirect localization, response accuracy was significantly enhanced in the context of negative compared to either neutral or positive sounds. In contrast, no significant effects of emotion were identified during direct localization. These results suggest that the ventral visual stream integrates both visual and emotional information, whereas the dorsal visual stream is uninfluenced by emotional cues. Furthermore, this study highlights the complexity of emotion-cognition interactions, indicating how emotion can have a differential impact on almost identical overt behaviours that happen to be governed by distinct neurocognitive systems.

B26

VISUO-OLFACTORY THREAT INTEGRATION AND ANXIETY INFLUENCE AFFECTIVE APPRAISAL OF NOVEL OBJECTS Lucas Novak[1], Wen Li[1]; [1]University of Wisconsin - Madison — Previous work in our lab has shown that subtle threat cues from different senses can be integrated to facilitate threat perception. Here, we investigated how this crossmodal integrative processing of threat could influence the perception of subsequent sensory input, and how it varies with individual differences in anxiety. Pairing face and odor stimuli containing minute threat or neutral emotion, we assessed shifts in affective appraisal of a novel (Greeble) object consequent to olfactory-visual integration of these threat cues. Indeed, pleasantness ratings were more negative for Greebles following bimodal than unimodal threat cues ($T(27)$ s>2.6, p s<.05). Notably, ratings following unimodal threat correlated inversely with anxiety (p=.02), suggesting that anxious participants were more sensitive to the influence of minute threat cues than non-anxious participants, although both high and low-anxious subjects showed equivalent priming effects of bimodal threat cues. In support of neural integration of threat, fMRI results showed response augmentation to bimodal versus unimodal threat presentation in a set of multisensory convergence regions (amygdala, superior temporal sulcus, orbitofrontal cortex), which was not modulated by anxiety. Anxiety was positively associated with stronger activity to bimodal (vs. unimodal) threat cues in hippocampus and fusiform cortex. The influence of visuo-olfactory integration on the ensuing Greeble processing was reflected in strengthened hippocampal response to Greebles following bimodal (vs. unimodal) threat. Finally, anxiety amplified the effect of threat integration on fusiform response to Greebles. The findings highlight the influence of multimodal threat on affective appraisal of novel objects, while also demonstrating the effect of anxiety on this process.

B27

UNDERSTANDING OTHERS' FEELINGS: THE ROLE OF THE RIGHT PRIMARY SOMATOSENSORY CORTEX IN ENCODING THE AFFECTIVE VALENCE OF OTHERS' TOUCH Angela Rossetti[1,2], Giuseppe Vallar[1,2], Silvia Convento[1], Nadia Bolognini[1,2]; [1]University of Milano Bicocca, 20126 Milano, Italy, [2]Neuropsychological Laboratory, IRCCS Istituto Auxologico Italiano, Milano, Italy — Brain imaging studies in humans have shown the existence of a shared somatosensory representation in the primary somatosensory cortex (S1), putatively involved in understanding others' sensations (Keysers et al., 2010); however, the role of S1 in such a high-level process is still unknown. To ascertain the causal involvement of S1, and its possible hemispheric lateralization, in encoding the affective valence of emotional scenes, depicting, or not, a tactile event, we gave to healthy participants a picture-based affective go/no-go task and low-frequency repetitive transcranial magnetic stimulation (rTMS). The dorsolateral prefrontal cortex (DLPFC) was chosen as control site. rTMS over the right, but not the left, S1 selectively increased the participants' latencies in the affective go/no-go task, but only when the affective state was conveyed by touch; intriguingly, this interfering effect was associated with the empathic ability to adopt the subjective perspective of others. The left, not the right, DLPFC is also involved in affective go/no-go performance, but regardless of the sight of touch, and independently of empathic abilities. This novel evidence demonstrates the crossmodal role of right S1 in encoding the pleasant and aversive consequences of others' sensations evoked by touch.

B28

THE EARLY VISUAL CORTEX SUPPORTS SPECIALIZED THREAT ENCODING-A MEG STUDY Yuqi You[1], Bhuvanesh Awasthi[1], Wen Li[1]; [1]University of Wisconsin-Madison — Increasing evidence from animal and human research suggests that the sensory cortex can sustain rapid and refined threat analysis independently of the amygdala threat processing via subcortical pathways (Weinberger, 2007; Li et al., 2008; Tsuchiya et al., 2009). To further dissect cortical-versus-subcortical processing of visual threat, we filtered images to contain only high (> 7 cycles/degree) or low (< 3 cycles/degree) spatial frequencies (H/LSFs), which preferentially activate the ventral cortical/parvocellular or subcortical/magnocellular visual pathways, respectively. Participants viewed threat-related images (fearful and disgusting) in both SFs while magnetoencephalography (MEG; with high spatial and temporal resolution) data were acquired. An early event-related magnetic field (ERF) component peaking at 116 ms after image onset (M100) distinguished the two threat subtypes (fear and disgust) in HSF only, showing enhanced response to fear relative to disgust ($t(13) = 2.05$, $p < .05$). Point-by-point t-tests further indicated that this fear-disgust discrimination persisted well beyond M100 time window to last till 280 ms ($p < .05$). Moreover, the divergent M100 response to HSF fear and disgust images was localized to left striate cortex (-14, -96, -10; $z = 3.11$, $p < .001$), supporting specialized encoding of individual threat subtypes in the visual cortex. By contrast, LSF images failed to generate such within-threat discrimination at this early stage. Taken together, these results highlight the role of the sensory cortex (and the parvocellular pathway) in rapid and refined threat encoding and representation.

EMOTION & SOCIAL: Person perception

B29

SEX DIFFERENCES IN THE NEUROMAGNETIC RESPONSE TO BIOLOGICAL MOTION Marina Pavlova[1], Alexander Sokolov[2], Christel Bidet-Ildei[3]; [1]Department of Pediatric Neurology and Developmental Medicine,Children's Hospital, Medical School, University of Tübingen, Tübingen, Germany, [2]Center for Pediatric Clinical Studies (CPCS), Children's Hospital, Medical

School, University of Tübingen, Tübingen, Germany, [3]University of Poitiers, CMRS, Poitiers, France — Visual sensitivity to human body motion may be considered as a hallmark of daily-life social cognition and a basis for nonverbal communication and social competence. Sex differences are often evident in the comprehension of social signals, but the underlying neurobiological basis for these differences is unclear. Here we assess sex impact on the magnetoencephalographic cortical response to point-light human locomotion. At early latencies, females exhibit a greater peak of root-mean-squire (RMS) activation than males over the right parietal, left temporal, and right temporal cortex, a core of the social brain. At later latencies, the boosts of activation are greater in males over the right frontal and occipital cortices. The findings deliver the first evidence for gender dependent modes in time-course and topography of the neural circuitry underpinning visual processing of biological motion. Gender-related dimorphism in the cortical response may prevent behavioral differences if they are maladaptive. The outcome represents a framework for studying sex differences in the social brain in neuropsychiatric and neurodevelopmental disorders.

B30

CEREBRO-CEREBELLAR PLASTICITY AND BIOLOGICAL MOTON PROCESSING Arseny Sokolov[1,2], Michael Erb[3], Wolfgang Grodd[4], Marcos Tatagiba[2], Richard Frackowiak[1], Marina Pavlova[5]; [1]Département des Neurosciences Cliniques, Centre Hospitalier Universitaire Vaudois (CHUV), Lausanne, Switzerland, [2]Department of Neurosurgery, University of Tübingen Medical School, Tübingen, Germany, [3]Department of Biomedical Magnetic Resonance, University of Tübingen Medical School, Tübingen, Germany, [4]Department of Psychiatry, Psychotherapy and Psychosomatics, University Hospital Aachen, Aachen, Germany, [5]Department of Pediatric Neurology and Child Development, Children's Hospital, University of Tübingen Medical School, Tübingen, Germany — A widespread cortical network subserves perception of others' actions that is indispensable for social cognition in everyday life. Recent data indicate that lesions to the left lateral cerebellum substantially impair visual processing of body motion (Sokolov et al. Cereb Cortex 2010), apparently due to perturbation of reciprocal cerebellar communication with the right superior temporal sulcus, STS (Sokolov et al. Neuroimage 2012; Cereb Cortex in press), a cornerstone of the action observation network. However, evolution of body motion processing after cerebellar lesion and possible network plasticity remain unclear. Psychophysical assessment in a patient SL with left cerebellar dysplastic gangliocytoma (WHO grade I) before, and 8 and 24 months after neurosurgery, and in six healthy matched controls revealed substantial postoperative improvement in visual sensitivity to point-light biological motion. By 24 months after neurosurgery, sensitivity to body motion in SL reached the level of controls. Functional magnetic resonance imaging (fMRI) showed activation of left cerebellar lobules III and IX in SL, implying a medial shift of cerebellar activity as compared to healthy controls. Psychophysiological interaction (PPI) analysis demonstrated effective connectivity between the left cerebellum and a region in the right STS, shifted to the anterior part as compared to controls. The study suggests a remarkable potential for recovery of biological motion processing after cerebellar damage, paralleled by topographical reorganization of the underlying cerebro-cerebellar circuitry. The findings open a window for further research on cerebellar plasticity and cognitive processing.

B31

DIFFERENT TIME COURSE OF VISUOCORTICAL SIGNAL CHANGES TO FEAR-CONDITIONED FACES WITH DIRECT OR AVERTED GAZE: A SSVEP STUDY WITH SINGLE-TRIAL ANALYSIS Matthias J Wieser[1], Vladimir Miskovic[2,3], Sophie Rausch[1,2], Andreas Keil[2]; [1]University of Würzburg, Germany, [2]University of Florida, Gainesville, FL, [3]State University of New York at Binghamton, Binghamton, NY — Social organisms fundamentally rely on experience to successfully navigate in a social world by associating social stimuli with aversive versus safe qualities. Cognitive neuroscience research has shown that visual cues reliably paired with danger are processed more efficiently than neutral cues, and that such facilitated sensory processing extends to low levels of the visual system. The present study aimed at determining the extent to which visual cortical engagement elicited by a face stimulus with learned affective value is modulated by relatively subtle facial features such as gaze direction and emotional expression. To this end, electro-cortical processing of direct-gaze compared to averted-gaze faces serving as CS+ cues was investigated in a differential fear conditioning paradigm. Furthermore it was investigated whether gaze shift interacted with angry facial expressions to confer greater immunity to extinction of learned associations. Behavioral ratings and visually evoked steady-state potentials (ssVEP) were recorded in healthy human participants. As expected, direct-gaze CS+ compared to averted-gaze CS- cues elicited larger ssVEP amplitudes during conditioning, whereas this differentiation was not observed when averted-gaze faces were paired with the aversive US. Importantly, a more fine-grained analysis examining trial-by-trial changes in visual cortical activation across the learning phases revealed that this effect was not necessarily due to a lack of learning per se, but mainly due to a delayed build-up of cortical amplification for the averted-gaze CS+ cues. This suggests that the temporal dynamics of cortical engagement with aversively conditioned faces vary as a function of the cue.

B32

PHASE LOCKING DURING PERSPECTIVE TAKING PREDICTS ENHANCED ENCODING OF COUNTER-STEREOTYPICAL INFORMATION AND PREDICTION ACCURACY FOR OUT-GROUP MEMBERS Kelly A. Jordan[1], Adam Magerman[1], Chad E. Forbes[1]; [1]University of Delaware — Whether we're calculating where to eat or what we should say during social interactions, we rely on past experiences, knowledge and situational cues to predict what responses will engender successful navigation through social environments. Despite the fundamental importance of prediction accuracy, people are inept when predicting other's behaviors; particularly, predicting out-group behaviors, which can be biased by inaccurate, stereotypic information. To the extent that accurate knowledge for out-group members can increase prediction accuracy, facilitating encoding of counter-stereotypic information may be a means of increasing prediction accuracy. Past research suggests that perspective taking can be effective in promoting encoding of counter-stereotypic information. Present research examined this, investigating whether perspective taking enhanced encoding of counter-stereotypical information for out-group members and subsequent ability to accurately predict out-group behaviors. White participants self-identified as Democrats or Republicans, viewed photos of political and ethnic in-group or out-group members. Photos were accompanied by information containing stereotypic or counter-stereotypic political viewpoints, which participants viewed objectively or from the perspective of the out-group member. Participants completed memory and prediction tasks, continuous EEG activity was recorded throughout. Time frequency analysis revealed interactions during the perspective taking condition unique to viewing Latino Republicans. Theta burst at Posterior Cingulate Cortex (PCC) predicted PCC-Medial Prefrontal Cortex (MPFC) phase-locking (PL) and PCC-Temporal-Parietal Junction (TPJ) PL. PCC, MPFC and TPJ power and PL were associated with greater accuracy for counter-stereotypical predictions only. These results are suggestive of communications occurring between the PCC, MPFC and TPJ early in the processing stream which is affecting prediction accuracy.

B33

STIMULATING INFERIOR FRONTAL CORTEX IMPROVES THE CONTROL OF IMITATION Jeremy Hogeveen[1], Sukhvinder Obhi[1], Michael Banissy[2], Idalmis Santiesteban[3], Clare Press[3], Caroline Catmur[4], Geoffrey Bird[5,6]; [1]Wilfrid Laurier University, Waterloo, Ontario, Canada, [2]Goldsmiths, University of London, United Kingdom, [3]Birkbeck College, University of London, United Kingdom, [4]University of Surrey, Guildford, UK., [5]Social, Genetic and Developmental Psychiatry Centre (MRC), Institute of Psychiatry, King's College London, UK., [6]Institute of Cognitive Neuroscience, University College London, UK. — There is a ubiquitous tendency for humans to unintentionally imitate one another, but we are also quite adept at exerting control over this "automatic" behavioural tendency. For example, during social interactions mimicry improves rapport between interaction partners and, correspondingly, people tend to increase imitation in this context. Conversely, in the imitation inhibition (II) paradigm, participants perform a choice response task whilst observing an action that is either similar or dissimilar to their response, and are required to inhibit imitation to perform the task correctly. These behavioural effects might be implemented, in part, by excitatory and inhibitory activity in the human mirror system - observed actions activate a matching motor representation, which either hits threshold and causes us to imitate (social mimicry), or is actively inhibited before it hits threshold to prevent imitation (II). To demonstrate involvement of the mirror system in

controlling imitation, we enhanced cortical excitability at the frontal node of the mirror system - inferior frontal cortex (IFC) - using anodal transcranial direct current stimulation (atDCS) prior to engaging participants in three tasks: i) a social interaction, ii) an II task, and iii) a well matched inhibitory control task. Relative to sham tDCS, atDCS to IFC increased social mimicry during the interaction, reduced interference during the II task, but did not affect the inhibitory control task. These results suggest a dynamic involvement of the mirror system in the control of imitation, with IFC involved in both imitation, and imitation-inhibition, depending on task demands.

B34

EVENT-RELATED POTENTIALS TO THE CATEGORIZATION OF GENDER AT THE BASIC AND SUBORDINATE LEVEL

William L. D. Krenzer[1], Callan Lujan[1], Kristina Pfeifer[1], Avi Ben-Zeev[1], Mark W. Geisler[1]; [1]San Francisco State University — Tanaka et al. (1999) showed that when categorizing an object, such as a beagle (subordinate level), there was an increase in the N1 amplitude, compared to when the same object was categorized as an animal (basic level). Ito and Urland (2005) showed a difference in the P300 amplitude when individuals viewed faces of different races. By adapting Tanaka's, Ito, and Urland's studies to look at gender, we were interested to see if amplitude and latency differences occurred in the N170 and the P300, when participants studied celebrity faces categorized by gender (basic level), or by name (subordinate level). Participants took part in a gender (male or female) by categorization level (basic or subordinate) image oddball paradigm task. Within each block, one gender was the target stimuli (presented 20% of the time) and the other was the distractor (presented 80% of the time). While participants responded to the stimuli, Event-Related Potentials (ERP's) were recorded from electrodes placed along the midline of the scalp at sites Fz, Cz, and Pz, and at the temporal lobe sites T5 and T6. Eye artifacts were recorded from electrodes placed below, and to the side of the left eye. Based on preliminary data, with a sample size of 19 (11 female), we observed an increase in the P300 amplitude and a delayed P300 latency to female celebrity faces at the subordinate level versus the basic level. This could indicate that processing women's names versus processing their gender requires more effort (see Kok, 1997).

B35

WHY CLARITY OF THE LOOKING-GLASS SELF DEPENDS ON POPULARITY: NEURAL MECHANISMS LINKING SOCIAL NETWORK POSITION TO ACCURACY OF REFLECTED SELF-APPRAISALS

Noam Zerubavel[1], Jochen Weber[1], Niall Bolger[1], Peter Bearman[1], Kevin Ochsner[1]; [1]Columbia University — It is entirely human to contemplate how others perceive us, but what factors explain individual differences in the accuracy of these reflected self-appraisals? We hypothesized that popular members of real-world social networks would more accurately understand how their peers perceived them, and that this relationship would be mediated by the efficiency of neural mechanisms underlying reflected self-appraisals. To test these predictions, we recruited two student organizations, each comprised of 13 well-acquainted group members (N=26). Utilizing a round-robin design, we obtained participants' predictions about how each of their group members would rate them on a series of traits and those group members' actual ratings. By correlating predicted and actual trait ratings, we computed each group member's reflected self-appraisal accuracy. We also utilized social network analysis to measure individuals' popularity. Confirming our first hypothesis, popularity was positively correlated with accuracy of reflected self-appraisals. We then used functional magnetic resonance imaging to scan these same participants (N=21) while they made reflected (other-about-you) and direct (you-about-you) self-appraisals. The other-about-you > you-about-you contrast identified brain regions uniquely recruited for reflected self-appraisals: middle temporal gyrus, precuneus, and temporo-parietal junction. Mediation analyses revealed that decreased middle temporal gyrus activation during reflected self-appraisals fully mediated the link between popularity and reflected self-appraisal accuracy, suggesting that popular individuals' enhanced accuracy results from greater efficiency of neural mechanisms underlying reflected self-appraisals. More broadly, we provide a theoretical framework and experimental methodology for integrating functional neuroimaging with social network analysis to understand individual differences in neurocognitive processes and their interpersonal consequences.

B36

THE ROLE OF THE VENTRAL ANTERIOR TEMPORAL LOBES IN PERSON PERCEPTION

Jessica Collins[1], Ingrid Olson[1]; [1]Temple University — Studies of nonhuman primates have reported the existence of face sensitive patches in the ventral anterior temporal lobes (vATLs). Using optimized imaging parameters recent fMRI studies in humans have identified a functionally homologous brain region, however the functional significance of this region in the greater face processing system remains unknown. Lesion evidence suggests that this region should be sensitive to certain perceptual features as well as conceptual knowledge related to person identity. The goal of this study was to investigate the following questions: (1) Are face sensitive neurons in the vATL sensitive to conceptual knowledge? And (2) Does the sensitivity profile of the vATL face patches differ from the occipital face area (OFA) and fusiform face area (FFA)? Participants learned to associate social conceptual information (names and occupations) with a set of previously unfamiliar faces over a two-day training regimen. These faces were then presented to participants during an fMRI session using a continuous carry over design. An independent functional localizer was used to identify each subject's OFA, FFA, and vATL face patches. Multivoxel pattern analyses (MVPA) revealed sensitivity in the vATL face patches to facial identity, and conceptual knowledge (occupation labels) that differed from the more posterior face-processing network, suggesting that this brain area may serve a key role in bridging face-memory and face-perception.

B37

LOOK ME IN THE EYE: AN IN-DEPTH INVESTIGATION OF FIXATION PATTERNS TO EMOTIONAL FACES IN PATIENTS WITH PREFRONTAL DAMAGE

Avinash Vaidya[1], Lesley Fellows[1]; [1]Montreal Neurological Institute, Dept. of Neurology & Neurosurgery, McGill University — Routine social interaction demands that we recognize the subtle emotional changes in people around us. Several neuropsychiatric disorders, characterized by deficits in emotion recognition and social cognition, are associated with unusual gaze patterns toward faces, suggesting that these patients fail to direct gaze to emotionally informative facial features. In particular, fixation of the eyes appears to be critical for the detection of fear, and instruction to fixate this region can improve performance. Anecdotal reports since the time of Phineas Gage have suggested that the frontal lobes play a role in mediating normal social interaction. Damage to orbitofrontal cortex (OFC) in particular impairs recognition of a wide range of emotions, particularly when expressions are subtle. This work suggests that OFC may play a role in guiding attention to emotionally diagnostic features. To test this hypothesis, we asked patients with OFC damage, patients with prefrontal damage sparing OFC, and healthy age-matched control subjects to judge emotional expressions while their eye movements were tracked. Subjects judged expressions when freely examining faces, when asked to look only at the eyes or mouth, and when viewing faces through a gaze-contingent spotlight. Preliminary analysis shows that patients with OFC damage, but not other frontal-damaged patients, are impaired in maintaining fixation to the eyes. OFC may play a role in maintaining eye contact, in turn facilitating social interaction.

B38

EFFECT OF A SINGLE MINIMAL DOSE OF AN ATYPICAL ANTIPSYCHOTIC (RISPERIDONE) ON THE LATE POSITIVE COMPONENT EVOKED BY NAMES OF SOCIAL ROLES IN HIGH SCHIZOTYPY SUBJECTS.

Fernanda Pérez Gay Juárez[1], Ola Mohamed Ali[2], Aisha Walker[3], Ana Lucia Fernandez Cruz[1], Bruno Debruille[1,2,4]; [1]McGill University, Neuroscience Department, [2]McGill University, Psychiatry Department, [3]McGill University, Psychology Department, [4]McGill University, Neurology and Neurosurgery Department. — Schizotypy is a cluster of personality traits that includes abnormal social functioning. Healthy individuals with high schizotypal traits share some predispositions and neurocognitive deficits with schizophrenia patients. This has led researchers to suggest the existence of a continuum between normality and schizophrenia, via schizotypy. The most widely used medications for schizophrenia are antipsychotics. The aim of the present study is to investigate their effect on social cognition, given the social withdrawal seen along the schizotypy continuum. To achieve this goal, we analyzed the effects of 1 mg of risperidone on Event Related Potentials (ERPs). We did this on healthy subjects rather than on schizophrenia

patients to ensure that effects seen are directly due to the medication, rather than secondary to symptom alleviation. We recorded the scalp electrical activity elicited by names of social roles in a group of 50 participants that scored high in the Raine's Schizotypal Personality Questionnaire (SPQ). These recordings were made before and after the neural effects of a pill containing either 1 mg of risperidone (25 subjects) or placebo (26 subjects). Participants were asked to decide whether or not they could consider themselves playing each presented social role at any moment in their lives. We found a before and after pill intake difference in the amplitudes of theLate Positive Component (LPC). These amplitudes were much larger in the medication group than in the placebo group. These differences were maximal at pre-frontal electrode sites and could thus provide an insight into the mechanism of action of antipsychotics.

EXECUTIVE PROCESSES: Development & aging

B39

A PHYSICALLY ACTIVE LIFESTYLE ENHANCES EXECUTIVE FUNCTIONING IN ELDERS

Kristy A. Nielson[1,2], Christina M. Figueroa[1], Kathleen E. Hazlett[1]; [1]Marquette University, [2]Medical College of Wisconsin — Physical activity (PA) is associated with maintenance of brain volume and cognitive functioning across the lifespan. Executive functioning has been suggested to particularly benefit from PA. The purpose of this study was to examine various metrics of executive functioning in healthy elders as a function of their self-reported PA. Forty-four cognitively intact older adults (age 54 to 92, mean = 68.2) were given the Stanford Brief Activity Scale to assess PA, the Mini-Mental State Exam (MMSE), the Synonym Knowledge Test (SKT), and three indices of executive functioning: the Trail-making Tests (TMT), the Wisconsin Card Sorting Test (WCST), the Parametric Go/No-go/Stop test (PGNGS; inhibitory control). Participants were separated into low (8 male, 14 female) and moderate-to-high PA groups (5 male, 17 female). Age, education, MMSE and SKT did not differ by PA. MANOVA neared significance for the TMT (p = .08), with Trails-A trending and Trails-B significantly faster in High PA participants. MANOVA was significant by PA for the WCST (p = .047), with Trials to First Category and Failure to Maintain Set significantly better in High PA; Categories Completed, Errors and Non-perseverative Errors trended toward significance. MANOVA was also significantly different by PA for the PGNGS (p = .009); all inhibitory indices were better in High PA, with Stop-signal inhibition reaching significance. Age, sex, education and Alzheimer's disease family history covariates did not change the results. Thus, even in a small sample, greater levels of regular physical activity result in better executive functioning across the older adult age spectrum.

B40

DISRUPTED FUNCTIONAL ACTIVATION DURING COGNITIVE DUAL-TASK PERFORMANCE IS ASSOCIATED WITH IMPAIRED MOBILITY: AN FMRI STUDY

Lindsay Nagamatsu[1], Chun Liang Hsu[1], Michelle Voss[2], Alison Chan[1], Todd Handy[1], Peter Graf[1], B. Lynn Beattie[1], Teresa Liu-Ambrose[1]; [1]University of British Columbia, [2]University of Iowa — Older adults with a history of falls have previously been shown to have impaired behavioural performance on dual-task paradigms, attributed to reduced cognitive functions and fewer available resources. However, it is currently unknown which brain regions may subserve the relationship between impaired dual-task performance and falls risk in older adults. Therefore, the primary aim of our study was to examine differences in functional brain activation between fallers and non-fallers during dual-task performance, and to ascertain whether such differences correspond to behavioural performance. We conducted a cross-sectional study of men and women aged 70-80 years with a history of multiple falls compared with those without such a history (n = 28 per group). Participants completed an event-related cognitive dual-task paradigm during functional magnetic resonance imaging (fMRI). Comparing functional activation during dual-task performance relative to single task performance (i.e., only responding to one set of stimuli), we found that visuomotor and attentional networks in the brain exhibited reduced hemodynamic response in fallers compared with non-fallers. In conjunction, fallers also had poorer dual-task behavioural performance during the task, with slower reaction times, whereas no significant difference between groups was observed during single-task performance. Lastly, task accuracy during dual-task performance was significantly associated with activation in sensori-motor brain regions. Our results suggest that falls risk is associated with altered neurocognitive responses during dual-tasking, which in turn, may contribute to reduced behavioural performance. Furthermore, our research has the potential to elucidate the role that the brain may play in the relationship between cognition and mobility.

B41

COGNITIVE CONTROL OVER PREVIOUSLY REWARDED STIMULI IN ADOLESCENCE IS ASSOCIATED WITH THICKNESS IN THE MEDIAL PREFRONTAL CORTEX

Margaret Sheridan[1], Alexandra Clarck[2], Katie McLaughlin[3]; [1]Boston Children's Hospital/Harvard Medical School, [2]University of California San Diego, [3]University of Washington — Adolescence is a period of the lifespan when challenges to behavioral regulation can have critical short and long-term repercussions. During adolescence, burgeoning independence and exposure to situations with tangible risk present a particular psychological challenge (Gruber, Sagar, Dahlgren, Racine, & Lukas, 2011; Nigg et al., 2004), whereby momentary motivation toward rewards comes into conflict with long-term goals that require inhibitory control processes. Thirty-one adolescents age 13-19 years (14 male) participated in a modified Go/NoGo task and structural MRI scanning. Adolescents first participated in a monetary incentive delay task where they came to associate one stimulus with a reward and another equally common stimulus with a neutral outcome. Following this task, adolescents participated in a go/no go task where they pressed to some stimuli but withheld a button press to the previously rewarded and the previously neutral stimuli. Adolescents made more false alarms to previously rewarded stimuli. Previously rewarded NoGo compared to the neutral NoGo ($t(30) = 2.43$, $p=.02$). Next we examined the association between thickness in the right inferior frontal gyrus (rIFG) and medial prefrontal cortex (mPFC) with the previously rewarded NoGo performance. Thickness was assessed using FreeSurfer (FS), an automatic cortical segmentation program. Thickness of the mPFC, but not rIFG was marginally associated with the effect of reward on NoGo false alarms ($Î²=.25$, $p=.06$). These data suggest that age related changes in mPFC structure support the development of a novel form of inhibitory control, control over previously rewarding stimuli. This ability may be particularly relevant for adolescent development.

B42

AGE-RELATED DIFFERENCE IN THE QUALITY OF LEARNING ACHIEVED WITH PARIETAL BRAIN STIMULATION

Marinella Cappelletti[1], Helen Pickat[1], Emily Upstill[1], Maarten Speekenbrink[2], Vincent Walsh[1]; [1]Institute of Cognitive Neuroscience, University College London, UK, [2]Department pf Psychology and Language Sciences, University College London, UK — Cognitive interventions aiming at improving cognitive skills have often proven successful in young and recently also in ageing participants. However, what exactly underlies the observed improvements is currently unknown: learning may reflect an enhancement of the conceptual understanding related to a cognitive task or instead of strategies that allow performing the task successfully. Here we combined cognitive training and brain stimulation (transcranial Random Noise Stimulation, tRNS) in 60 participants in order to measure: (i) whether improvements in a cognitive task concerned concept-based or strategy-based skills; (ii) whether learning was modulated by the type of cognitive training received (i.e. training only or training+tRNS to critical or control brain regions -parietal or motor); (ii) any age-related difference in amount or type of learning. We trained younger and older participants on a well-known (Halberda et al, 2008) and previously used paradigm (Cappelletti et al, 2013) measuring the ability to judge the more numerous of two sets, an established measure of a parietal lobe-based number skill, which allows distinguishing between concept-based and strategy based trials; additional tasks controlled for spurious effects of training. All participants benefited from training, irrespective of age and of stimulation group, although participants receiving training+parietal stimulation showed a significantly larger improvement not differing between younger and ageing participants. There was, however, a significant difference regarding the quality of learning: ageing participants improved more in strategy-based performance, and younger in

concept-based performance. These results suggest the importance of identifying the exact cognitive processes underlying learning to plan more effective training programs.

B43

MULTIPLE BRAIN MARKERS CONTRIBUTE TO AGE-RELATED VARIATION IN COGNITION AMONG COGNITIVELY NORMAL OLDER ADULTS Trey Hedden[1,2], Aaron Schultz[1], Anna Rieckmann[1], Elizabeth C. Mormino[1], Keith A. Johnson[1,2,3], Reisa A. Sperling[1,2,3], Randy L. Buckner[1,2,4]; [1]Massachusetts General Hospital, [2]Havard Medical School, [3]Brigham and Women's Hospital, [4]Harvard University — Evident changes in brain morphometry, function, and disease-related biomarkers accompany advanced aging, but the impact of these neural markers on cognition remains difficult to characterize. Most studies compare small numbers of brain markers or exhibit relatively small effect sizes (Hedden et al., 2013; Salthouse, 2011). We examined shared and selective contributions of multiple brain markers to age-related variation in cognition. 144 cognitively normal older adults aged 65-90 from the Harvard Aging Brain Study were characterized on MRI markers of gray matter thickness and volume, white matter lesions (WML), fractional anisotropy (FA), resting-state functional connectivity, task-related activity, and PET markers of glucose metabolism and amyloid burden. Episodic memory, executive function, and processing speed were separately assessed. Brain markers were primarily global in nature and were selected a priori. Hierarchical regression analyses examined the age-related variance in cognition shared with each brain marker individually and unique to each marker when controlling for all other markers. The largest individual and unique relationships to all cognitive factors involved FA and WML, with an additional contribution of hippocampal volume to episodic memory. Approximately 60% of the age-related variance in cognition could be accounted for by combining all brain markers (but only ~20% of total variance); most of this age-related variance was shared among two or more brain markers. These results suggest that the majority of age-related variation in cognition is shared among multiple brain markers, but potential specificity of associations between brain markers and cognitive domains motivates additional study of age-related markers of neural health.

B44

FUNCTIONAL CONNECTIVITY IN MULTIPLE CORTICAL NETWORKS IS ASSOCIATED WITH COGNITION DURING AGING Emily E. Shaw[1], Aaron Schultz[1], Reisa A. Sperling[1,2,3], Randy L. Buckner[1,2,4], Trey Hedden[1,2]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Brigham and Women's Hospital, [4]Harvard University — Resting state functional connectivity MRI has become a widely-used tool for measuring the integrity of large-scale cortical networks. We examined multiple cortical networks using Template-Based Rotation (TBR), a method that applies a priori network and nuisance component templates defined from an independent dataset to test datasets of interest. We applied a priori templates to a test dataset of 66 younger (ages 18-34) and 237 older adults (ages 65-90) from the Harvard Aging Brain Study to examine the relationship between multiple large-scale cortical networks and cognition. Cognition was assessed with factor scores derived from a neuropsychological battery, representing processing speed, executive function, and episodic memory. Resting-state BOLD data were acquired in two six-minute acquisitions on a 3-Telsa scanner, screened for data quality metrics including motion, and processed using the TBR procedure to extract individual-level metrics of network integrity in multiple cortical networks. Age differences between younger and older adults were observed in the integrity of multiple cortical networks and in cognition. Within the older adults, integrity in multiple large-scale cortical networks was positively related to all cognitive domains. Controlling for the correlations between networks, only a positive relation between the fronto-parietal control network and executive function was significant, suggesting specificity in this relationship. These results extend prior work (e.g., Andrews-Hanna et al., 2007), demonstrating that functional connectivity metrics in multiple cortical networks are associated with individual variation in cognition, and further suggesting that TBR may be a useful tool for measuring relationships between reduced network integrity and cognition during aging.

B45

AGE DIFFERENCES IN PREFRONTAL CONTRIBUTIONS TO SELECTIVE ENCODING OF VALUABLE TO-BE-REMEMBERED WORDS Michael S. Cohen[1], Jesse Rissman[1], Nanthia A. Suthana[1], Saskia Giebl[1], Alan D. Castel[1], Barbara J. Knowlton[1]; [1]UCLA — Young and older adults both need to be selective in what they remember, but this ability is particularly important for older adults, given the memory declines typical in healthy aging. Castel et al. (2002) showed that older adults are able to perform as well as or better than young adults on measures of selective encoding in a value-directed remembering task. We adapted this paradigm for fMRI, presenting participants with a series of lists containing words assigned either high or low point values, and examined how value affects BOLD signal at encoding. Free recall tests after each list, with feedback on point total, encouraged strategic encoding. Previously, we found that encoding of valuable items in young adults is associated with increased activity in brain regions associated with semantic processing, including left ventrolateral prefrontal cortex (PFC). This difference in encoding-related activity as a function of value also correlated with individual differences in selectivity, suggesting that selectivity is mediated by increased engagement of semantic strategies during encoding of high-value words. Presently, we report a similar association between effects of value on left prefrontal BOLD signal and selectivity in older adults. However, in older adults, activations are shifted towards dorsal and anterior regions of PFC, consistent with Rajah and D Esposito (2005). We do not find evidence associating increased bilaterality with successful selective encoding (cf., Cabeza, 2002). Older adults thus appear to engage somewhat different patterns of activity within left PFC to differentially encode valuable items.

EXECUTIVE PROCESSES: Monitoring & inhibitory control

B46

THE EFFECT OF INDUCING TIME PRESSURE ON RESPONSE INHIBITION IN EARLY CHILDHOOD: AN ERP STUDY Aishah Abdul Rahman[1], Sandra A. Wiebe[1], Daniel J. Carroll[2], Kimberly Andrews Espy[3]; [1]University of Alberta, [2]University of Sheffield, [3]University of Oregon — Response inhibition predicts important behavioral outcomes in childhood and develops rapidly in early childhood. In this study, we examined the neural correlates of response inhibition when time pressure was induced in a go/no-go (GNG) task; previous work has shown that decreasing the response time window increases response prepotency and thereby inhibitory demands. To investigate how this manipulation affects young children, 5-year-old children (n = 34) completed a GNG task while we recorded scalp EEG; children were divided into two groups that differed in the response time window (Fast group = 750 msec; Slow group = 1500 msec). Dependent measures included accuracy, response times (RT), and event related potentials (ERP) measures (N2 and P3 amplitude and latency). Children in the Fast group responded more quickly, suggesting that the time pressure manipulation was effective. Research in older children and adults typically finds that N2 amplitude and latency differ between go and no-go trials. In contrast, present findings in early childhood revealed P3 amplitude and latency to be the distinguishing markers between go/no-go trials, where on no-go trials P3 amplitude was higher in both groups and latency was earlier in the Fast group. Our results are in line with suggestions that neural markers of inhibition have not yet fully migrated to frontal regions in early childhood, and suggest that when children must respond quickly under time pressure, they must engage inhibitory mechanisms more quickly in order to successfully suppress prepotent responses.

B47

AWARENESS OF OBSERVATION AFFECTS RESTING STATE BRAIN ACTIVITY Jeanne Li[1], Benjamin Turner[1], Evan Risko[2], Alan Kingstone[3], Michael Miller[1]; [1]University of California, Santa Barbara, [2]Arizona State University, [3]University of British Columbia — It is well established that awareness of observation (AO) can have behavioral (e.g., Zajonc, 1965) and physiological (e.g., Risko & Kingstone, 2011) effects on participants. In the present study, we sought to investigate this effect in fMRI, where the only observation is of resting state brain activity. Using a series of simple instructional manipu-

lations - first, describing true functional scans as functional or anatomical with minimal extra detail, and then with more detail and a cover story purporting the use of "mind-reading technology" - we were able to demonstrate widespread changes in both brain activity and connectivity due to AO. In addition to illustrating how fundamental the observation effect is, this research has implications for the broader cognitive neuroscience field. For researchers interested in studying resting state, it highlights the importance of being precise in instructions: our results show that even mild instructional variation can alter brain activity. However, our results have a more far-reaching message: because most participants in fMRI experiments understand that their brains are being observed, this AO activity may be tacitly present in most or all fMRI studies. Moreover, capacity for AO is a previously-unrecognized axis along which experimental conditions or tasks and participants or populations can vary. Researchers should therefore exercise caution in attributing differences between conditions or participants to other explanatory variables without first accounting for this potential confound. This research was supported by the Institute for Collaborative Biotechnologies under grant W911NF-09-D-0001.

B48

INTEGRATING RECOMMENDATIONS DURING PERCEPTUAL JUDGMENTS: THE ROLE OF CUE UTILITY.

Jihyun Cha[1], Sanghoon Han[2], Ian G. Dobbins[1]; [1]Washington University in St. Louis, [2]Yonsei University — External recommendations can alter or reinforce initial judgments. We examined integration of recommendations as a function of utility. Observers rendered initial perceptual judgments followed by recommendations. For the informative group, the recommendations generally disagreed with initial errors ("disagree" prompt) and for the uninformative group, recommendations generally supported initial errors ("agree" prompt). All initially correct responses garnered agreement for both groups. Subjects were then allowed to revise or confirm initial judgments followed by feedback. Recommendation utility was reversed for the groups in the final, sixth session. Behaviorally, the informative group corrected initial errors more often than the uninformative group, with this pattern reversing in the final session. fMRI revealed a group by recommendation (agree versus disagree) interaction implicating prefrontal and lateral parietal areas including posterior cingulate, angular/middle temporal gyrus, and superior/lateral premotor prefrontal regions. In the majority of regions, this resulted because the informative group showed similar activation for agreement and disagreement trials whereas the uninformative group showed a differential response (disagreement > agreement). This pattern fully reversed in the final session during which the utility of the recommendations unexpectedly reversed. We suggest these responses carry information about the relative utility of confirmations and disconfirmations from external agents during decision making.

B49

AN EVALUATION OF COGNITIVE WORKLOAD DURING VISUAL STORAGE TASKS USING AN AUDITORY ODDBALL PARADIGM

Kathleen Van Benthem[1], Sarah Cebulski[1], Jocelyn Keillor[2], Chris Herdman[1]; [1]Carleton University, [2]National Research Council — Spectral and event-related components can serve as workload indices during visual storage tasks. The current study identified components related to workload and classified them according to our unique workload conditions. The current study used 128-channel dense array electroencephalography and independent component analysis to systematically identify the components, or neurological signatures, associated with low and high workload situations. Participants were 20 English speaking, right-handed students with normal or corrected-to-normal visual acuity who received course credit for participating. We manipulated cognitive workload during a delayed match-to-sample task while simultaneously presenting an auditory oddball paradigm. As expected, behavioral data demonstrated significant effects of workload, with reduced accuracy and increased reaction time for visual storage tasks in the high workload condition ($p < .05$). The auditory oddball paradigm produced mismatch negativity effects with preliminary analyses revealing an increased negativity for deviant tones across the entire time window in frontal and occipital regions ($p<0.01$). Preliminary wavelet analyses revealed both alpha and theta band response to tone and workload in frontal and parietal regions. Specifically, in frontal regions theta power reductions were less pronounced during deviant tone processing as compared to standard tone processing in the low workload condition. Our findings have applications for brain-computer interfaces and can extend to occupations where high cognitive workload is known to impact worker safety. Ongoing work will explore machine learning as a methodology for accurately classifying workload condition in real-time.

B50

HIGHLY FLUENT BALANCED BILINGUALISM DOES NOT ENHANCE EXECUTIVE PROCESSING

Oliver Sawi[1,2], Jack Darrow[1], Hunter Johnson[1], Kenneth Paap[1]; [1]San Francisco State University, [2]University of Connecticut — Paap and Greenberg (2013) concluded that there is no coherent evidence for bilingual advantages in executive processing compared to monolinguals. More optimistic researchers believe that the advantages may be constrained to certain types of bilinguals. Following the tradition of Green's influential inhibitory control model, bilingual researchers have frequently focused on the need to manage the competition between the two languages. One perspective on the role of balance between L1 and L2 is that the level of competition is greatest when one language is dominant and must be suppressed during the comprehension and production of the less dominant L2. From an opposing perspective the greatest competition occurs for highly fluent and balanced bilinguals because the non-target language is always automatically activated and generates strong competition. The present study used a composite database of 168 bilinguals and 216 monolinguals who participated in two or more of the following tasks: Simon, flanker, color-shape switching, and antisaccade. Regression analyses do not support either possibility. A second strategy for testing the competition hypothesis is to see if executive processing is enhanced by having three competing languages (trilinguals) compared to only one (monolinguals) or two (bilinguals). There was no consistent evidence supporting the hypotheses that either bilingualism or trilingualism enhances inhibitory control, monitoring, or switching compared to a monolingual control group.

B51

METHADONE MAINTENANCE TREATMENT OF HEROIN ADDICTS RESPONSE INHIBITION FUNCTION IMPAIRMENT: EVIDENCE FROM ERPS

Ling Yang[1], Qiongying Xu[1], Shifeng Li[2], Xin Zhao[1], Li Ma[1], Youfen Zheng[1], Juanjuan Zhang[1], Yi Li[1], Yueyue Cai[1]; [1]School of Psychology, Northwest Normal University, Lanzhou, China., [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China. — Abstract: Response inhibition has been a core issue in addictive behavior. There are many previous studies that have found that the ability of response inhibition of drug dependences have been damaged, however, the ability of response inhibition of methadone maintenance treatment of heroin addicts whether abnormal is not clear. In order to investigate the response inhibition function of heroin addicts in methadone maintenance treatment, this study record the EEG of GO/NO GO task of 14 heroin addicts with methadone maintenance treatment and 18 normal people. The behavior results have revealed that the reactions of the GO stimuli of the methadone maintenance treatment of heroin addicts were greater than normal people. At the same time, the EEG results have found that compared with the normal people, the methadone maintenance treatment of heroin addicts elicited smaller N2 amplitude than the normal people. In addition, the methadone maintenance treatment of heroin addicts was associated with the longer P3 latency. Our result demonstrated that there is damage of the response inhibition of the methadone maintenance treatment of heroin addicts.

B52

PARAMETRIC MANIPULATIONS IN SIMON AND GO/NOGO TASKS: AN FMRI STUDY OF RESPONSE INHIBITION

Sobanawartiny Wijeakumar[1], Eliot Hazeltine[1], Aaron Buss[1], Vincent Magnotta[1], John Spencer[1]; [1]University of Iowa — Few studies have explored the shared and unique neural mechanisms underlying types of response inhibition. Here, we used functional magnetic resonance imaging to investigate these mechanisms in a Simon and Go/NoGo (GnG) task. There were two manipulations: a working memory load manipulation implemented by varying the number of stimuli (2, 4, or 6; half the stimuli were Go/Compatible trials) and a proportion manipulation implemented by varying the proportion of Go/Compatible trials with either 25% or 75%. There was an increase in reaction time (RT) as the load increased and a reduction in RTs as the proportion of Go/Compatible trials increased. Both tasks showed enhanced activation in the cerebellum, putamen, and thalamus on Go/Compatible trials, as well as

robust motor-preparatory activations in regions like the pre and postcentral gyri. Medial frontal activation was observed when Go trials were more frequent. Across No-Go trials, we found activation of the middle frontal gyrus for the proportion (25% - 75% No-Go trials) and load (loads 6 - 2) contrasts, demonstrating greater need for active inhibitory control on No-Go and incompatible trials. The Simon task yielded less robust neural activation overall relative to the GnG task. However, we did find unique activation of the superior parietal lobule and precuneus when comparing load 6 to 2 on incompatible trials when there would be a greater need to ignore spatial information. This is consistent with previous work that has implicated these areas in spatial selective attention and inhibitory control.

B53

DIFFUSION TENSOR IMAGING REVEALS STRUCTURAL DIFFERENCES RELATED TO ANTISACCADE PERFORMANCE IN PEOPLE WITH SCHIZOPHRENIA David J Schaeffer[1], Amanda L Rodrigue[1], Jordan E Pierce[1], Brett A Clementz[1], Jennifer E McDowell[1]; [1]University of Georgia — Schizophrenia is characterized by problems with cognitive control, as demonstrated with antisaccade tasks. When paired with neuroimaging, antisaccade tasks are useful for studying inhibitory failures mediated by prefrontal cortex (PFC) circuitry. Antisaccades require suppression of a reflexive glance toward a suddenly appearing cue and generation of a saccade to the mirror image location of that cue. An initial glance toward the cue constitutes an error. People with schizophrenia typically make more errors than healthy people, although antisaccade error rates are also variable across healthy groups, with some participants showing similar performance to people with schizophrenia. Whether the neural circuitry differs between people with schizophrenia and otherwise healthy individuals with low levels of cognitive control remains to be elucidated. Recent evidence suggests that deficits of cognitive control may be apparent at the level of white matter connections. Diffusion tensor imaging was used to evaluate white matter integrity (as indexed by fractional anisotropy (FA)) in 13 participants with schizophrenia and 13 healthy participants selected for low levels of cognitive control (determined by span task performance). Tract-based spatial statistics showed that the groups were generally similar across whole brain FA with the exception of greater FA in the healthy group in an extensive prefrontal cluster. Across both groups, prefrontal FA correlated with the percentage of correct antisaccades such that increased FA was associated with better performance. These results suggest that PFC white matter mediated deficits in cognitive control are more robust in people with schizophrenia when compared to their low cognitive control counterparts.

B54

ERROR-RELATED ACTIVITY DURING ANTISACCADES IS LINKED TO INCREASED COUPLING OF MIDDLE TEMPORAL GYRUS AND POSTERIOR CINGULATE Amanda Rodrigue[1], David Schaeffer[1], Jordan Pierce[1], Brett Clementz[1], Jennifer McDowell[1]; [1]University of Georgia — Cognitive control supports goal related behavior in the presence of distracting stimuli, although lapses do occur resulting in errors. The goal of this study was to identify regions that differentiate between correct and error responses and quantify their level of activity to further explore a potential mechanism behind error commission. A well-documented model of cognitive control that includes frequent errors (even in healthy people) is the antisaccade task. This task requires inhibition of a prepotent response to look towards a peripheral cue and a volitional saccade to the mirror location. Errors are defined as an initial glance toward the peripheral cue and are indicative of a failure to inhibit distracting stimuli to make task related responses. Participants completed an fMRI imaging session in which they performed the antisaccade task; subjects who made a sufficient number of correct and error responses were selected for further analysis. Consequently, voxel-wise analysis differentiated activity during correct and error antisaccades and relationships among distinguishing areas were evaluated by correlating BOLD signal activity within and across trial types. There was a significant change in relationship (increase in correlation) in the BOLD signal between two clusters (middle temporal gyrus and posterior cingulate) during error trials compared to correct trials. Closer coupling between these two regions may not only be indicative of error commission, but also a possible mechanism by which errors can occur.

EXECUTIVE PROCESSES: Working memory

B55

AN INVESTIGATION OF EFFECTIVE CONNECTIVITY IN TRAUMATIC BRAIN INJURY DURING A NOVEL WORKING MEMORY TASK. Glenn Wylie[1,2,3], Ekaterina Dobryakova[1,2], Adam Staffaroni[1], John DeLuca[1,2], Nancy Chiaravalloti[1,2]; [1]Kessler Foundation, [2]Rutgers University, [3]Department of Veteran's Affairs — Working memory (WM), one's ability to maintain and manipulate information on-line for a short period of time, has been studied with various paradigms. However, all of them engage several WM subprocesses such as capacity and manipulation. While a distributed network of brain regions are involved during these subprocesses, no single paradigm has been able to isolate the network responsible specifically for capacity and manipulation. A WM task that allows separation of these subprocesses is required. Previously, we identified areas involved solely in capacity and manipulation of information in healthy individuals with a novel WM task - CapMan. The objective of the current investigation was to identify differences in information flow during high capacity demands and high manipulation demands between healthy participants (n=15) and individuals with traumatic brain injury (n=15) who have cognitive deficits as a result of diffuse axonal damage. We examined effective connectivity using Independent Multiple-sample Greedy Equivalence Search method (Ramsey et al., 2010). Effective connectivity allows inference of causal relationships between brain regions engaged in a specific cognitive process. Raw time series were extracted from the regions previously identified to be engaged during high capacity and high manipulation demands of the CapMan task. While sharing some connections, the TBI participants' exhibited a greater number of connections between the regions engaged in capacity and manipulation processes. More connections in the TBIs might suggest that the information flow during high capacity and high manipulation demands is not as efficient as in healthy individuals.

B56

WORKING MEMORY CONTRIBUTIONS TO REINFORCEMENT LEARNING IMPAIRMENTS IN SCHIZOPHRENIA. Anne Collins[1], James Gold[2], James Waltz[2], Michael Frank[1]; [1]Brown University, Providence, [2]University of Maryland School of Medicine, Baltimore — Previous research has shown that patients with schizophrenia show impairment on reward- and punishment-driven learning tasks. However, the observed learning behavior originates from the interaction of multiple neural processes, such as incremental basal-ganglia and dopamine-dependent reinforcement learning (RL) systems, but also prefrontal-cortical-dependent working memory (WM). Thus, the degrees to which specific systems contribute to learning impairments in schizophrenia are unclear. We recently developed a task and computational model allowing us to separately assess the roles of (slow, cumulative learning) RL mechanisms vs. (fast, but capacity limited) WM mechanisms, in healthy adults. Here, we used this task with 48 patients and 37 healthy controls, in order to assess the specific sources of learning impairments. In 15 separate blocks, subjects learned to pick 1 of 3 actions for stimuli. The number of stimuli to learn in each block varied from 2 to 6, allowing us to separate influences of capacity limited WM from RL system. As expected, both patients and controls were able to learn in all blocks, but showed effects of set size and delay between identical stimulus repetition, confirming the presence of working memory effects. Patients performed significantly worse than controls. Fit of our working-memory reinforcement-learning model accounted better for the data than all other models. Model fits showed a significant difference between patients and controls for working-memory parameters (capacity and reliability), but not for reinforcement learning parameters (learning rate, softmax temperature). These results indicate that dysfunctional prefrontal working memory mechanisms make an inordinate contribution to learning impairment in schizophrenia.

B57

HOW ARE ATTENDED AND UNATTENDED ITEMS IN SHORT-TERM MEMORY REPRESENTED? AN FMRI/EEG/TMS STUDY

Nathan S Rose[1], Joshua J LaRocque[1], Adam C Riggall[1], Olivia Gosseries[1], Bradley R Postle[1]; [1]University of Wisconsin-Madison — Multivariate pattern analysis (MVPA) has failed to find evidence for an active neural trace of stimuli that are in short-term memory (STM) but outside focal attention. We examined the physiological bases of representing information in different attentional states with a two-step experimental procedure. In an initial fMRI session, we scanned participants performing single-item delayed-recognition for words, faces, or the direction of moving dots, and applied MVPA to identify category-selective regions for subsequent targeting with transcranial magnetic stimulation (TMS). In the subsequent TMS-EEG session, participants performed a two-item delayed recognition task in which they were cued to maintain one of the items in focal attention while still holding the other item in STM. By targeting a category-selective region with a single-pulse of TMS during the delay, we could probe the physiological state of the neural representation of information when it was in one of three states: in focal attention; in STM but not in focal attention; or not in STM. Preliminary data showed that the TMS-evoked response in channels over category-selective regions was larger when the item from the corresponding category was in focal attention than when it was unattended but in STM. Additionally, TMS differentially perturbed cross-channel coherence in the gamma band between the critical channel and its contralateral homolog as a function of an item's attended state. These results suggest a difference in local cortical excitability and connectivity for items in versus out of the focus of attention during their short-term retention.

B58

EFFECT OF THETA BURST STIMULATION ON VISUAL REPRESENTATION DURING A SHORT-TERM MEMORY TASK

Olivia Gosseries[1], Joshua, J. LaRocque[1], Adam, C. Riggall[1], Michael, J. Starrett[1], Bradley, R. Postle[1]; [1]University of Wisconsin — With fMRI of short-term memory (STM) for the direction of motion, elevated delay period activity is observed in frontal and parietal cortex, including the intraparietal sulcus (IPS). Multivariate pattern analysis (MVPA), however, fails to find evidence for stimulus representation in these regions. Stimulus identity is decodable from posterior visual regions, from V1 to MT+, despite the fact that they do not exhibit elevated delay-period activity. When memory load is increased, signal intensity in frontal and parietal regions increases monotonically, and MVPA decoding performance from posterior cortex declines monotonically, as do behavioral estimates of mnemonic precision. To further explore the functions of IPS and extrastriate cortex (EC), we transiently induced hypometabolism in these regions with transcranial magnetic stimulation (TMS) using a theta burst stimulation (TBS) protocol. Immediately thereafter, we scanned subjects while they performed the STM-for-motion task. Preliminary data confirmed that STM precision declined from load-1 to load-3, and revealed that TBS exacerbated this effect: TBS of IPS produced a modest decline in precision, and TBS of EC produced a markedly larger decline. General linear model analysis showed that, after TBS of IPS or EC, decreased delay-period activity was observed in that region compared to when it was not targeted by TBS. Thus, these data suggest a causal role for EC in the precision stimulus representation during visual STM.

B59

IN SHORT-TERM MEMORY BUT OUTSIDE OF THE FOCUS OF ATTENTION: A ROLE FOR LONG-TERM MEMORY?

Michael J. Starrett[1], Joshua J. LaRocque[1], Nathan S. Rose[1], Bradley R. Postle[1]; [1]University of Wisconsin-Madison — Many behavioral and neuroimaging studies have provided evidence for distinct states of short-term memory (STM) for information in vs. out of the focus of attention (FOA), as controlled, e.g., with retrocues instructing subjects which of two memory items is relevant for an upcoming probe. Intriguingly, multivariate pattern analyses (MVPA) of fMRI and EEG data from such studies have found no evidence for an active neural representation of the uncued memory item (Lewis-Peacock et al., 2012; LaRocque et al., 2013a; b). These results suggest that items retained in STM, but outside the FOA, might be encoded by a passive storage mechanism, such as that used by long-term memory (LTM). To evaluate whether LTM, specifically, may be recruited during tests of STM, subjects first performed a two-step, delayed-recognition task with retrocues (similar to LaRocque et al. (2013)), using pictures of common objects as stimuli. To control for any potential rehearsal benefit of the memory probes, we also included catch trials that ended after the first delay-period without any memory probe. To assess if uncued items were encoded via LTM mechanisms, a 2-alternative forced choice LTM recognition task was administered 1 week later. As expected, preliminary behavioral data (N=10) showed significantly greater LTM accuracy for items cued and probed twice over items never cued or probed ($p<.05$). However, LTM did not differ for cued and uncued items on catch trials ($p=.48$). The absence of any memory enhancement for uncued items suggests that STM items retained outside the FOA are not stored in LTM.

B60

THE PRECISION OF SHORT-TERM MEMORY ITEMS RETAINED INSIDE AND OUTSIDE THE FOCUS OF ATTENTION

Adam Eichenbaum[1], Joshua J. LaRocque[1], Stephen M. Emrich[2], Bradley R. Postle[1]; [1]University of Wisconsin-Madison, [2]Brock University — Several models of short-term memory (STM) posit distinct states corresponding to items retained in and out of the focus of attention; this distinction has been supported by behavioral and neural evidence (Oberauer, 2002; Lewis-Peacock et al., 2012; LaRocque et al., 2013). However, it is unclear how the retention of memory items outside the focus of attention might affect the fidelity of the memory. We sought to test the hypothesis that retaining memory items outside the focus of attention causes a loss of precision for those items. Participants performed a free recall memory task in which they were cued to direct their attention towards one of two motion directions held in STM. Of particular interest were trials in which participants held one item in the focus of attention for the entire trial before recalling it (an "attended memory item", or AMI) and trials in which an item that was initially uncued was subsequently cued and recalled (an "unattended memory item," or UMI). We fit participants' responses to a model that assumes a mixture of response types: target responses, non-target responses, and guesses (Bays et al., 2009). This model provided estimates of the precision of AMIs and UMIs. Recall of UMIs was significantly less precise than AMIs. These results support STM models that distinguish between attended and unattended memory items, and suggest that retaining information outside the focus of attention incurs a cost in precision upon retrieval.

B61

FRONTOPARIETAL TRANSCRANIAL DIRECT CURRENT STIMULATION MODULATES WORKING MEMORY TRAINING BENEFITS AND EVENT-RELATED SCALP TOPOGRAPHY

Dwight Peterson[1], Kevin Jones[1], Gabriella Dimotsantos[1], Marian Berryhill[1]; [1]University of Nevada, Reno — Working memory (WM) training aims to improve WM function. Recent findings show that pairing WM training with noninvasive transcranial direct current stimulation (tDCS) to frontoparietal sites provides significantly larger and longer lasting improvements than WM training alone. However, the mechanism of these improvements remains unclear. One possibility is that local activity is strengthened by anodal (+) tDCS. Alternatively, network-level activity may underlie improvements. We tested these possibilities by combining high-density EEG (HD-EEG) with tDCS and WM training in healthy young adults. Training took place over a 1-week period. HD-EEG recordings were recorded during the first and last sessions while participants performed a WM task. On days 1-4 participants received right frontoparietal tDCS (alternating F4/P4, or sham; 15 minutes 1.5 mA) paired with WM training. As expected, over the course of the weeklong experiment all participants showed improvement in the WM task, but the tDCS-linked WM training paradigm produced significantly greater behavioral improvements. Importantly, we observed dynamic neural changes evidenced in both event-related brain components and dense-array EEG topography. Specifically, the amplitudes of early event-related components (e.g., N1/P1) at the stimulated sites (P4, F4) were enhanced following training selectively for the participants who received anodal tDCS; those receiving sham tDCS showed no local ERP changes. Additionally, distributed changes in dense-array EEG scalp topography from pre-training to post-training were evident across the right hemisphere. These findings suggest that local and global cortical changes underlie tDCS-linked WM benefits.

B62

THE TIME-COURSE OF STRESS AND ITS EFFECTS ON RULE-BASED CATEGORY LEARNING Steve Hutchinson[1], Lauren Hawthorne[1], Lauren Szymula[1], Shannon K. McCoy[1], Shawn W. Ell[1,2]; [1]University of Maine, [2]Maine Graduate School of Biomedical Sciences & Engineering — Stressful situations trigger a cascade of physiological processes. Recent research suggests that the time varying nature of these processes has important implications for cognitive function, particularly processes dependent upon prefrontal cortical function. In the present study, we investigate this question in the context of rule-based categorization - a task that his highly dependent upon cognitive control processes mediated by prefrontal cortex. After completion of a social-evaluative stressor (i.e., a modified version of the Trier Social Stress Test), participants completed a rule-based categorization task at varying time delays relative to cessation of the stressor (no delay, short delay, long delay). Preliminary data indicate that participants were stressed in all three conditions (cardiovascularly) and that participants in the no delay and short delay conditions had worse performance on the rule-based task than participants in the long delay condition. These data are consistent with the animal literature in suggesting that cognitive control tasks performed relatively soon after commencement of a stressful event, are susceptible to stress-related impairment. The implications for understanding the stress-cognition relationship will be discussed.

B63

SHORT-TERM MEMORY REQUIRES STABLE MODULATION OF EEG ALPHA OSCILLATIONS Abigail Noyce[1], Lisa Payne[1], Robert Sekuler[1]; [1]Brandeis University — Alpha-band (8-14 Hz) oscillations during short-term memory retention are hypothesized to act as a sensory gating mechanism, protecting the contents of memory. The magnitude of these oscillations is observed to increase with memory set size. To understand the roles that subjects' effort and cognitive control play in this response to increasing task difficulty, we offered a bonus monetary payment on one block of a short-term recognition memory experiment while recording electroencephalogram (EEG). On each trial, subjects viewed six briefly-presented consonants, and, after a three-second retention interval, reported whether a probe letter was old or new. We measured the magnitude and instability of alpha-band oscillatory activity over parietal electrodes during a time window from one second post-stimulus to one second pre-probe. Magnitude and instability were operationalized as the mean power and variance of alpha-band activity in that window on each trial. Unstable retention-period alpha activity was negatively correlated with old/new discrimination scores in both the baseline and the bonus conditions. When offered a bonus, 65% of subjects improved their memory performance from a baseline block to the bonus experimental block. A composite score derived from both magnitude and variance of alpha power predicted the degree of bonus-induced improvement or impairment. Subject effort, as well as memory set size, can modulate alpha power during retention, and the stability of alpha-band activity is an important predictor of short-term memory performance.

B64

WORKING MEMORY ON VISUOMOTOR ADAPTATION AMONG ADULTS WITH MOTOR DIFFICULTIES Chi-Mei Lee[1], Jin Bo[1]; [1]Eastern Michigan University, Michigan, United States — Cognitive functions, such as spatial working memory (SWM), play important roles in visuomotor adaptation. Previous studies reveal that motor deficits in Developmental Coordination Disorder (DCD) are related to poor spatial working memory (SWM). The current study aimed to study the relationships between cognitive functioning and visuomotor adaptability in individuals with and without motor difficulties. Twenty-seven adults (aged from 18 to 34) were recruited with self-reported as having motor coordination problems. The Wechsler Adult Intelligence Scale (WAIS-IV) working memory index, the Wechsler Memory Scale (WMS-III) letter-number sequencing, and WMS-III spatial span were administrated to assess general working memory (WM), verbal WM, and spatial WM, respectively. All participants completed a center-out rotation task with the visual feedback of the hand movement rotated 30° counter-clockwise. The adaptability was measured by the after-effect on directional error (DE), which is the maximum directional deviation of the actual movement direction from the ideal movement direction. Results revealed that participants with lower motor ability showed less adaptability than those with normal motor ability. Individuals with better SWM displayed bigger after-effect on DE, suggesting better visuomotor adaptability. Interestingly, the verbal WM, general WM, and IQ were not correlated with the adaptability measure. It seems like SWM can serve as a protective factor to enhance motor learning in the visuomotor adaptation, even though poor motor ability compromised individuals' adaptability. Further exploration of the contributions of other cognitive processes on visuomotor adaptation and the influence of SWM on motor learning processes are needed to increase understanding of the complex relationships.

LANGUAGE: Other

B65

A CLINICAL MODEL OF LANGUAGE FOR PRESURGICAL LANGUAGE LOCALIZATION USING FMRI Christopher Benjamin[1,2], Kayleigh Hale[1,3], Patricia Walshaw[1], Monika Polczynska[1], Susan Bookheimer[1]; [1]Semel Institute, UCLA, [2]Computational Radiology Laboratory, Harvard Medical School, [3]Graduate School of Education and Psychology, Pepperdine University — Functional MRI (fMRI) has been successfully used to answer a range of research questions about the relationships between brain, cognition and behavior. Its clinical applications, however, remain largely limited to the presurgical mapping of language, particularly in planning epilepsy surgery. Here fMRI can remove two boundaries that contraindicate potentially curative surgery through determining hemispheric dominance for language or memory (lateralization), and localizing the actual extent of eloquent language cortex (localization). While our ability to lateralize language has advanced to the stage that it is arguably unethical to proceed to surgery without completing language fMRI, fMRI language maps should not yet be routinely used for planning resection boundaries (i.e., localization; Binder, 2011). We believe that central to this limitation is the widespread use of an outdated model of the language system focusing almost exclusively on Broca's and Wernicke's areas. We hypothesized that there is sufficient evidence to support involvement of a set of regions beyond these areas, namely the Basal Temporal Language Area; Exner's area; the Supramarginal and Angular gyri; and the "Supplementary Speech Area", in language function. We systematically queried the pubmed online database to review lesion, direct cortical stimulation and fMRI research on the involvement of these areas in language. Results indicate damage to these regions can impair language function and that these regions can be imaged using fMRI. These findings suggest a comprehensive clinical model of language and we detail how this can be used to achieve fMRI-based localization of language cortex in the clinic.

B66

AN ELECTROPHYSIOLOGICAL INVESTIGATION OF NATIVE AND SECOND-LANGUAGE SPEAKERS' PROCESSING OF SPELLING-SOUND REGULARITY AND CONSISTENCY IN ENGLISH Mona Roxana Botezatu[1,2], Carol A. Miller[3], Maya Misra[4]; [1]Department of Psychology, Drexel University, Philadelphia, PA, [2]Moss Rehabilitation Research Institute, Elkins Park, PA, [3]Department of Communication Sciences and Disorders, Pennsylvania State University, University Park, PA, [4]Previously at the Department of Communication Sciences and Disorders, Pennsylvania State University, University Park, PA — We examined the time course of processing spelling-sound regularity and consistency in English (a deep orthography) in non-native English speakers with differing first language (L1) orthographic depths (shallow: Spanish; deep: Chinese) and native controls. English monolinguals (N=21) and highly proficient, but L1-dominant, Spanish-English (N=22) and Chinese-English (N=18) bilinguals decided whether visually presented letter strings were English words, while behavioral and EEG measures were recorded. The spelling-sound regularity and consistency of stimuli were co-varied such that words had either regular/consistent (e.g., GATE) or irregular/inconsistent mappings (e.g., PINT). Irregular/inconsistent words generated smaller N400s than regular/consistent words in both monolinguals and bilinguals, but the effect began earlier and ended later (spanning from the P200 to the LPC) and was more robust in bilinguals. The size of the electrophysiological regularity/consistency effect was positively correlated with Woodcock Word Attack scores, a behavioral measure of English pseudoword reading, in Spanish-English bilinguals, but negatively correlated with Woodcock Word Identification and Word Attack scores, behavioral measures of English word and pseudoword reading, respectively, in Chinese-English bilinguals. Results indicate that bilinguals may

have used the transparency of their L1 orthography as a reference point for judging the transparency of their second language (L2-English) orthography. Bilinguals with low English proficiency used distinct reading strategies in the L2 than the L1, whereas bilinguals with high English proficiency transferred reading strategies from the L1 to the L2 as appropriate. Results are interpreted in light of the contrastive analysis hypothesis (Lado, 1957; Stockwell, Bowen, & Martin, 1965).

B67

HEMISPHERE DIFFERENCES: INFERENCES AND EMOTIONAL LANGUAGE Connie Shears[1], Adriana Ariza[1], Jay Kim[1], Erika Sam[1], Melissa Bond[1], Maisy Lam[1], Shaun Flax[2]; [1]Chapman University, [2]American University — The research on the lateralization of processing emotions or processing emotional language has been confounded by whether participants are experiencing the emotion or whether they are reading about a character's emotional state (Beeman et al, 2000 vs Engles, et al, 2007). The right-hemisphere has been linked to processing one's own emotions (Borod, 1992), while the left-hemisphere is dominant for most language processes except the formation of inferences (Beeman and Chiarello, 1998). We investigated hemisphere differences for emotional language that conveyed a character's emotional state and either supported a causal inference or did not (control). We hypothesized that if the right hemisphere is better adapted to processing inferences drawn from emotional language (regardless of the reader's own emotional state), then we expected to see a right-hemisphere advantage for forming inferences from positive or negative sentences, relative to neutral. We developed two-sentence stimulus pairs that related a fictional character's positive, neutral, or negative emotion. Using a divided visual field paradigm, we were able to measure inference processing in each hemisphere separately by the response times and accuracy of target word recognitions. The results show that readers made more causal inferences following positive and negative sentences when targets were presented to the right-hemisphere and no differences between hemispheres following neutral sentences. These results indicate that the right hemisphere is forming the causal inferences necessary to comprehend a fictional character's emotional state. Thus, the right-hemisphere has an advantage over the left hemisphere when processing emotional language.

B68

NEUROCHEMICAL BASIS OF READING ABILITY IN EMERGENT READERS Stephanie Del Tufo[1,2], Stephen J. Frost[1], Peter Molfese[1], Robert K. Fulbright[1,3], Doug L. Rothman[1,3], Graeme F. Mason[1,3], Jonathan L. Preston[1,6], Nicole Landi[1,2,4], W. Einar Mencl[1], Fumiko Hoeft[1,5], Elena L. Grigorenko[1,4], Kenneth R. Pugh[1,2]; [1]Haskins Laboratories, [2]University of Connecticut, [3]Yale University School of Medicine, [4]Yale University Child Studies Center, [5]University of California, San Francisco, [6]Southern Connecticut State University — The neural basis of reading suggests a network of areas that work in coordination to allow adults to read fluently (Pugh et al., 2013). Evidence from Bruno et al. (2013) and Pugh et al. (under review) found an inverse relationship between Choline (Cho) & Glutamate (Glu) and reading ability. Taking advantage of a novel neuroimaging technique, magnetic resonance spectroscopy (MRS), we examined the neurochemical basis of reading letters, words and pseudowords in emergent readers across a spectrum of ability, across three visits. At the letter, word and pseudoword levels, we find the predicted effects of stimuli difficulty, prime, and visit. A mixed effects model was used to determine individual neurotransmitter contributions to increased reaction time as well as percent accuracy. At the word and pseudoword levels we find that Choline is the best predictor of accuracy, and replicate previous work showing that high choline suggests lower accuracy in reading ability. Increased N-Acetylaspartylglutamic acid (NAA) was found to show a relationship with increased reaction time, while increased gamma-Aminobutyric acid (GABA) and Glu were found to show a relationship with decreased reaction time. Previous studies have suggested that NAA is an indicator of intact neuronal processes or axonal integrity (Moffett et al., 2007). While, decreases in GABA have been showed to reduce inhibition allowing for faster reaction times (Stagg, 2013). Taken together this suggests that the neurochemical basis of reading ability relies on a network of neurotransmitters, which work in coordination to facilitate reading ability at the single word and psuedoword level.

B69

EFFECTS OF AGE OF ACQUISITION ON NEURAL RECRUITMENT FOR NON-NATIVE CATEGORICAL PERCEPTION Victoria Wagner[1], Pilar M. Archila-Suerte[1], Jason Zevin[2], Arturo E. Hernandez[1]; [1]University of Houston, [2]Sackler Institute for Developmental Psychobiology, Weill Medical College of Cornell University — It is well established that there are differences between early and late bilinguals in perceived L2 speech. The current study further investigated the effects of age of acquisition on the neural recruitment associated with categorical perception in a second language. Early and late Spanish-English bilingual adults participated in a categorical perceptual judgment task while undergoing fMRI. Stimuli varied along two continuums with the vowels being modified along seven even points, either spectrally from "pin" to "pen" or in duration from "pen" to "pan". Stimuli were grouped in 6 categories based on monolinguals' responses with those that fell clearly within a category and those that were in between categories. Participants viewed two images that corresponded to the categories and then listened to a stimulus that was randomly selected from the 7 stimuli within the continuum. Participants had to select the picture that matched the auditory stimulus. The results showed that for the ambiguous stimuli only in the pin-pen continuum, late bilinguals had greater activation in the inferior frontal gyrus; corresponding to Brodmann areas 44/45 and a second region of activation in IFG pars orbitalis corresponding to BA 47. The pin-pen continuum is not common to Spanish dialects spoken. Therefore, the late bilinguals may need to recruit knowledge from speech motor commands to make judgments about ambiguous stimuli compared to early bilinguals. These results suggest that late bilinguals rely to a greater extent on the motor systems expanding on current theories of speech processing (Galantucci, 2006).

B70

ARE BILINGUALS BETTER THAN MONOLINGUALS AT FOREIGN LANGUAGE LEARNING? AN EVENT-RELATED POTENTIAL STUDY Sarah Grey[1,2], Cristina Sanz[2], Kara Morgan-Short[3], Michael T. Ullman[2]; [1]The Pennsylvania State University, [2]Georgetown University, [3]University of Illinois-Chicago — This study investigated the neurocognitive underpinnings of hypothesized bilingual advantages at adult additional language learning. Our study addressed limitations and provided a more detailed perspective on potential advantages by measuring behavioral and neural outcomes (using event-related potentials, or ERPs), at different points in the learning trajectory, and for different linguistic targets (word order and gender agreement). Highly proficient Mandarin-English early bilingual adults and matched English monolinguals were trained and tested on learning an artificial language (Brocanto2). Participants were trained under an Uninstructed condition, which did not provide explicit grammar information, but consisted of numerous meaningful examples, and was designed to mimic naturalistic, immersion-like foreign language exposure. Both language groups (bilinguals and monolinguals) engaged in the same comprehension and production practice, and ERP data were gathered after low and high levels of experience with the language. Results showed somewhat different patterns for behavioral and neural measures. Behaviorally, the two language groups did not differ at low experience, whereas at high experience the monolinguals outperformed the bilinguals, both at practice and at grammaticality judgment for both word order and agreement. The ERP data suggested that the monolinguals showed more native-like ERP components than bilinguals for word order processing, whereas the bilinguals showed more native-like effects for agreement. The data suggest that bilinguals may not always show previously-claimed behavioral advantages, and that their neural patterns are meaningfully different from monolinguals'. The results will be discussed as they relate to bilingualism and the neurocognition of late-learned language.

B71

CROSSED SUBCORTICAL APHASIA: A CASE STUDY Venugopal Balasubramanian[1], Maha Aldera[1], Maureen Costello[1]; [1]Seton Hall University — Studies in subcortical aphasias have pointed out the lack of fine grained analysis of impairments of language and emphasized the need for a theoretical/model oriented description of subcortical aphasias (Cappa & Wallesch, 1994; Crosson, 1985). Hence, a longitudinal case study was undertaken to describe the patterns of language impairment in SE, a 69 year-old female who had a sudden onset of aphasia and left hemiplegia. In acute phase: A

C.T scan done at three days post onset reveled hemorrhage in the putamen. S.E was globally aphasic. At six weeks post onset S.E's language and speech were characterized to be severe auditory comprehension deficits for following simple commands, profound apraxia of speech, neologistic speech, nonfunctional verbal expression and limb apraxia. At three months post onset the patient's symptom complex included severely impaired auditory comprehension of conversational speech, Broca's aphasia, apraxia of speech and semantic phonemic paraphasias. At two years post onset the following test instruments were used: Boston Diagnostic Aphasia Examination, Apraxia Battery for Adults, Boston Naming Test and Token Test. Test results confirmed the observations made at three months post onset. At six years post onset, S.E's linguistic performance was analyzed using the following tasks: phonological analysis of spontaneous speech and naming responses, grammaticality judgment, writing to dictation and discourse production. As predicted by Crosson's model (1985), at six years post-onset, S.E's linguistic performance was characterized by reduced ability to make grammaticality decisions, sentence comprehension deficits,decreased use of story schemas, agrammatic speech and writing.

B72

HIERARCHICAL ORGANIZATION OF THE HUMAN AUDITORY CORTEX: EVIDENCE OF A GRADIENT FOR PHONOLOGICAL GRAIN SIZE SENSITIVITY

Christine Brennan[1], James Booth[1]; [1]Northwestern University — There is evidence showing that processing of temporal and spectral features in the auditory cortex is hierarchical (Zatorre & Berlin, 2001), but there is no direct evidence that the processing of phonemes in speech is hierarchical. There is some indirect evidence suggesting that a gradient of selectively based on phonological grain size sensitivity may exist within the belt and/or parabelt regions (DeWitt and Rauschecker, 2012); however, selectivity of the superior temporal cortex to systematically varying grain sizes has not been directly tested. Using functional magnetic resonance imaging (fMRI) in adults, the current study examines the auditory cortex under different phonological grain size conditions to determine if there is a gradient from smaller (i.e., single phones) to larger (i.e. quadraphones) units within the superior temporal cortex. We found extensive activation throughout the left superior temporal gyrus for small phonological grain size compared to large phonological grain size. However, we found significant differences for large greater than small grain size only in anterior superior temporal gyrus. These findings are consistent with the prediction that there is a gradient of sensitivity to phonological grain size within the auditory cortex. Our results delineate the hierarchical organization of the superior temporal cortex and have implications for understanding developmental disorders such as language impairment and reading disability in which, it has been argued, deficits in speech processing are central.

LANGUAGE: Semantic

B73

FUNCTIONAL LINKS OF NEURAL CORRELATES OF WORD MEANING: BEHAVIORAL AND NEUROPHYSIOLOGICAL EVIDENCE

Sungbong Kim[1], Peter Gordon[1], Lucy Owen[1], Hillary Levinson[1], Michael Small[1], Mary Llenell Banzuela Paz[1]; [1]Teachers College, Columbia University — Harnad (1990) claimed that some words are grounded in neural networks by means of direct sensorimotor interaction with the environment while other words are grounded through symbol grounding transfer, a process by which new concepts borrow sensorimotor groundings from previously grounded symbols. The current study examined whether sensorimotor groundings of words transfer to new words that were acquired by means of the symbolic manipulation "A=B". Adult English speakers were trained to learn 30 new L2 words. The L2 words were matched to three categories of L1 (English) verbs (i.e., 10 foot-related, 10 hand-related, and 10 non-action verbs). Subjects were asked to press either a hand button with a finger or a foot pedal (at different blocks) as soon as they read either L2 words or L1 words on the monitor. In the L2 condition, subjects had shorter response times (RTs) for button pressing in response to the hand-related words and, shorter RTs for foot pedal pressing in response to the foot-related new words. The preliminary analysis on ERP waveforms (recorded by EGI 128channel EEG systems) showed that the late positivity (P3) for L2 words at Cz and neighboring electrodes was larger than non-words, but started and reached their peaks about 100ms later than L1 words, which corresponds to the slower RTs to L2 words than L1. Together these results suggest the words learned without direct sensorimotor experiences still interact with body movement though we need further analysis with EEG source localization to see neural correlates of different categories of verbs.

B74

RESTRICTING SPONTANEOUS GESTURE USE WHEN TALKING ABOUT SPATIAL EVENTS

Tilbe Goksun[1], Lorna Quandt[1], Samuel Cason[2], Anjan Chatterjee[1]; [1]University of Pennsylvania, [2]University of Delaware — People often use spontaneous gestures when communicating spatial information such as describing spatial motion in events. A spatial event like "climbing up a tree," involves the manner (verb; climbing) and the path (preposition; up) of the motion. Previous findings suggest that manner and path production can be impaired separately. Patients having left superior temporal gyrus (STG) damage might use gestures to compensate for difficulties with spatial language. In a case series, we tested the role of gesture as a compensatory mechanism. Elderly controls (n=20) and patients with left hemisphere damage (n=7) were shown motion events (e.g., the woman hops across the street), depicted in brief video clips. Participants described the actions in two conditions: 1) no mention of gesture by the experimenter (spontaneous gestures); and 2) by sitting on their hands (gesture prohibition). We coded the use of path/manner information in Condition 1 (speech or gesture) and Condition 2 (speech only). Results indicated that controls produced more prepositions in Condition 2 compared to Condition 1 ($p<.05$). Although patients with damage to the left inferior frontal gyrus (IFG) and left STG produced significantly fewer prepositions in Condition 1 compared to controls, prohibiting gesture in Condition 2 led to a significant decrease in preposition use (case statistics, Crawford & Gartwaite, 2007). The patients also used significantly more gestures referring to path in Condition 1, compared to controls. For both groups, inhibiting gesture use did not affect information about manner. We conclude that patients' spontaneous gestures helps compensate for problems with preposition production.

B75

N400 PROCESSES INHIBIT DISCONFIRMED HIGH CLOZE PROBABILITY SENTENCE ENDINGS: FINDING A BEHAVIORAL EFFECT OF THE INHIBITION

J. Bruno Debruille[1], Jun Jun Wu[1], Ola Mohamed Ali[1]; [1]McGill University — The N400 event-related brain potential (ERP) could the inhibition of representations that have been inappropriately activated. Accordingly, the large N400s evoked by low cloze probability sentence endings would be generated in part by processes that inhibit the high cloze probability endings disconfirmed by the low-cloze words. The high cloze endings would then be harder to activate by the sentence frame. Accordingly, they would be less likely to be produced by subjects who are presented with that sentence frame for a second time. To test this prediction, 140 sentences with low cloze probability endings were presented to 27 participants in a first block of trials. In a second block, participants were shown the sentence frames again but without any endings. There, their task was to verbalize aloud the first word that came to mind, which was noted by the experimenter. In accordance with the inhibition idea, the high cloze probability endings were produced on average only 34% of the times whereas, according to their high cloze probability alone, they should have been produced 62% of the times. Also consistent with the N400 inhibition idea, N400s elicited by low cloze probability endings in the 1st block were smaller when the high cloze probability endings were produced by subjects. They were larger when they were not produced but when it was a new ending that was verbalized, which happened in 43% of the trials. Finally, N400s were small when the presented ending was verbalized, which could be due to a Dm effect.

B76

USING FUNCTIONAL TRANSCRANIAL DOPPLER SONOGRAPHY (FTCD) TO INVESTIGATE HEMISPHERIC LATERALISATION OF BRITISH SIGN LANGUAGE (BSL) PRODUCTION

Eva Gutierrez[1], Heather Payne[1], Mairead MacSweeney[1]; [1]University College London — fTCD is a simple and non-invasive technique which can be used to measure changes in blood flow velocity to the left and right cerebral hemispheres and can therefore be used to infer lateralisation of function. Due to concerns about artefacts induced by jaw movements during overt speech production,

most previous studies of language have required covert production, where words are subvocally produced. In Experiment 1 we directly contrasted covert and overt speech production in hearing right-handed adults during a phonological fluency task. We also tested semantic fluency to assess consistency of hemispheric dominance across different language tasks. The laterality index (LI) was left lateralized in all conditions and there was no difference in strength of LI between overt and covert speech. This supports the validity of using overt language production in fTCD studies, another benefit of which is a reliable measure of number of items generated. In Experiment 2 we adapted the paradigm to test phonological and semantic fluency during both overt and covert BSL production in right-handed deaf native signers. Phonological fluency was tested using a handshape cue. All LIs were left lateralized and there was no difference in strength of LI between overt and covert sign production. A contrast of Experiments 1 and 2 showed that LIs were higher during sign than speech production. The relationship between semantic and phonological fluency also differed between languages. These results may reflect stronger links between form and meaning during signed than spoken language lexical access.

B77

INHIBITION PLAYS A ROLE WHEN READERS PREDICT IN A FIRST OR SECOND LANGUAGE

Megan Zirnstein[1], Janet G. van Hell[1,2], Judith F. Kroll[1]; [1]Pennsylvania State University, [2]Radboud University — Readers use contextual information to generate expectations about the meaning of upcoming words. Individuals benefit when upcoming words are better supported by context and therefore more easily anticipated (Federmeier, 2007; Van Berkum, 2008), suggesting that the ability to predict upcoming words may reduce processing load and free up cognitive resources for more demanding tasks. Reducing cognitive load may be especially helpful for individuals who are reading in a second language (L2). Past neurocognitive research demonstrates that reading in the L2 imposes greater cognitive demands than reading in the L1 (e.g., Hasegawa et al., 2002), suggesting there may be particular benefits when prediction is successful in L2 reading. Recent studies also suggest that the experience bilinguals have in negotiating cross-language competition creates benefits in inhibitory control (Bialystok et al., 2004; Gold et al., 2013). We investigated the extent to which the bilingual experience and inhibitory control may influence prediction during reading. Bilingual and monolingual participants read sentences while their EEG was recorded. ERPs were time-locked to target words that varied in their predictability (expected vs. unexpected), which were presented in sentences that varied in terms of semantic constraint (high vs. low). Both bilinguals and monolinguals showed significant N400 modulation for target words presented in highly constraining sentence contexts, as well as frontal positive responses to unexpected targets in highly constraining sentences. Importantly, this latter effect interacted with inhibitory control ability, suggesting that the ability to inhibit previously formed predictions is necessary when reading in a first or second language.

B78

HAND PREFERENCE, HAND PERFORMANCE, AND CREATIVITY

Adam Felton[1], Christine Chiarello[1]; [1]University of California, Riverside — There is a growing literature documenting a vast array of cognitive differences between consistent and mixed (not left and right) handers (Prichard, Propper, & Christman, 2013). The purpose of this study was to investigate the extent to which hand preference and hand performance related to convergent creativity. Hand preference was assessed with a modified Edinburgh Handedness Inventory (EHI). Hand preference scores were calculated for the EHI tasks in addition to scores for the Bryden subtasks of the EHI, providing two handedness scores for each participant. Hand preference was transformed into a dichotomous variable (consistent/mixed) by converting scores into absolute values and then using a pre-determined cut-off to determine group membership. Hand performance was assessed using a pegboard task (Annett, 2002). A timed, vocal-response version of the remote associates test (RAT) was used to measure convergent creativity. It was predicted that hand preference, not performance, would be related to creativity and that mixed handed participants would perform better than consistent handed participants. Contrary to the prediction, it was observed that handedness groups did not differ on creativity and, unexpectedly, hand performance was significantly related to creativity. These findings conflict with data previously reported (Felton, Holtgraves, Vazquez, 2013) demonstrating an advantage for mixed handers over consistent handers on creativity. In light of these results and previous studies, the relationship between hand preference, hand performance, and creativity is unclear.

B79

WHAT'S RIGHT ABOUT THE RIGHT HEMISPHERE HYPOTHESIS FOR METAPHOR?

Marguerite McQuire[1], Eileen Cardillo, Geena Ianni, Anjan Chatterjee; [1]University of Pennsylvania — Despite the traditional association of right hemisphere injury with metaphor comprehension deficits, neuroimaging studies indicate inconsistent or weak right hemisphere involvement. We designed a novel comprehension task to test the necessity of right and left hemisphere contributions to metaphor comprehension. Stimuli consisted of low familiarity metaphors of three different types: predicate metaphors based on action verbs (The debate spun into a brawl), nominal metaphors based on event nouns (The divorce was a hard fall), and nominal metaphors based on entity nouns (The coffee was a caffeine bullet). For each metaphor (n = 60), a closely matched literal sentence with the same base term was also generated. Sentences were presented visually, followed by four adjective-noun answer choices (target + three foil types). Participants were instructed to select the phrase that best matched the meaning of the sentence. Healthy older adults (N=12) indicated comparable accuracy across conditions. Contrary to the right hemisphere hypothesis for metaphor comprehension, our preliminary data indicate that both patients with left hemisphere damage (N=16) and right hemisphere damage (N=15) found metaphors more difficult than literal sentences, a difference that was larger for the left not right hemisphere patients, particularly in the nominal conditions. Error analysis indicated the nature of comprehension failure differed between groups only for literal not metaphoric sentences; both groups showed a literal bias when reading metaphors. These data do not support a privileged role of the right hemisphere in metaphor processing. We conclude metaphor comprehension is a bilaterally mediated process.

LANGUAGE: Syntax

B80

EXPLORING THE CROSS-LINGUISTIC NATURE OF SIMPLE AND COMPLEX WORDS AND EXPRESSIONS IN HUMAN LANGUAGE THROUGH EVENT-RELATED POTENTIALS

Miwako Hisagi[1,3], Michael Yoshitaka Erlewine[1], Sachiko Kato[2], Hadas Kotek[1], Ayaka Sugawara[1], Daichi Yasunaga[2,4], Dimitrios Pantazis[1], Masatoshi Koizumi[2], Shigeru Miyagawa[1]; [1]MIT, [2]Tohoku University, [3]Iona College, [4]Kanazawa University — This study uses Event-Related Potentials (ERP) to explore the relationship between simple and complex words and expressions in human language, with data drawn from both American English (AE) and Japanese (JP). We seek to distinguish between two leading approaches to morphological blocking effects in current linguistic literature theory - one based on the construction of complex morphology in syntax and one assuming competition of forms stored in the lexicon. We created four types of causative sentences. Two are judged by native speakers as grammatical: (a) inanimate subject + V and (b) animate subject + make V; and two are judged as deviant: (c) inanimate subject + make V and (d) animate subject + V. Electroencephalogram (EEG) was recorded for AE and JP, and magnetoencephalography (MEG) was also recorded for AE. The two approaches to blocking make different predictions about the ERP reactions expected from subjects exposed to conditions (c) and (d). We observed an N400 from all conditions, as expected. We also observed a small P600, 600ms-800ms after the presentation of the verbs for condition type (c), although less clearly in AE. Additionally, condition (d) unexpectedly did not elicit a larger N400 than the other three conditions in AE. Our results show that the nature of the anomalies in types (c) and (d) is different: type (c) involves a violation of a derivational rule, while type (d) is semantically incongruent. These findings support the view that derivational morphology is computed in syntax, and is unpredicted by lexical approaches to blocking effects.

B81

SENTENCE PROCESSING DIGGING DEEP: THETA-BAND AND ALPHA-BAND OSCILLATIONS DURING STRUCTURED-MEMORY RETRIEVAL

Lars Meyer[1], Maren Grigutsch[1], Noura Schmuck[2], Phoebe Gaston[3], Angela D. Friederici[1]; [1]Max Planck Institute for Human Cognitive and

Brain Sciences, Leipzig, Germany, [2]University of Mainz, Mainz, Germany, [3]New York University — Storage and retrieval are working-memory processes ubiquitous in sentence processing. While storage of argument noun phrases has been found to increase left parietal oscillatory synchronization in the alpha band, the oscillatory brain dynamics of retrieval during sentence processing are still poorly understood. The current work studied retrieval during sentence processing by employing pronoun-noun dependencies: Pronouns trigger retrieval of their antecedent nouns, that is, the lexical-semantic item the pronoun is referring to. Retrieval performance depends on the antecedent's nestedness inside the sentence structure, predicting harder retrieval from subordinate as compared to main clauses. To understand better the neural underpinnings of this increased retrieval demand, we assessed the oscillatory brain dynamics in the electroencephalogram during non-nested-antecedent and nested-antecedent retrieval at sentence-final pronouns. Comprehension performance was lower for nested-antecedent as compared to non-nested-antecedent sentences. Time-frequency analyses during antecedent-noun retrieval at sentence-final pronouns revealed that nested-antecedent pronouns, relative to non-nested-antecedent pronouns, elicit left fronto-central theta-band synchronization, followed by bilateral anterior alpha-band desynchronization. While the theta power increase was negatively correlated with the performance decrease, the alpha power decrease was positively correlated with the performance decrease. Our findings may reflect staged mechanisms during pronoun processing: Initial theta synchronization may reflect sentence-structure-sensitive retrieval from working-memory, consistent with the proposed role of left-hemispheric theta synchronization outside of the sentence-processing domain. The observed bilateral frontal alpha desynchronization may reflect subsequent lexical-semantic access to the antecedent noun's long-term-memory representation, consistent with previous proposals on a role of distributed alpha desynchronization in long-term-memory access.

B82

A "SYNTACTIC PERTURBATION" PARADIGM DURING SENTENCE PRODUCTION REVEALS SENTENCE PROCESSING NETWORKS IN THE BRAIN

William Matchin[1], Gregory Hickok[1]; [1]University of California, Irvine — An elusive goal of neurolinguistics is the search for neural networks underlying syntax and sentence processing. The present study investigated networks underlying sentence production using a target perturbation technique. Perturbation techniques have been used previously to investigate speech production, involving auditory feedback perturbation and measuring the neural response to perturbation and compensation. Here, we adopted a similar approach at the sentence level involving perturbation of the planned syntactic structure. Subjects were cued pictorially to produce simple sentences (active or passive), including a proportion of trials in which the subject's target syntactic structure shifted mid-utterance (e.g., active to passive). Our control condition consisted of identical cues where the subject's task was to produce lists of words. The design produced three key contrasts: (i) active vs. passive (complexity), (ii) switch vs. non-switch (perturbation), and (iii) sentences vs. word lists (structure). The complexity effect revealed activity in the right precentral gyrus. The sentence perturbation effect activated the right IFG, right anterior insula, right orbitofrontal cortex, the left inferior frontal gyrus, the left inferior parietal lobe, and the right caudate nucleus. A similar network of regions and the right-hemisphere preference were observed in a previous study of pitch perturbation and compensation (Tourville et al., 2008). The effect of structure revealed activity in the left postcentral gyrus and bilateral caudate nucleus. We posit that sentence production can be integrated into models of hierarchical control and brain networks underlying sentence processing can be revealed using a perturbation paradigm.

B83

CAN UNIVERSITY SECOND LANGUAGE LEARNERS ATTAIN NATIVE-LIKE BRAIN PROCESSING OF MORPHO-SYNTAX?

Harriet Wood Bowden[1], Cristina Sanz[2], Karsten Steinhauer[3], Michael T. Ullman[2]; [1]University of Tennessee-Knoxville, [2]Georgetown University, [3]McGill University — Can adult second language (L2) learners attain native-like brain processing of grammar with sufficient exposure/proficiency, and does this vary with different aspects of grammar? We examined the neurocognitive processing of L2 Spanish morpho-syntax, specifically gender and number agreement. We tested native (L1) speakers (n=15) and two groups of university-level L2 learners: low experience/proficiency learners (n=16), who were enrolled in 2nd-4th semester college Spanish, and high experience/proficiency learners (n=14), who had about 7 semesters of college Spanish plus 1-2 semesters of immersion. Proficiency was measured with the Simulated Oral Proficiency Interview, the Elicited Imitation task, and self-ratings. Neurocognitive processing of (visually-presented) Spanish sentences was tested with event-related potentials (ERPs) in a balanced violation paradigm. Preliminary results indicate that (1) L1 speakers displayed a LAN+P600 for both gender and number, (2) L2 Low speakers displayed a P600 to number violations only, and (3) L2 Advanced speakers displayed a P600 (but no LAN) to both gender and number violations. These results contrast with those of a recently-published study (Bowden, Steinhauer, Sanz & Ullman, 2013), in which the same high experience/proficiency learners showed native-like (LAN+P600) neurocognitive processing of syntactic word-order. Taken together, the results suggest that adult L2 learners are more likely to attain fully native-like brain processing for syntactic word-order than morpho-syntactic agreement, and that within morpho-syntax, native-like processing can be achieved earlier for number than gender. The results suggest that native-like processing of grammar can be achieved, even in university learners, but that it varies according to different aspects of grammar.

B84

ERP RESPONSES TO SUBJECT AGREEMENT VIOLATIONS IN AFRICAN AMERICAN ENGLISH: EVIDENCE FOR DIGLOSSIC REPRESENTATION

Felicidad Garcia[1], Trey Avery[1], Khamis-Dakwar Reem[2], Froud Karen[1]; [1]Teachers College, Columbia University, [2]Adelphi University — Diglossia refers to a specific sociolinguistic situation where two language varieties co-exist in complementary functional distribution (such as the spoken and Standard varieties of Arabic that are used in different communicative settings). Although this phenomenon is under-studied, the application of neuroscientific methods shows great promise for elucidating the nature of underlying linguistic representations in diglossia (e.g., Khamis-Dakwar & Froud, 2007). We suggest that the status of African American English (AAE) is consistent with the defining characteristics of diglossia (Ferguson, 1959), and therefore grammatical violations of Standard American English (SAE) that are acceptable to AAE speakers will not be automatically detected by bidialectal speakers. To evaluate this hypothesis, we compared event-related potential (ERP) responses to syntactic differences in SAE and AAE. Adult monodialectal SAE speakers (n = 7) and bidialectal SAE/AAE (n = 6) listened to 30 sentences in two conditions presenting the inclusion or omission of a third-person singular agreement on a present tense verb (e.g., The black cat *lap/laps the milk). Participants also performed grammaticality judgments for each sentence (omitted s-markers in this context are an acceptable variation in AAE). Monodialectal SAE speakers showed expected LAN and P600 responses to agreement marker omission, but these responses were absent in SAE/AAE bidialectal speakers. However, grammaticality judgment responses and reaction times were consistent across participant groups. These findings indicate that AAE might be neurologically represented like a diglossic language variety, and underscore the need for new approaches to understanding of language processing in bidialectal populations.

B85

NEURAL CORRELATES OF MERGING NUMBER WORDS IN CHINESE AND FRENCH SPEAKERS

Yi-hui Hung[1,2], Denise H. Wu[2,3], Marco Lai[2,3], Ovid J.-L. Tzeng[1,2,4], Daisy L. Hung[1,2,3], Stanislas Dehaene[5,6,7,8], Christophe Pallier[5,6,7,8]; [1]Institute of Neuroscience, National Yang-Ming University, Taiwan,, [2]Laboratories for Cognitive Neuroscience, National Yang-Ming University, Taiwan,, [3]Institute of Cognitive Neuroscience, National Central University, Taiwan, [4]The Institute of Linguistics, Academia Sinica, Taiwan, [5]INSERM, U992, Cognitive Neuroimaging Unit, F-91191 Gif/Yvette, France, [6]CEA, DSV/I2BM, NeuroSpin Center, F-91191 Gif/Yvette, France, [7]Univ Paris-Sud, Cognitive Neuroimaging Unit, F-91191 Gif/Yvette, France, [8]Collège de France, F-75005 Paris, France — Large numerical quantities are typically expressed by chaining multiple number words. Even when they rely on base ten, the principles for building up large number words vary across languages (e.g., Chinese is more transparent than French). Here, we focused on the merging operation for combining successive number words (e.g., "twenty two" vs. "two twenty", the latter does not combine). We wondered to what extent this

merging operation engages the brain networks involved in number processing (e.g. parietal regions) and in lexical composition and phrase structure building (i.e. superior temporal sulcus and inferior frontal regions). Because we also wondered whether cross-linguistic differences could exist in this respect, we tested both Chinese and French speakers in their own languages. Their task was to name number words presented in rapid serial visual presentation. Measures of naming times showed that number words were produced more quickly when they could merge with the preceding ones. Functional magnetic resonance data showed, in both groups, that mergeability provoked increased activations in the left inferior frontal gyrus (pars opercularis / pars triangularis and pars orbitalis) and in the left inferior parietal sulcus. The comparison between the two groups revealed increased activation in the right prefrontal regions for Chinese but not for French. Future research will need to address whether this is specific to number word processing or a general syntactic processing difference between Chinese and French speakers. Finally, these results reveal that, in contrast to lexical composition, merging number words does not involve superior temporal sulcus.

B86

EFFECTS OF AGE OF ACQUISITION (AOA) AND PROFICIENCY ON PROCESSING OF SYNTAX IN 6- TO 8-YEAR OLD MONOLINGUAL AND BILINGUAL CHILDREN: AN ERP STUDY Annika Andersson[1], Lisa D Sanders[2], Christina Karns[3], Helen J Neville[3]; [1]Lund University, [2]University of Massachusetts, [3]University of Oregon — Even though language proficiency in children is strongly related to success in almost all domains, neurocognitive studies of L2 processing are typically limited to adults with several years of exposure, who may use general cognitive mechanisms to compensate for any difficulties in L2 processing. For example, whereas previous studies of adult bilinguals have reported differences in the anterior negativity elicited by syntactic violations with delays in exposure to English of less than 3 years (Weber-Fox & Neville, 1996) a precursor to the anterior negativity has been reported in monolingual children as young as 2.5 years of age (Oberecker, et al., 2005). In the current ERP study, processing of English phrase structure was explored in 6- to 8-year old monolingual and bilingual children who acquired English as a second language around 4 years of age. Monolingual children of higher proficiency displayed relatively mature processing of phrase structure violations as indicated by a left anterior negativity over lateral sites and a posterior positivity. High-proficiency bilingual children tended to display a medial anterior negativity and a posterior positivity. The difference in distribution of the anterior effect across groups could only be explained by AoA. However, lower proficiency affected the posterior ERP effect and amplitude of the anterior effects in response to syntactic violations. These results suggest that the more automatic syntactic processing in children is affected by AoA while more controlled, metalinguistic processing may be related to language proficiency.

LONG-TERM MEMORY: Development & aging

B87

TEACHING OLD BRAINS NEW FACTS: INCIDENTAL LEARNING OF NOVEL CONCEPTS IN OLDER ADULTS AND ALZHEIMER'S DISEASE Eve Attali[1], Asaf Gilboa[1,2]; [1]Rotman Research Institute at Baycrest, [2]University of Toronto — Fast Mapping (FM) is a process supporting incidental vocabulary acquisition in children as they infer the meaning of novel words based on contextual cues. Preliminary findings that amnesics with Medial-Temporal Lobe lesions are able to acquire novel associations through FM, suggest FM supports direct neocortical declarative learning. Pathological and normal age-related decline in declarative memory is correlated with hippocampal dysfunction but also with neocortical atrophy. We tested older adults' ability to learn through FM and the impact of dementia on such learning. Eighteen patients with mild Alzheimer's Disease and 26 controls performed a FM task and a standard explicit encoding task (EE). During FM, subjects saw a sentence containing the target label along with 2 pictures. They had to infer the association between novel labels and novel items. Associative recognition was tested at 10 minutes and 1 week. Aging was associated with poor FM performance. However, AD performed as well as NC on FM despite significant EE impairment. There was variable 1-week retention of associations learned through FM, but complete loss following EE. EE scores were correlated with Hippocampal volumes and with clinical episodic memory tests. By contrast, FM scores were correlated with posterior lateral neocortical regions and with semantic tasks. In conclusion, AD patients were able to learn new associations through FM despite impaired episodic memory. FM is less sensitive to hippocampal atrophy and more sensitive to neocortical degeneration. Learning through FM depends on the lateral neocortex probably due to its role in representing semantic associative networks.

B88

AMYLOID DEPOSITION IS LINKED TO ABERRANT ENTORHINAL ACTIVITY AMONG COGNITIVELY NORMAL OLDER ADULTS Willem Huijbers[1,2,3], Elizabeth Mormino[2,3], Sarah Wigman[1,2,3], Andrew Ward[1,2,3], Patrizia Vannini[1,2,3], Donald McLaren[2,3], Alex Becker[2,4], Aaron Schultz[2,3], Trey Hedden[2,4], Keith Johnson[2,4], Reisa Sperling[1,2,3]; [1]Center for Alzheimer Research and Treatment, Department of Neurology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, [2]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, [3]Department of Neurology, Massachusetts General Hospital, Harvard Medical School, Boston, MA., [4]Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston MA. — Normal aging is often difficult to distinguish from the earliest stages of Alzheimer's disease (AD). Years before clinical memory deficits manifest, amyloid-Î² deposits in the cortex in many older individuals. Neuroimaging studies indicate that neocortical regions of default-network are especially vulnerable to amyloid-Î² deposition. Yet, the impact of amyloid-Î² on age-related changes within the medial temporal lobe (MTL) memory system is less clear. Here we demonstrate that cognitively normal older adults, compared to young adults, demonstrate reduced ability to modulate hippocampal activations and entorhinal deactivations during an episodic memory task. Among the older adults, amyloid-Î² deposition was associated with failure to modulate activity in entorhinal cortex, but not hippocampus. Furthermore, we show that entorhinal regions demonstrating amyloid-Î² related dysfunction are directly connected to the neocortical regions of the default-network. Together these findings link neocortical amyloid-Î² deposition to neuronal dysfunction specifically in entorhinal cortex, while aging is associated with more widespread effects across the MTL.

B89

AGE DIFFERENCES IN THE ASSOCIATION OF PHYSICAL ACTIVITY, SOCIOCOGNITIVE ENGAGEMENT, AND TV VIEWING ON FACE MEMORY. Jennifer J. Heisz[1], Susan Vandermorris[2], Johnny Wu[3], Anthony R. McIntosh[3], Jennifer D. Ryan[3]; [1]Department of Kinesiology, McMaster University, [2]Baycrest Health Sciences, [3]Rotman Research Institute — Physical and sociocognitive lifestyle activities promote aspects of cognitive function in older adults. Very little is known about the relation between these lifestyle activities and cognitive function in young adults. One aspect of cognitive function that is critical for everyday function is episodic memory. The present study examined the relationship between lifestyle activities and episodic memory in younger and older adults. Participants were sixty-two younger and older adults. The augmented Victoria Longitudinal Study Activities Questionnaire was used to quantify level of engagement in physical activity, sociocognitive activity, and TV viewing. Episodic memory was assessed using the old-new face recognition paradigm in which memory for younger and older faces was tested. Compared to younger adults, older adults reported being less physically and sociocognitively active while engaging in more passive behaviours such as TV viewing. A positive association was observed between physical activity and episodic memory for young adults but not for older adults. Interestingly, TV viewing was negatively associated with episodic memory in older adults but not younger adults. No relationship was found between sociocognitive activity and episodic memory for either younger or older adults. Although the own-age effect was observed for older adults, face age did not interact with lifestyle activities. The positive cognitive benefits of physical activity extend to younger adults; however, the interplay between physical activity and cognition may differ across the lifespan. Furthermore, TV viewing may be particularly detrimental to cognitive performance later in life.

B90

MINIMIZING VISUAL INTERFERENCE IMPROVES RECOGNITION MEMORY PERFORMANCE IN AMNESIA Rachel N. Newsome[1], Alexandra N. Trelle[1,2], Gillian Rowe[1,3], Rosemary Cowell[4], Morgan D. Barense[1,3]; [1]University of Toronto, [2]University of Cambridge, [3]Baycrest, Rotman Research Institute, [4]University of Massachusetts, Amherst — A new framework for understanding medial temporal lobe (MTL) function has recently been developed. Under this representational-hierarchical model, simple features of objects are thought to be represented in posterior regions of the ventral visual stream (VVS), and complex conjunctions of features - putatively comprising an entire object - are thought to be represented in anterior regions of the VVS. When these complex object-level representations are damaged, due to MTL damage, one must rely on simple feature representations in intact posterior VVS regions. This leads to increased vulnerability to interference, simply because everyday objects tend to share features (e.g., similar colors, shapes). In support of this idea, recent work has shown that MTL-lesioned rats were impaired in an object recognition task under conditions of normal visual interference, but that performance could be rescued by reducing visual interference. In the present study, we administered an object recognition task to a group of amnesics. We manipulated interference during the delay period in three conditions: cognitive interference (neuropsychological testing), visual interference (viewing scrambled versions of foil objects, designed to create feature-level interference), and minimal interference (dark room). As a group, amnesics performed better on the minimal interference condition, relative to the cognitive and perceptual interference conditions. Investigation of single-case data revealed that a subset of amnesics performed normally on the cognitive and minimal interference conditions, but were dramatically impaired on the visual interference condition. These results support the representational-hierarchical model and suggest the mechanism by which reducing visual interference improves memory in amnesia.

B91

NORMAL AGING DELAYED EVENT-RELATED POTENTIAL (ERP) WORD REPETITION EFFECTS Jin-Chen Yang[1,2], Lawrence Chen[1,3], Yu-Qiong Niu[1,2], Randi Hagerman[4], Marta Kutas[5], John Olichney[1,2]; [1]Center for Mind and Brain, University of California Davis, Davis, CA, USA, [2]Department of Neurology, University of California Davis, School of Medicine, Sacramento, CA, USA, [3]Department of Psychology, University of California Davis, Davis, CA, USA, [4]MIND Institute, University of California Davis, School of Medicine, Sacramento, CA, USA, [5]Department of Cognitive Science, University of California, San Diego, CA, USA — The N400 and P600 event-related potential (ERP) word repetition effects have demonstrated sensitivity to verbal memory impairments in neurodegenerative disorders including amnesia, Alzheimer's disease and the fragile X-associated tremor/ataxia syndrome (FXTAS). However, the impact of normal aging on the two ERP word repetition effects has not been quantified systematically. In the present study, data from 74 cognitively normal participants (mean age = 63.2 ± 9.2, age range = 42-86, females = 35) were analyzed. EEG/ERP recordings were obtained during a category judgment task in which semantically congruous (50%) and incongruous category-exemplar pairs were repeated ~10-140 seconds later. Results showed that the older group (N = 24, mean age = 73.8) had prolonged latencies of both the N400 and P600 repetition effects, when compared to the middle-aged (N = 24, mean age = 53.2) and young elderly (N = 26, mean age = 62.7) subjects. Linear regression analyses across all the participants revealed a 1.81 ms/year prolongation of the N400 repetition effect latency with aging. The P600 repetition effect latency displayed an insignificant increase of 0.42 ms/year. No significant impact of age was observed for the amplitude of either the N400 or the P600 repetition effect. The results suggest that a progressively slowing might characterize the effects of advanced aging on verbal memory, especially on implicit memory as measured by the ERP repetition priming.

B92

DEVELOPMENT OF SUBJECTIVE RECOLLECTION: EVIDENCE FROM EVENT-RELATED POTENTIALS Leslie Rollins[1], Tracy Riggins[1]; [1]University of Maryland, College Park — Dual-process models of recognition memory propose that memory is subserved by familiarity and recollection. The most common method used to assess recollection in adults is Tulving's remember/know paradigm (1985), a subjective measure of recollection. Most developmental studies have assessed recollection based on objective memory for specific details (e.g., item color) due to concerns about children's ability to perform subjective tasks. However, recent evidence shows that children can reliably make subjective memory judgments. The current studies examine age-related differences in ERP correlates of subjective recollection at encoding (Study 1) and retrieval (Study 2) in two separate samples of 6- to 8-year-old children and adults. Behavioral data revealed that both child and adult participants used subjective judgments accurately (i.e., memory for two objectively assessed contextual details was higher for items given "remember" versus "familiar" judgments). We assessed ERP data from both studies for the presence of recollection effects (i.e., differences in response amplitude between items given a "remember" judgment and those given a "familiar" judgments and missed/novel items. At encoding, subsequent recollection effects were present in children (n = 17) and adults (n = 25) in the 700-900ms time window. There was no difference between age groups. In contrast, at retrieval adults (n = 22) but not children (n = 17) demonstrated a recollection effect. Consistent with previous studies in adults, this effect was maximal across left centro-parietal leads 500-700ms poststimuus onset. These findings suggest that age-related differences in recollection may be predominantly due to the development of retrieval processes.

B93

DISTINCT RESTING-STATE FUNCTIONAL NETWORKS RELATED TO MOTIVATED LEARNING BEHAVIOR IN ADULTS COMPARED TO ADOLESCENTS Maheen Shermohammed[1], Aaron Mattfeld[1], John Gabrieli[1]; [1]Massachusetts Institute of Technology — Motivation and learning are fundamental cognitive processes, but how the brain supports them and how they change across development is unknown. Task-based studies have shown that adolescents have stronger reward-related activity when compared to both children and adults. We were interested whether similar differences were apparent in the brain at rest and whether these resting-state differences were related to motivated learning and memory behavior. We collected resting-state scans from 24 adolescents and 22 adults and conducted a seed-based functional connectivity analysis. The regions we used as seeds were obtained from an independent motivated learning task that showed differences in adults compared to adolescents when viewing reward-related cues. Specifically, we used the left anterior putamen (seed 1) as well as the left dorsolateral prefrontal cortex, left superior parietal lobule, and bilateral hippocampal cortex collectively (seed 2) to examine how resting state correlations were related to motivated learning and memory performance. In our resting state analyses we observed that in adults memory performance was positively correlated with functional connectivity between regions typically related to goals and attention (seed 2) and the bilateral insula. In contrast, in adolescents behavioral performance was positively correlated with functional coupling between the left anterior putamen (seed 1) and the medial prefrontal and left temporopolar cortices. These results suggest that distinct functional networks at rest are related to behavioral performance in adults and adolescents and may reflect developmental differences in the neurobiology of motivated learning and memory.

B94

AGE-RELATED COMPENSATORY OVER-RECRUITMENT DURING RECOGNITION MEMORY: EVIDENCE FROM SUPPORT VECTOR MACHINE PATTERN CLASSIFICATION Tyler Santander[1], Brian A. Lopez[2], Misty Schubert[2], Craig Bennett[2], Michael B. Miller[2]; [1]University of Virginia, [2]University of California, Santa Barbara — As individuals develop and age, the brain undergoes considerable structural and functional changes, which mediate the development and decline of higher-order cognition. It is currently unknown, however, how the deterioration of brain systems with old age may be ameliorated to maintain healthy behavior. One hypothesis involves the compensatory recruitment of additional brain regions not normally activated in a given task. To test this, recognition memory behavior and associated brain activity were examined in young (ages 25-35) and older (ages 60-75) adults during fMRI scanning. The informational value in brain areas that older adults activated beyond the typical young adult was probed using support vector machine (SVM) pattern classification. Classifiers were trained to distinguish between successful memory responses (hits and correct rejections) over several feature sets and tested using an itera-

tive leave-one-subject-per-class-out procedure. Among voxels both groups commonly activated, the classifier significantly distinguished between successful memory responses (balanced accuracy, BAcc = 72%). Likewise, among voxels that older adults activated beyond the average young adult, the classifier again significantly distinguished between successful memory responses (BAcc = 70%). This suggests that activations in these voxels carry discriminative value among older adults, which may be evidence of age-related compensatory over-recruitment. Importantly, when applied to voxels activated in young adults that diverged from the group average, classifier performance was nonsignificant. Contrary to the second model, this suggests that any residual activations in young adults largely appear to be just noise. Given roughly equivalent task performance, age-related over-recruitment may facilitate healthy cognitive aging among older adults.

B95

REJECTING EMOTIONAL GIST: AGE-RELATED DIFFERENCES IN RIGHT DORSOLATERAL PREFRONTAL CORTEX AND FALSE RECOLLECTION OF AROUSING PICTURES Stephen J. Gray[1], Ian M. McDonough[2], Sasha N. Cervantes[3], David A. Gallo[1]; [1]University of Chicago, [2]University of Texas - Dallas, [3]California University at Pennsylvania — Research suggests that age-related increases in false recollection are partly due to dysfunctional use of right dorsolateral prefrontal cortex (dlPFC) during retrieval monitoring (e.g., McDonough et al, 2013). In the current study, we extended this finding to false recollection of emotional pictures. Participants studied emotionally arousing and neutral pictures, and on a subsequent cued recollection test they were provided with descriptions of studied pictures (targets) or descriptions of nonstudied pictures (lures) during fMRI. Consistent with prior behavioral work, we found increased false alarms to emotionally arousing lures compared with neutral lures in older adults, suggesting an effect of emotional gist on false recollection. The absence of this behavioral effect in younger adults (YAs) suggested that YAs were better able than OA at suppressing the effects of emotional gist on false alarms. Whole-brain fMRI analyses at test revealed that the rejection of emotionally arousing lures (relative to neutral lures) was related to increased activity in right frontal regions including dlPFC, as well as activity in other regions linked to episodic retrieval, including precuneus, parahippocampal gyrus, and posterior cingulate. Critically, the right dlPFC activity was significantly greater in YAs than in OAs, consistent with the idea that OAs are less likely than YAs to use dlPFC to reject emotional gist during retrieval monitoring. These findings complement behavioral and neuroimaging research suggesting that gist-processing is less likely to be opposed by retrieval monitoring processes in older adults, leading to poorer memory accuracy.

LONG-TERM MEMORY: Episodic

B96

DIFFERENCES IN CRITERION PLACEMENT AND THE VENTRAL PARIETAL CORTEX Amy Frithsen[1], Michael Miller[1]; [1]University of California, Santa Barbara — Within the lateral parietal cortex, a dissociation has been found between activations in the dorsal and ventral areas. While dorsal activations have been linked to cognitive processes such as post-retrieval monitoring of memory evidence, it is less clear what functional role the ventral regions are playing during retrieval. Dorsal areas have been found to be correlated with a subject's criterion placement, a measure of how much memory evidence is required to respond "old" to an item during a recognition test. Previous studies have also shown this region to be modulated by the ratio of old items present during a memory test. When the ratio of old items is high (lax criterion), this region is much less active than when the ratio of old items is low (conservative criterion). While this relationship between criterion placement and activity within the dorsal parietal cortex has been relatively established, not much is known about its relationship with the ventral regions of this area. The current fMRI study tested this relationship using a probability manipulation during a remember-know test. During "likely" blocks, 70% of test items were old, while only 30% of test items were old during "unlikely" blocks. Differences in activation between blocks were then compared. Implications of these results are discussed in terms of how they may guide theories of ventral parietal activations during memory retrieval. This research was supported by the Institute for Collaborative Biotechnologies through contract W911NF-09-D-0001 from the U.S. Army Research Office.

B97

SEPARATING DECISIONAL AND MNEMONIC PROCESS IN RECOGNITION MEMORY Benjamin Turner[1], Alec Nisbet[1,2], Michael Miller[1]; [1]UC Santa Barbara, [2]Cardiff University — Most researchers in the field of recognition memory would agree that two interacting but distinct cognitive processes underlie recognition memory performance: first, memory-related processes that reflect the amount of mnemonic evidence associated with different items; and second, decision-related processes that use this evidence to guide responding. However, separating these processes can be surprisingly difficult, as evidenced by the ongoing debate over what, exactly, successful retrieval activity reflects, particularly in areas like posterior parietal cortex (e.g., Herron, Henson, & Rugg, 2004; Wagner et al., 2005; O'Connor, Han, & Dobbins, 2010; Guerin & Miller, 2011). In the present study, we analyzed data from 95 participants in a criterion-shifting recognition memory paradigm, making use of the prediction from signal detection theory (SDT) that mean mnemonic evidence per trial type (e.g., hit, false alarm, etc.) depends in a nonlinear way on sensitivity and bias. More specifically, as the criterion becomes more conservative, the mean amount of mnemonic evidence increases for all four trial types according to SDT. By accounting for this phenomenon, it is possible to attribute changes in activity that accompany changes in criterion to either the criterion placement per se, or else to these changes in memory evidence. Our results demonstrate that we were able to separate out mnemonic and decisional contributions to successful retrieval activity, revealing distinct brain networks associated with each. This research was supported by the Institute for Collaborative Biotechnologies under grant W911NF-09-D-0001.

B98

SUBSEQUENT MEMORY IN SCHIZOPHRENIA Azurii Collier[1], Dan Wolf[1], Jeffrey Valdez[1], Raquel Gur[1], Ruben Gur[1]; [1]University of Pennsylvania School of Medicine — Differential neural activation at encoding can predict which stimuli will be subsequently remembered or forgotten. We used event related fMRI to investigate subsequent memory effects for visual fractals in patients with schizophrenia (n=26) and healthy controls (n=28). Participants incidentally encoded the fractals during an oddball task and 10 minutes later they made old/new recognition memory judgments on 30 targets and 30 foils. Responses and reaction times were recorded. Both groups found the task challenging and performed at chance. Patients' memory accuracy was similar to controls; however, patients were slower to identify targets. We found evidence for subsequent memory (SM, subsequently remembered > subsequently forgotten) in both groups but with distinct patterns. Region of interest analyses in controls demonstrated activation in both the middle temporal lobe (MTL) and the fusiform cortex (FF); whereas, patients activated only the fusiform. There were no significant between group differences in MTL activation; however, patients demonstrated greater FF activation than controls. Notably, greater FF activation during successful encoding was associated with more severe negative symptoms. Whole brain analyses in patients demonstrated SM activation in the occipital pole, temporal occipital fusiform cortex, lateral occipital cortex, and left inferior temporal gyrus; whereas, there was no significant activation in controls. Taken together, our findings suggest that patients may activate FF as a compensatory strategy to promote successful encoding, with less reliance on the MTL recruitment found in controls. Such compensatory activation is needed especially for patients with more severe negative symptoms.

B99

THE MEDIAL TEMPORAL LOBES ARE CRITICAL FOR REWARD-BASED DECISION-MAKING UNDER CONDITIONS THAT PROMOTE EPISODIC FUTURE-THINKING Daniela J. Palombo[1,2], Margaret M. Keane[3,1,2], Mieke Verfaellie[1,2]; [1]VA Boston Healthcare System, [2]Boston University School of Medicine, [3]Wellesley College — Recent evidence suggests a tight link between re-experiencing the past and imagining future events (episodic future-thinking) in humans. Patients with amnesia due to medial temporal lobe (MTL) damage show deficits in episodic future-thinking that are correlated with their episodic memory loss, suggesting a common

MTL-based substrate. Yet, the broader functional significance of this association has not been firmly established. In the present study, we investigated the consequences of MTL damage on human decision-making in the context of reward-based inter-temporal choice. In a temporal discounting task, humans typically devalue a future reward to account for its delayed arrival (e.g., preferring $30 now over $40 in 6 weeks). We hypothesized that this type of inter-temporal choice would be selectively impaired in amnesic patients in a condition where episodic future-thinking promotes selection of the larger future reward in control participants. Accordingly, in a standard-temporal discounting task, amnesic patients showed temporal discounting indices similar to healthy controls, replicating previous work. In contrast, while healthy controls demonstrated attenuated temporal discounting (i.e., an increased likelihood to select the larger future reward) in a condition that first required participants to engage in episodic future-thinking (e.g., imagine spending $40 at a theatre in 6 weeks), amnesic patients failed to demonstrate this effect. These data suggest an adaptive role for MTL-based processes: One's ability to simulate future events, via flexible recombining of details from episodic memory, aids humans in predicting the outcome of actions and thus aids in decision-making.

B100

THE IMPACT OF PERCEPTUAL EVENT BOUNDARIES ON MEMORY-RELATED NEURAL OSCILLATIONS

Andrew Heusser[1], Youssef Ezzyat[1], Lila Davachi[1]; [1]New York University — The human brain imposes structure on the world, segmenting experience into discrete, but temporally contiguous events. Prior work has shown that associative memory (e.g. memory for temporal order) is reduced for information presented with an intervening event boundary compared to representations experienced within the same event (Dubrow et al., 2013; Ezzyat et al., 2011). This is thought to be related to augmented attentional allocation to boundary items (Boltz, 1992; Swallow et al., 2007), perhaps at the cost of ongoing across-trial associative processing. Here, we examined two distinct forms of associative memory: across-trial temporal order memory and within-trial item-feature binding. We hypothesized that event boundaries might facilitate encoding for information studied at boundaries, and simultaneously disrupt temporal order memory for items that span a boundary. Participants encoded a series of trial-unique grayscale objects presented on colored backgrounds that changed periodically. Shifts in background color were operationalized to act as perceptual event boundaries. Object-color memory and temporal order memory was tested after each encoding block. Interestingly, object-color memory was significantly better for boundary (compared to non-boundary) items, but order memory that spanned a boundary was significantly reduced compared to non-boundary order memory. MEG analyses reveal that oscillatory power in the theta (4-8 Hz), alpha (9-12 Hz), and beta (13-30 Hz) bands in posterior sensors increased as a function of within-event position and this increase was related to the benefit for within-event order memory. Further analyses will characterize memory-related oscillatory activity at event boundaries.

B101

AWARENESS OF MEMORY FOLLOWING THETA-BURST TMS TO DISTINCT PREFRONTAL CORTICAL LOCATIONS

Anthony Ryals[1], Evan Gross[1], Kelly Brandstatt[1], Mehmet Dokucu[1], Lynne Rogers[2], Joel Voss[1]; [1]Northwestern University Feinberg School of Medicine, [2]Rehabilitation Institute of Chicago (RIC) — Evidence from neuroimaging and lesion studies suggests that memory and subjective memory awareness may involve different prefrontal cortex regions. A rostrocaudal hierarchy has been proposed whereby increasingly anterior prefrontal regions are more heavily involved in memory awareness. We used theta-burst transcranial magnetic stimulation (TMS) to create "virtual lesions" of posterior versus anterior prefrontal regions in order to test for differences in memory awareness in healthy individuals. For each subject, theta-burst TMS was delivered to bilateral frontopolar cortex (FPC), bilateral dorsolateral prefrontal cortex (DLPFC), and to a sham (vertex) location, prior to performance of an item-location recognition memory task (with one region targeted in each of three distinct sessions, in counterbalanced order). The memory task involved global prospective and retrospective estimates of performance and also prospective and retrospective item-by-item judgments of performance. Overall recognition performance did not differ based on stimulation location, nor did item-by-item prospective or retrospective confidence for recognition hits. After DLPFC stimulation there was a trend for higher prospective confidence for subsequent recognition misses compared to both FPC and sham ($p=0.09$). FPC stimulation caused lower prospective confidence for recognition misses (i.e., higher monitoring accuracy) compared to both DLPFC ($p< 0.01$) and sham ($p<0.05$). FPC and DLPFC stimulation were associated with a shift towards underconfidence for global retrospective estimates compared to sham. Findings suggest that DLPFC and FPC have distinct roles in memory awareness, and are consistent with a hypothesized role for FPC in supporting awareness of performance, perhaps via integration of information about accuracy over time.

B102

INTERSECTION OF CHOICE, PREFERENCE, AND MEMORY: THE SIMPLE ACT OF CHOOSING ENHANCES DECLARATIVE MEMORY.

Vishnu Murty[1], Sarah DuBrow[1], Lila Davachi[1]; [1]New York University — Individuals value the freedom to make choices in their environment. The opportunity to choose is associated with positive affect and engagement of the mesolimbic dopamine system. Positive affect and mesolimbic dopamine activation have both been demonstrated to enhance long-term memory. Together these findings suggest that giving an individual the ability to make choices about their learning experience should enhance their later memory, even when choices do not influence the content of memoranda. To investigate these processes, we had participants perform an intentional encoding task in which they studied object images. On each trial, participants were shown a display with two cover screens that concealed to-be-encoded objects. Participants made a button press to remove one screen, which revealed the underlying object. We manipulated participant's opportunity to choose which screen was revealed across conditions. In the choice condition, participants chose one of the two screens to remove. In the fixed condition, participants were instructed to select a particular screen. Critically, the object on each trial was pre-determined; thus, choices had no influence on the content of the memoranda. Results indicated that memory was greater for objects in the choice versus fixed condition. Behaviorally, choice-induced preference for cover screens tracked memory enhancements for the revealed objects. Neurally, anticipatory engagement of the striatum predicted memory in the choice but not fixed condition. These findings suggest that choice recruits valuation systems to promote long-term memory encoding. This demonstrates a novel mechanism to motivate memory encoding in the absence of extrinsic rewards: manipulating agency during learning.

B103

RELATEDNESS-BASED UNITIZATION MODULATES ASSOCIATIVE RETRIEVAL PROCESSES

Daniel Levy[1], Roni Tibon[1], Anna-Lena Scheuplein[2], Axel Mecklinger[2], Nurit Gronau[3]; [1]Interdisciplinary Center Herzliya, [2]Saarland University, [3]Open University of Israel — Although memory of episodic associations is generally considered to be recollective in nature, it has been suggested that when stimuli are experienced as a unit, familiarity processes might contribute to their subsequent associative recognition. Factors of semantic and spatial relatedness may modulate such unitization. To investigate the effect of relatedness-based unitization at encoding on the processes of retrieval of associative information, we had participants interactively encode pairs of object pictures, arranged in a near-vertical format so as to suggest a functional or configural relationship between them. Half of pairs were independently judged to be of related objects (e.g., a coffee pot over a mug) and half of unrelated objects (e. g., a shovel over a table). At test, participants discriminated intact, recombined, and new pairs while EEG event related potentials (ERPs) were recorded. In an early ERP marker of retrieval success generally associated with familiarity processes, peaking ~400 ms after test pair presentation, correctly identified new unrelated pairs elicited the most negative deflection, correctly identified intact related pairs elicited the least negative deflection, and waveforms elicited by correctly identified related new and unrelated old pairs fell between those deflections, and were indistinguishable. In contrast, in a later parietal-maximal ERP marker associated with recollection, extending ~500-1000 ms after test pair presentation, correctly identified intact related pairs elicited a more positive deflection than other intact and new conditions. These findings may indicate that unitization resulting from semantic relatedness at encoding may modulate both familiarity and recollective processes at retrieval.

B104

NEURAL CORRELATES OF RETRIEVAL ORIENTATION MODULATED BY THE ORDER OF TEST CONDITIONS Timm Rosburg[1], Mikael Johansson[2], Axel Mecklinger[1]; [1]Saarland University, Germany, [2]Lund University, Sweden — Retrieval orientation refers to a pre-retrieval process and conceptualizes the specific form of processing that is applied to a retrieval cue. In our event-related potential (ERP) study, we sought to find evidence for an involvement of the auditory cortex when subjects attempt to retrieve vocalized information, and hypothesized that adopting retrieval orientation would be beneficial for retrieval accuracy. Participants saw object words that they subsequently vocalized or visually imagined. In the subsequent memory exclusion task, participants responded more slowly and less accurately to targets of the vocalize condition than to targets of the imagine condition. ERPs to new items varied at the left-temporal electrode T7 between 500 and 800 ms, indicating a retrieval orientation effect in the subject group as a whole. However, whereas the effect was strongly pronounced in participants with high retrieval accuracy, it was absent in participants with low retrieval accuracy. Current source density (CSD) mapping of the retrieval orientation effect indicated a source over left temporal regions. Independently from retrieval accuracy, the ERP retrieval orientation effect was surprisingly also modulated by test order, showing more positive ERPs to new items when participants first targeted vocalized information. Findings are suggestive of an involvement of the auditory cortex in retrieval attempts of vocalized information and confirm that adopting retrieval orientation may improve retrieval accuracy. The effects of test order on retrieval-related processes might reflect a stronger focus on the newness of items in the more difficult test condition when participants started with this condition.

B105

THE ROAD LESS TRAVELED (VS. THE ROAD MORE TRAVELED): HIPPOCAMPAL CONTRIBUTIONS TO REMOTE SPATIAL MEMORY DURING VIRTUAL NAVIGATION Jason Ozubko[1], Jessica Robin[1,2], R. Shayna Rosenbaum[1,3], Cheryl Grady[1,2], Gordon Winocur[1,2], Morris Moscovitch[1,2]; [1]Rotman Research Institute, [2]University of Toronto, [3]York University — Understanding of human spatial memory has expanded greatly in the past few decades with the rise of virtual reality (VR) paradigms. Studies of active navigation in realistic environments have consistently demonstrated that the hippocampus (HPC) is necessary for navigation in newly-learned environments. By contrast, it is not known whether the HPC is implicated when navigating in familiar environments, though behavioural studies of remote spatial memory in patients with HPC lesions, and fMRI studies with healthy individuals using mental navigation, suggest it is not. To address this question, we developed a versatile VR paradigm that uses real-world panoramic, ground-level views of streetscapes. Applying our technology to a large scale city (Toronto, ON), we found that the HPC plays an important role in navigating in less familiar areas of a city, but not when navigating in highly familiar environments. Importantly, when the position of landmarks was mirror-reversed, the extra-hippocampal representations that support navigation in highly familiar environments were insufficient, and the HPC was recruited once again. Additionally, individuals who self-reported that they did not use mapping strategies while navigating were found to rely significantly less on their HPC during navigation, except under the most demanding (i.e., mirrored) conditions. Our results suggest that the HPC may represent detailed spatial maps but, over time simpler versions of these representations are supported by the neocortex. Neocortical spatial maps may frequently be sufficient to navigate along well-known routes, but if navigation becomes difficult or a detailed spatial map is needed for reference, the HPC is recruited.

B106

DOES AROUSAL INDEPENDENTLY BOOST MEMORY FOR EMOTIONAL SCENES? INVESTIGATING THE EFFECTS OF EMOTION WITH THE LEFT-PARIETAL ERP OLD/NEW EFFECT. Graham MacKenzie[1], Emma Neilson[1], David I Donaldson[1]; [1]University of Stirling — Emotion can enhance or impair episodic memory, with increases in "emotional arousal" significantly enhancing recollection of prior events. The emotion dimensions of arousal and valence are rarely manipulated independently: consequently, the discrete effect of arousal remains unclear. Here we ask whether selectively manipulating the arousal of negatively valenced scenes affects recollection - does increased arousal provide an additional boost to memory? Images of scenes were studied with either a square or circle pattern overlaid, providing source information to remember. All scenes had negative valence, with either high or low arousal. Event-Related Potentials (ERPs) were recorded at test, time-locked to stimulus onset. Old and new scenes were presented alone and participants made initial old/new decisions before making source judgments for all recognized scenes. Behaviourally there was no effect of arousal on source memory, but response bias was more conservative for low-arousal scenes. In accordance with source memory performance, ERPs revealed no difference in magnitude of the left-parietal old/new effects (500-700msec) for high and low arousal scenes. However, the old/new effects associated with familiarity (300-500msec) were topographically dissociable, with a classic mid-frontal old/new effect for high arousal scenes and a right-frontal effect for low arousal scenes - suggesting that arousal may influence recognition memory by changes in response bias influencing how familiarity is processed. Critically, and contrary to expectations, behavioural and neural findings provide convergent evidence that increasing the arousal of negative scenes does not enhance recollection. Although increases in emotional arousal may enhance memory, increasing arousal alone does not boost recollection.

B107

OSCILLATING AUDITORY STIMULATION DURING SLEEP PROMOTES SLEEP SPINDLES. James Antony[1], Jinkyung Bae[1], Ken Paller[1]; [1]Northwestern University — Two types of neural oscillation are important for memory processing during sleep: slow oscillations (<1 Hz) during slow-wave sleep (SWS) and spindles (11-16Hz, 0.5-2s) during stage-2 and SWS. Several methods have been used to show that facilitating slow waves can enhance memory, perhaps due to indirect effects on spindle activity. Here we attempted to manipulate spindles directly by presenting oscillating white-noise bursts at spindle frequencies. In separate groups we used one of three frequencies, 12Hz, 15Hz, and 50Hz, corresponding roughly to slow spindle, fast spindle, and a non-spindle control frequency, respectively. Each 2s burst was followed by 8s of white noise at the background amplitude. Subjects napped for 90 minutes. Spindles were detected using an established automated algorithm. For 15Hz, there was an increase in fast spindles during stimulation relative to non-stimulation periods. Slow spindles did not differ between stimulation and non-stimulation periods. For 12Hz, there was a trend for an increase in slow spindles. For 50Hz, no effects were found. Between-group comparisons confirmed that spindle frequency varied reliably as a function of stimulation frequency. Further analyses compared spindles during stimulation to spindles following stimulation, and no differences were found in spindle power, duration, or topography, suggesting that induced spindles were physiologically similar to spontaneous spindles. Prior findings have linked spindles with memory consolidation, general intelligence, and sleep stability. This successful demonstration of a method to selectively and non-invasively facilitate spindles opens the door to research into the physiological functions of spindles and to practical applications of spindle induction methods.

B108

AN ERP STUDY OF THE DISSOCIATION BETWEEN RECOLLECTION- AND FAMILIARITY-RELATED PRESTIMULUS ENCODING ACTIVITIES Tzu-Ling Liu[1], Yi-Jhong Han[1], Shih-kuen Cheng[1]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan — Recent findings in long-term memory suggest that successful encoding is modulated by the neural activities prior to encountering the to-be-encoded items. The current study examined whether this "prestimulus subsequent memory effect" dissociates between recollection-related and familiarity-related encoding. Participants first engaged in a study phase, during which they made one of two types of judgments to concrete nouns. The judgment to be made for each word was signaled by a cue presented prior to the nouns. In the following test phase, participants differentiated studied words from unstudied ones and identified the judgment type for the studied words. ERPs elicited by the task cues during the study phase were sorted according to whether the study items were correctly recognized with its source judgment. Results showed that when comparing cue-eliciting waveforms between hit items and missed items, waveforms of correctly recognized items showed a left frontal negativity which was also found in previous studies. By contrasting cue-elicited activity of source correct hits to those of source incorrect hits,

we extracted activities which is defined as recollection-related prestimulus effect. Also, we contrasted activity of source incorrect hits to those of misses to extract familiarity-related prestimulus effect. It was found that hit trials with correct source memory showed a negativity over the frontal areas compared to source incorrect hits; while source incorrect hits showed a wide-spread positivity compare to miss items. These findings suggest that the prestimulus subsequent memory effect may consist of multiple processes, including processes which support recollection-related and familiarity-related memory encodings.

B109

ERP EVIDENCE FOR FEATURE-SPECIFIC EXPLICIT MEMORY RETRIEVAL IN THE ABSENCE OF RETRIEVAL MODE Kristina Küper[1,2], Hubert D. Zimmer[2]; [1]Leibniz Research Centre for Working Environment and Human Factors, Dortmund, Germany, [2]Brain and Cognition Unit, Department of Psychology, Saarland University, Saarbruecken, Germany — Explicit but not implicit memory retrieval is feature-specific in that old/new effects are reduced when arbitrary stimulus features, such as color, are modified from study to test. In contrast to implicit retrieval, explicit retrieval is characterized by retrieval mode, a tonic state in which stimuli are deliberately processed as memory retrieval cues. In the present ERP (event-related potential) study, we examined whether retrieval mode is a prerequisite for feature-specific explicit retrieval by having participants perform a direct memory test either in a blocked fashion or under task-switch conditions which prevent the establishment of retrieval mode. Participants were asked to memorize line drawings of familiar objects and the color they were presented in. At test, we presented new items and study items which were either repeated identically or in a different color than at study. Participants performed a memory inclusion task in which both types of study items had to be categorized as "old". In the task-switch group, a cue indicated on a trial-by-trial basis whether participants had to perform the inclusion task or a semantic retrieval task (natural/artificial decision). ERPs were generally more positive-going on switch-trials in the task-switch group than with blocked retrieval likely reflecting increased processing demands. Both behavioral and LPC (late positive component) old/new effects indexing recollection processes were feature-specific in the task-switch group and thus not contingent on the presence of retrieval mode. The absence of retrieval mode did, however, disrupt familiarity processes as unspecific FN400 old/new effects emerged only with blocked retrieval.

B110

POST-RETRIEVAL SELECTION MODULATES PROCESSING OF RETRIEVED ASSOCIATES TO OVERCOME INTERFERENCE IN MEMORY Michael Dulas[1], Audrey Duarte[1]; [1]Georgia Institute of Technology — fMRI evidence suggests that overcoming interference in memory may require post-retrieval selection, a process thought to be mediated by the left mid-ventrolateral prefrontal cortex (VLPFC). Further, research has shown selective attention can modulate activity in perceptual processing regions, enhancing activity for attended-to stimuli and suppressing activity for ignored stimuli. Thus, one possible way in which post-retrieval selection resolves interference in memory is by enhancing/inhibiting representations of retrieved associates. The present study investigated whether VLPFC-mediated post-retrieval selection modulates perceptual processing of retrieved associates in the face of competing alternatives. During encoding, participants were shown objects paired with either a face or a scene. Each object was shown multiple times, and its paired associate changed partway through encoding. Interference was manipulated by how often the object was paired with the lure (least recent) associate versus the target (most recent). At test, participants determined if objects were seen previously and whether they were most recently paired with a face or a scene. Behavioral results showed that associative memory performance decreased with increasing interference. fMRI results revealed activity in the left mid-VLPFC increased with higher interference. Further, activity in parahippocampal place area was enhanced when participants successfully remembered a target scene associate, and inhibited when participants correctly rejected a scene lure. These results suggest that one way in which post-retrieval selection resolves interference in memory is by inhibiting processing of irrelevant retrieved associates and enhancing processing of relevant ones.

NEUROANATOMY

B111

INDIVIDUAL VARIABILITY IN CORTICAL STRUCTURE I: NOT UNIFORM ACROSS CORTICAL SUBREGIONS David Vazquez[1], Omesh Ranasinghe[1], Adam Felton[1], Adam Daily[1], Christine Chiarello[1]; [1]University of California, Riverside — Recent advances in neuroimaging techniques allow us to examine cortical morphometry across various metrics. Such measurements of surface area, thickness, and gyrification are not uniform across the cortex. What is yet unknown is the extent of the variability among healthy adults for these cortical measurements, and whether this variability is uniform across various regions of the cortex. To explore the degree to which cortical surface area, thickness and local gyrification (LGI) vary among 200 young adults, we computed the coefficient of variation (CV) for each measure for 68 FreeSurfer parcellations (Destrieux et al., 2010). For all measures, variation was not uniform across the cortex (CV range 10.6 - 33.4 for surface area; 4.5 - 15.4 for thickness; 4.05 and 11.9 for LGI). Surface area showed the greatest between-subject variation of the three measures (median CV: surface area = 17.63; thickness = 7.37; LGI = 5.9). Inter-subject variability maps will be presented to illustrate areas with high and low variability. For thickness and surface area, high variability regions were generally not found in adjacent, or nearby regions. In contrast, for LGI we found the most inter-subject variability centered in insular and opercular regions. The superior frontal gyrus was the least variable region across all three cortical measures. Correlates of the regional differences in inter-subject variability are described in companion posters (Chiarello et al.; Daily et al.). We suggest that such differences provide an important population-level metric of cortical organization.

B112

INDIVIDUAL VARIABILITY IN CORTICAL STRUCTURE II: INVESTIGATING A POTENTIAL ROLE FOR DEGREE OF POSTNATAL SURFACE AREA EXPANSION Christine Chiarello[1], David Vazquez[1], Adam Felton[1], Adam Daily[1]; [1]University of California, Riverside — A recent study indicated that postnatal expansion of cortical surface area is nonuniform (Hill et al., 2010). High expansion regions in the lateral temporal, parietal, and frontal cortex had double the rate of postnatal growth as compared to low expansion regions in medial temporal, occipital, and insular cortex. Data from our laboratory also document substantial regional differences in the extent of intersubject variability in surface area, as well as thickness and degree of gyrification - high variability regions have 2-3 times greater intersubject variation than low variability regions (companion poster, Vazquez et al.). If this individual variation is strongly influenced by postnatal experience, high expansion regions should also have greater between-subject variability than low expansion regions. To test this idea, we computed the coefficient of variation for cortical surface area, thickness, and local gyrification in a sample of 200 healthy young adults. We contrasted values for FreeSurfer parcellations corresponding to high expansion areas (lateral STG, STS, temporal pole, MTG, postcentral gyrus and sulcus, IPS, SFS, MFS, MFG, anterior cingulate) with low expansion parcellations (parahippocampal gyrus, collateral & lingual sulci, calcarine and parieto-occipital sulci, precuneus, Heschl's gyrus, insula). Across all three measures of cortical structure, there was greater between-subject variability in low expansion as compared to high expansion, regions $F(1,102) = 26.6$, $p < .0001$. Contrary to the prediction, regions with lower postnatal expansion are more variable in cortical structure across individuals. Longer periods of postnatal development do not appear to promote between-person variation in some regional measures of cortical organization.

B113

INDIVIDUAL DIFFERENCES IN CORTICAL STRUCTURE III: VARIABILITY PREDICTS DEGREE OF STRUCTURAL HEMISPHERIC ASYMMETRY Adam Daily[1], David Vazquez[1], Adam Felton[1], Christine Chiarello[1]; [1]University of California, Riverside — Reliable structural asymmetry has been observed in many cortical regions. Data from our laboratory indicate regional differences in inter-subject variability for several neocortical metrics (companion poster, Vazquez et al.). However, the relationship between hemispheric asymmetry and regional inter-subject variability is unknown. Given that certain regions show a high degree of variability

between individuals, we reasoned that in those regions the two hemispheres should differ more in cortical morphology, producing greater asymmetry. In a sample of 200 young adults, we investigated the correspondence between inter-subject variability in a particular cortical region and hemispheric asymmetry within that region. We computed the coefficient of variation (CV) for cortical surface area, thickness, and Local Gyrification Index (LGI) for 68 cortical subregions using FreeSurfer. For each cortical metric within each hemisphere, we correlated regional CV with the absolute value of the corresponding asymmetry quotient (AQ). Significant positive correlations (all ps < .001) were obtained for all measures: surface area (LH r = .47; RH r = .52), thickness (LH r = .85; RH r = .81), and LGI (LH r = .58; RH r = .64). We suggest that greater inter-subject variability within a region is an indication of less biological constraint. Our findings indicate that such reduced constraint allows greater hemispheric differentiation. Inter-subject variation, which is often treated as a nuisance variable, may help elucidate some features of cortical organization.

B114

BILATERAL ATYPICAL PARIETAL SULCAL PATTERN IN DEVELOPMENTAL DYSLEXIA Kiho Im[1,2], Nora Raschle[2,3], Sara Smith[3], P.Ellen Grant[1,2,4], Nadine Gaab[2,3,5]; [1]Fetal Neonatal Neuroimaging and Developmental Science Center, Division of Newborn Medicine, Boston Children's Hospital, Boston, [2]Harvard Medical School, [3]Laboratories of Cognitive Neuroscience, Division of Developmental Medicine, Department of Medicine, Boston Children's Hospital, Boston, [4]Deptartment of Radiology, Boston Children's Hospital, Boston, [5]Harvard Graduate School of Education, Cambridge — Previous MRI studies observed decreased cortical volume, reduced white matter organization and functional alterations in pre-literate children at familial risk for developmental dyslexia (DD). Sulcal patterns are hypothesized to relate to white matter and cortical functional organization under genetic influence. Therefore we hypothesized that sulcal patterns would be atypical in pre-readers with a familial risk and young readers with DD. We analyzed the sulcal pattern using graph-based sulcal pattern comparison method in pre-readers/beginning readers with and without familial risk of DD (n = 15, 16; mean age = 70.4, 69.5 months) as well as child readers with and without DD (n = 13, 14, mean age = 116.2, 127.9 months). Bilateral parietal sulcal patterns were significantly atypical in pre-readers/beginning readers with a familial risk of DD compared to controls. An atypical right parietal sulcal pattern was further correlated with reduced phonological processing and rapid automatized naming skills. Significantly atypical bilateral parietal sulcal patterns were also shown in children with DD compared to controls, as well as its relationship with phonological processing and single word reading. As sulcal patterns are determined during prenatal development, our sulcal pattern analysis provides further support for atypical early brain development in DD and suggests that DD may originate from altered arrangement or connections of cortical areas in bilateral parietal regions. Future studies are needed to determine if sulcal pattern analysis can identify children at risk for DD as neonates or even fetuses.

B115

HEARING-AID USE AND WHITE-MATTER INTEGRITY AFTER EARLY DEAFNESS Martha M. Shiell[1,2,3], François Champoux[2,3,4], Robert J. Zatorre[1,2,3]; [1]Montreal Neurological Institute, McGill University, [2]BRAMS International Laboratory for Brain, Music, and Sound Research, [3]CRBLM Centre for Research on Brain, Language, and Music, [4]Université de Montréal — In people with early deafness, superior temporal cortical regions show decreased white-matter volume and integrity (e.g. Kim et al. 2009, Neuroreport). Despite that these changes have been attributed to disuse-driven atrophy of auditory cortex, research with adolescents suggests no relationship with residual auditory input through a hearing-aid (Miao et al., 2013, Am J Neuroradiol). To our knowledge, the role of residual hearing in adults has not been examined. We tested the hypothesis that auditory input through a hearing-aid inhibits atrophy of white-matter in adults with early and profound deafness. We recruited 18 hearing and 16 deaf adults. We used magnetic resonance imaging to collect T1- and diffusion-weighted images, and analyzed these data with tract-based spatial statistics (FMRIB's Software Library) to compare groups on fractional anisotropy (FA), a metric of white-matter integrity. Consistent with previous research, deaf people showed decreased FA in Heschl's gyrus in the right hemisphere (p < 0.001, uncorrected), and a sub-threshold trend in the left-hemisphere. We then looked at the variation of FA within this region in the deaf group, according to duration of hearing-aid use, expressed as percent years of lifetime. In the right-hemisphere Heschl's gyrus, FA correlated with duration of hearing-aid use, with longer hearing-aid use associated with higher FA (R = 0.55, p = 0.0138, one-tailed). We conclude that hearing-aid use can preserve white-matter integrity in auditory regions, despite profound deafness. This finding is consistent with evidence that auditory input from hearing-aids can inhibit cross-modal reorganization (Shiell et al., 2013, in review).

B116

USING PCA TO EVALUATE THE EFFECTS OF CARDIORESPIRATORY FITNESS ON CORTICAL THINNING AND COGNITION IN HEALTHY OLDER ADULTS. Mark Fletcher[1], Kathy Low[1], Nils Schneider-Garces[1], Benjamin Zimmerman[1], Chin-Hong Tan[1], Rachel Boyd[1], Edward Northrup[1], Alexander Gorsuch[1], David Cui[1], Christine Ventrella[1], Gabriele Gratton[1], Monica Fabiani[1]; [1]University of Illinois at Urbana-Champaign — Research has shown that differences in cardiorespiratory fitness (CRF) are correlated with age-related variations in neuropsychological performance and volumetric brain measures during aging. Here we examined differential cortical thinning patterns, and associations between anatomy and cognition, in a group of healthy older adults differing in fitness (N=54, ages 55-87). To increase statistical power, we used PCA to group brain regions whose volumes were correlated across subjects, and a similar PCA to group neuropsychological test scores. Subjects participated in neuropsychological testing and structural magnetic resonance imaging (sMRI). CRF was estimated using a non-exercise prediction model proposed by Jurca and colleagues (2005). Participants were split by age and gender before being classified as high- or low-fit. Measurements of cortical thinning/volume were obtained using FreeSurfer© and were normalized for head size. The results confirmed that cortical thinning patterns differed in high- versus low-fit older adults. High-fit older adults had increased "thicknesses" with age encompassing medial superior frontal, superior temporal and precentral cortical regions. Additionally, CRF was positively associated with a factor encompassing basal ganglia volume, whereas age was negatively associated with factors encompassing regions of the lateral cortex and corpus callosum. High-fit older adults also had higher scores on a factor related to performance in verbal fluency, vocabulary and the "Riddles" subscore of the KBIT. Our data indicate that higher CRF is associated with preserved anatomy and higher cognition in older adults.

B117

ALCOHOL'S EFFECT ON THE CORTISOL AWAKENING RESPONSE Tony Cunningham[1], Enmanuelle Pardilla-Delgado[1], Jennifer Rawding[1], Kelsey Blomeke[1], Michelle Wirth[1], Jessica Payne[1]; [1]University of Notre Dame — The cortisol awakening response (CAR) is a sharp increase in cortisol that occurs at awakening from sleep. It is a reliable biomarker of HPA activity and has high intra-individual reliability over time. Both previously experienced psychosocial stress, and perceived upcoming stress influence the CAR. As such, the CAR is pronounced on weekdays, but less so on weekends when people are less stressed and often sleep in later. However, little attention has been paid to the effects of acute physiological stress on the CAR. Alcohol consumption impacts the HPA axis, generally increasing cortisol and affecting sleep architecture in light-drinking populations, yet how it affects the CAR remains unknown. We employed a within-subjects design to investigate alcohol consumption's influence on the CAR. Saliva samples were collected one weekend morning after alcohol consumption (avg. 4.5 ±2.2 drinks) and another weekend morning after subjects abstained from alcohol. Baseline samples were taken upon awakening and subsequent samples were taken 30, 45, and 60min post-awakening. Although data collection is ongoing, we already see a significant increase in cortisol from baseline to maximum concentration during sampling in the alcohol consumption condition (t(16)=2.2,p=.043). A significant change was not observed in the abstinence condition, however, which is more typical of a weekend morning. Area under the curve with respect to cortisol increase (AUCi) indicates a trend toward increased CAR after consuming alcohol (t(16)=1.833,p=.085). These results point to an acute effect of alcohol consumption on the CAR in a normal college population and implicate alcohol consumption as a physiological stressor.

PERCEPTION & ACTION: Motor control

B118

RELIABILITY OF NEGATIVE BOLD RESPONSE ACROSS AGE GROUPS Keith McGregor[1,2], Atchar Sudhyadhom[3], Bruce Crosson[1,2], Andrew Butler[1,4]; [1]Center for Visual and Neurocognitive Rehabilitation, Atlanta VA Medical Center, [2]Department of Neurology, Emory University, [3]Department of Radiation Oncology, UCSF, [4]Department of Physical Therapy, Georgia State University — Within the motor system, there have been numerous reports within cross-sections of individuals of sustained negative BOLD in the ipsilateral primary motor areas respective to the moving hand (Newton et al., 2005; Stefanovic et al., 2004; Riecker et al., 2006; Lenzi et al., 2007; McGregor et al., 2011). In this context the evoked negative BOLD likely represents an active inhibition of the ipsilateral primary motor areas mediated by transcallosal mechanisms (Meyer et al., 1995, 1998; Stefanovic et al., 2004; Lenzi et al., 2007; McGregor et al., 2011). However, despite its obvious potential and increasing representation in imaging related literature, the within-subject reliability of evoked negative BOLD has, to our knowledge, never been tested. The current fMRI investigation tests multi-session within-subject reliability of negative BOLD in the motor system using high-spatial resolution (2mm x 2mm x 2mm) echo planar imaging. Sixteen participants (18-69 years) were scanned over three sessions while engaging in a simple finger opposition task previously shown to evoke a negative BOLD response in the ipsilateral cortex of healthy younger adults (Allison et al., 2000; Riecker et al., 2006; McGregor et al., 2011). After session co-registration for both anatomic and functional runs, we analyzed the spatial reliability of suprathreshold voxels activity in sensorimotor cortex.

B119

SOCIAL AND NON-SOCIAL VIOLATIONS OF EXPECTANCY RELY ON TWO DIFFERENT SUBREGIONS OF THE MEDIAL PREFRONTAL WALL. Charlotte Desmet[1], Marcel Brass[1]; [1]Department of Experimental Psychology, Ghent University, Ghent, Belgium — The dorsal and posterior part of the medial prefrontal cortex (pMPFC) is often described in cognitive control literature. It seems that this region is active when we monitor our performances. For example, this region is active when we make errors. Also when we observe errors by others this region is activated. This is in line with current research that suggests a general role for the pMPFC in detecting salient events. Interestingly, a region more ventral and anterior in the medial prefrontal cortex, the anterior medial prefrontal cortex (aMPFC), is involved in processing social situations. Moreover, this region is considered part of the mentalizing system and is active when we try to understand why somebody is performing a specific action. This brain area strongly responds to situations of social incongruency, or to violations of expectancies in social situations. For example, this region is activated when we observe somebody performing an unusual, although correct, action. In the current meta-analysis we integrated studies from these two research fields. Our results indicate that there are indeed two systems in the medial prefrontal wall that respond to violations of expectancies; one general purpose system in the pMPFC and one system responding to social situations in the aMPFC. Further, this distinction seems to rely on the intentionality of the observed behaviour. Moreover, when a certain behaviour is intentional we use the more ventral part of the MPFC, while observing unintentional behaviour (such as errors) we use the more dorsal part of the MPFC.

B120

EVIDENCE FOR COMPENSATORY AND PATHOLOGICAL CEREBELLAR CONNECTIVITY IN PARKINSON'S DISEASE Sara B. Festini[1], Jessica A. Bernard[2], Youngbin Kwak[3], Scott Peltier[1], Nicolaas I. Bohnen[1], Martijn L. T. M. Muller[1], Praveen Dayalu[1], Rachael D. Seidler[1]; [1]University of Michigan, [2]University of Colorado Boulder, [3]Duke University — Parkinson's disease is a progressive neurodegenerative disorder associated with both motor and cognitive impairments. We have previously reported altered resting state functional connectivity between the basal ganglia and the cerebral cortex in Parkinson's disease, including hyperconnectivity in Parkinson's patients OFF medication compared to healthy controls that is down-regulated by L-DOPA medication (Kwak et al., 2010). Although the basal ganglia are a primary target of degeneration in Parkinson's disease, other structural and functional brain changes involving the cerebellum have been observed. For instance, it has been suggested that Parkinson's patients may recruit cerebellar networks to compensate for striatal dopaminergic denervation (e.g., Palmer et al., 2010). We implemented a lobule-based cerebellar resting state functional connectivity analysis, comparing intra-cerebellar and cerebellar-cortical connectivity in patients ON and OFF medication and healthy controls. Twenty-five Parkinson's patients and twenty-three matched controls completed structural and functional MRI scans. Functional scans were collected at rest, while participants viewed a fixation cross for 8 minutes. Outside the scanner participants completed a battery of motor and cognitive assessments. Results indicate that PD OFF display increased cerebellar connectivity, whereas PD ON display decreased connectivity relative to controls. Behavioral regressions reveal that hyperconnectivity in PD OFF may reflect compensatory cerebellar recruitment, as greater connectivity can be associated with faster motor performance, better cognition, and reduced disease severity. Nonetheless, increased connectivity in PD OFF can also be detrimental and associated with slower motor performance and worse disease severity. Our results provide evidence for both compensatory and pathological cerebellar connectivity in Parkinson's disease.

B121

PREFERRED TEMPO IS FASTER IN PARKINSON'S DISEASE Nathaniel S. Miller[1], Kelvin L. Chou[1], Nicolaas I. Bohnen[1], Martijn L. T. M. Müller[1], Rachael D. Seidler[1]; [1]University of Michigan — Parkinson's disease (PD) is characterized by slowed movement (bradykinesia). Previous studies suggest that slowing of the "internal clock" underlies bradykinesia; however, support for this relies upon indirect measures of the clock (Yahalom et al., 2004). The spontaneous motor tempo (SMT) task, or the preferred rate of hand tapping, directly measures internal clock rate (McAuley et al., 2006). Previously, we demonstrated faster hand, foot and speech SMT in patients relative to controls, but neither medication state nor affected side influenced SMT (Miller et al., 2013). Though these findings suggest that the internal clock speeds up in PD, motor symptoms may have biased our measure. Here, we used a direct, perceptual measure of clock rate, preferred perceptual tempo (PPT), to estimate clock rate without motor bias. Thirty-eight controls and 36 patients (ON and OFF medication) rated their preference (e.g., "too fast or too slow") for 21 monotone sequences of different tempi. Sequences were logarithmically spaced and centered on participants' SMT. Mirroring our earlier findings, patients (both ON and OFF medication) had faster PPT relative to controls [$Fs(1,72)=4.29\&6.30$, $ps<.05$], but medication state did not affect PPT [$p=.23$]. PPT correlated with hand and foot SMT in both patients and controls [$rs = .36\text{-}.76$, $ps<.03$], but PPT only correlated with speech SMT in controls ($r(36)=.53$, $p<.01$). These findings support the notion that the internal clock speeds up in PD. We conclude that motor symptoms do not affect SMT; however, the internal clock may be less involved in speech timing in PD.

B122

CONSISTENCY OF SELF-PACED UNIMANUAL AND BIMANUAL TAPPING Alison Colbert[1], Kaitlin Oswald[1], Rachel Bellono, Jin Bo[1]; [1]Eastern Michigan University — To execute bimanual coordination tasks efficiently, complex interhemispheric communication between motor areas via the corpus callosum must occur. Previous studies reveal that unsynchronized bimanual tasks are more challenging than synchronized bimanual tasks due to increased interhermispheric interaction between motor areas, and unimanual task execution is more complex than similar synchronized bimanual tasks. The current study examined the consistency of unimanual and bimanual tapping in a continuous tapping task. Forty-three young adults (39 with Edinburgh handedness scores > 0) tapped their index finger repetitively at 1s rate without auditory/visual guidance in five conditions: unimanual tapping with either the left or right hand, synchronized bimanual tapping, and 180ms out-of-phase unsynchronized bimanual tapping led by either the left or right hand. Results generally revealed that synchronized bimanual tapping resulted in greatest mean variability (left hand variability ranging from marginally significant to significant $P = .231\text{-} .046$; right hand variability marginally significant $P = .189\text{-}.347$). In the left-lead condition, out-of-phase bimanual tapping had the next greatest mean variability ($P = .238\text{-}.051$), followed by left-hand unimanual tapping ($P = .223\text{-}.046$). However, in the right-lead condition, out-of-phase bimanual tapping and right-hand unimanual tapping resulted in similar variability ($P = .641 - .829$). These results suggest that synchronized bimanual tapping is not the easiest task to perform. When the movements are self-paced, temporal

control predominantly relies on the cerebellum and is less influenced by interhemispheric interconnectivity through the corpus callosum. Thus, the unimanual tapping becomes less complex, whereas synchronized bimanual tapping is more difficult.

B123

THE EFFECTS OF HANDEDNESS ON UNIMANUAL AND BIMANUAL TAPPING

Kaitlin Oswald[1], Alison Colbert[1], Rachel Bellono[1], Jin Bo[1]; [1]Eastern Michigan University — Tasks requiring bimanual coordination are essential to daily functioning. To execute tasks requiring bimanual coordination efficiently, complex interhemispheric communication between motor areas must occur. The current study examined effects of handedness on the consistency of unimanual and bimanual movements. Forty-three young adults (39 with Edinburgh handedness scores > 0) performed finger tapping tasks in five conditions: unimanual tapping with the left or right hand, synchronized bimanual tapping, and out-of-phase bimanual tapping led by either the left or right hand. It was predicted that out-of-phase bimanual tapping would reveal more variability than unimanual tapping, and synchronized bimanual tapping would have the lowest variability. In addition, individuals with reduced handed dominance would have lower variability in synchronized bimanual movements, but higher variability in unimanual and out-of-phase bimanual tapping than those with strong handed dominance. Results generally revealed that the out-of-phase bimanual tapping resulted in greatest mean variability, followed by unimanual tapping. The synchronized bimanual condition had the least mean variability (left hand variability ranged from marginal to strong significance: P = .67 - .01; right hand variability marginally significant: P = .49- .05; between hands variability strongly significant: P < .00). Handedness score was significantly correlated with the variability for right-hand unimanual tapping and right-hand lead out-of-phase bimanual tapping (both P <.05). These results suggest that stronger right-handed individuals tend to perform well on tasks in which the right hand plays dominant roles. More left-handers are under recruitment to further evaluate the importance of handedness on unimanual and bimanual coordination.

B124

WHAT AFFECTS AUDITORY FEEDBACK IN SPEECH MOTOR CONTROL?

Clara Martin[1,2], Jon Andoni Duñabeitia[1], Caroline A. Niziolek[3], Manuel Carreiras[1,2], John F. Houde[3]; [1]BCBL, San Sebastian, Spain, [2]Ikerbasque, Bilbao, Spain, [3]University of California at San Francisco — When a speaker's auditory feedback is altered, he compensates for the perturbation by altering his own production, which demonstrates the role of auditory feedback in speech motor control. In the present study, we explored the role of hearing competence and executive control in this process. Spanish native speakers performed (1) an altered feedback compensation experiment, (2) a numerical Stroop task and (3) a hearing competence questionnaire. (1) In the compensation experiment, subjects had to produce the pseudoword "pep" while perceiving their auditory feedback in real time through earphones. The auditory feedback was first unaltered and then progressively altered in F1 and F2 dimensions until maximal alteration (F1 -150; F2 +300). Around 80% of the participants compensated for the alteration. (2) Individual measures of inhibition of conflicting information capacities were obtained from the results in the Stroop task. When comparing participants with high versus low level of inhibition, we observed that the former compensated slower than the latter. (3) Additionally, we compared participants with high versus low hearing competence, based on subjective values obtained from the questionnaire. Participants who self-reported a high hearing competence compensated slower and to a lesser degree than participants with low hearing competence. We concluded that speech motor control depends on hearing competence and executive control capacities. We suggest that being good at inhibiting conflicting information (and/or having good hearing competence) makes participants better at detecting and inhibiting conflicting altered auditory feedback, leading to a slower compensation.

B125

ERP COMPONENTS UNDERLYING PRISM ADAPTATION

Stephane MacLean[1], Yoko Ishigami[1], Cameron Hassall[1], Olave Krigolson[1], Gail Eskes[1]; [1]Dalhousie University — Adapting to visual field-displacing prism goggles plays a crucial role in improving spatial neglect, by shifting visual orienting in the opposite direction. Immediate strategic recalibration of visuomotor aiming and slower visuo-motor spatial realignment (Redding & Wallace, 2002) are suggested processes involved in PA. Vocat et al (2011) showed that event-related brain potentials (ERPs) were associated with size of errors during PA. The purpose of our study was to replicate and extend these findings to examine ERPs over a longer and more typical time course of adaptation. Twenty-two participants executed goal directed reaching movements to targets presented on a touchscreen monitor. During reaching, participants wore goggles that contained sham or prism lenses alternating over 13 blocks. Endpoint errors and the ERPs associated with movement completion were examined as a function of time-course (divided into early, middle, and late thirds within each block) and averaged over sham and prism conditions. Adaptation to prism goggles was confirmed by a decrease in error magnitude over the prism blocks, and by an increase in errors in the following sham blocks (aftereffect) that also diminished over time. Movement completion elicited two ERP components with different time course properties during exposure: an ERN component that remained constant in latency and amplitude during each block, and a P200 component that showed a decrease in amplitude from early to late phases of adaptation. These results suggest two neural processes underlying prism adaptation: an invariant ERN response sensitive to error commission and a P200 response possibly reflecting conscious visuomotor re-calibration.

PERCEPTION & ACTION: Multisensory

B126

MAGNIFICATION OF THE HAND INCREASES MOTOR EVOKED POTENTIAL

H. Branch Coslett[1], Olu Faseyitan[1], Jared Medina[2]; [1]University of Pennsylvania, [2]University of Delaware — Enlarging the image of one's hand has been demonstrated to increase tactile acuity and alter the perception of pain. To date there is little evidence of magnification effects on motor performance. MEPs, a measure of motor system excitability, were assessed in the first dorsal interosseus muscle of 17 right-handed normal subjects using single-pulse Transcranial Magnetic Stimulation (TMS) at 120% of motor threshold. There were 3 blocks of 40 trials. In the first and third blocks subjects sat in a comfortable chair gazing at their right hand resting on a table directly in front of them. In the second block subjects viewed their hand through a 2.2x magnifying lens. For each subject, the grand mean MEP from all artifact-free trials (>95% of trials) was determined; trials deviating by more than 2 SDs from the grand mean were discarded. To adjust for the variability in MEPs across subjects, each MEP was divided by the grand mean. Mean MEPs for the three blocks were .967, 1.074, and .974 respectively; that is, magnification increased mean MEP by approximately 10%. The mean MEP with magnification was significantly larger than the first and third conditions (p=.027 and p=.028, respectively) and the first and third conditions did not differ from each other. The effect was also significant across subjects as 14/17 subjects had larger MEPs with magnification (Chi-square p<.05). These findings have implications for the understanding of visuo-motor interactions and may have important consequences for therapy.

B127

ERP MARKERS OF PERCEPTION AND ACTION REVEAL THAT THE MAGNITUDE OF DELAY MATTERS FOR MEMORY-GUIDED REACHING

Leanna Cruikshank[1], Jeremy Caplan[1], Anthony Singhal[1]; [1]University of Alberta — Delayed action research has suggested that perceptual information about a visual stimulus decays over several seconds. In exchange, visuomotor behaviour is thought to rely more on working memory as delays increase. Recently, Cruikshank et al. (2012) found that the N170 ERP component reflected ventral-stream processes linked to motor planning and perception for action. Specifically, the N170 was larger for actions that relied on perceptual-based information. However, the delay was very short (tens of ms). Behavioral and neuroimaging studies suggest that when longer delays are employed, reactivation of ventral areas is necessary in order to access a stored representation of the target's characteristics. Therefore, the N170 may reflect not only perception-for-action processes, but the accuracy of the representation. We traced the timecourse of the N170 in memory-guided reaching when 1, 2, and 3 s delays separated target occlusion and response initiation. We also tested whether the P300 component might track the increasing demand on working memory with increasing delay. During reach-initiation, the N170 was more negative and peaked

earlier for the 1-s than the 2-s and 3-s delays and correlated significantly with performance at the longest delay. The P300 was more positive for the 2-s and 3-s delays than the 1-s delay. These results suggest that the neural mechanisms involved in movement planning change for delays beyond 1 s. The larger N170 and P300 may reflect an impoverished visual perceptual representation in the ventral stream and an increasing tax on working memory, respectively.

B128

THE SOUND-INDUCED PHOSPHENE ILLUSION Silvia Convento[1], Martina Fusaro[1], Giuseppe Vallar[1,2], Nadia Bolognini[1,2]; [1]University of Milano-Bicocca, Milan, Italy, [2]IRCCS Istituto Auxologico Italiano, Milan, Italy — Cross-modal illusions show how perception can be dramatically altered by interactions between senses. For example, when a single flash is accompanied by multiple beeps, it is perceived as multiple flashes. This effect is known as the Sound-induced Flash illusion (Shams et al., 2000). To verify whether this illusion is generated in primary visual areas, and the association between visual cortical excitability and auditory stimulation, we create the Sound-induced Phosphene illusion. In Experiment 1, healthy participants performed the standard task for the Sound-induced Flash illusion and the phosphene version of the same task, in which external flashes were replaced by phosphenes induced by Transcranial Magnetic Stimulation (TMS) of the primary visual areas. In Experiment 2, we then characterized the temporal window within which sounds can alter vision perception. When TMS is accompanied by two auditory beeps, the second beep induces the perception of an illusory second phosphene, namely the Sound-induced Phosphene Illusion. This perceptual effect, namely the "fission" of a single phosphene, due to multiple beeps, is not matched by a "fusion" of double phosphenes due to a single beep and is characterized by an early auditory modulation of the TMS-induced visual responses (~80 ms). We conclude that auditory alteration of visual perception as reflected by the Sound-induced Phosphene illusion is causally linked to the auditory modulation of activity in the visual cortex. An auditory stimulation may cause a phenomenological change in the conscious visual experience produced by occiptial TMS, revealing crossmodal binding mechanisms within early stages of visual processing.

B129

CATEGORY REPRESENTATION ACROSS THE OLFACTORY SENSORY HIERARCHY Jaryd Hiser[1], Takuya Sato[2], Wen Li[1]; [1]University of Wisconsin-Madion, [2]Kikkoman USA R&D — Human olfactory sensory encoding is an area that is understudied, and it is unclear how odor categories are represented. Using pattern correlation and classification (support vector machine/SVM), this study examined representations of odor category, odor affective valence, and motivational value in ensemble neuronal activity at different levels of the olfactory sensory hierarchy. Participants (N=20) smelled an odor at a merely detectable level from one of three categories (food, floral, or wood) while viewing a picture that was congruent or incongruent to the odor, and then made a category decision on the odor. Based on SVM pattern classification, fMRI response patterns in all levels of olfactory sensory hierarchy could be separated by perceived odor category. However, only in anterior piriform cortex, a low-level olfactory cortex, is stimulus-based odor classification supported. These findings suggest that the perceptual experience rather than the sensory input dominates the response patterns in the olfactory sensory hierarchy (except for the low-level area that preserves considerable fidelity to the sensory input). Pattern correlation analysis showed greater relatedness in response patterns for within than between category trials in posterior piriform cortex, orbitofrontal cortex, and amygdala, albeit only based on perceived (vs. actual) odor categories. Notably, this effect was primarily observed in the food category, suggesting that response convergence is facilitated by the incentive value of the percept. This dimensional measure of categorization aligns with the behavioral results that showed greater accuracy and faster response times for food classification.

B130

SEQUENTIAL ROLES OF PRIMARY SOMATOSENSORY CORTEX AND POSTERIOR PARIETAL CORTEX IN TACTILE-VISUAL CROSS-MODAL WORKING MEMORY: A SINGLE-PULSE TRANSCRANIAL MAGNETIC STIMULATION (SPTMS) STUDY Yixuan Ku[1], Di Zhao[1], Yong-Di Zhou[2]; [1]The Key Lab of Brain Functional Genomics, MOE & STCSM, Institute of Cognitive Neuroscience, School of Psychology and Cognitive Science, East China Normal University, [2]Department of Neurosurgery, Johns Hopkins University — Both monkey neurophysiological and human EEG studies have shown that association cortices, as well as primary sensory cortical areas, play an essential role in sequential neural processes underlying tactile-visual cross-modal working memory. In the present study, to further examine the neural mechanisms of tactile-visual cross-modal working memory, we applied individual MRI-based single-pulse transcranial magnetic stimulation (spTMS) to bilateral primary somatosensory cortices (SI) and the right posterior parietal cortex (PPC), while subjects were performing a tactile-visual cross-modal delayed matching-to-sample task. Time points of spTMS were 300ms, 600ms, 900ms after the onset of the tactile sample stimulus in the task. The accuracy of task performance and reaction time were significantly impaired when spTMS was applied to the right SI, (contralateral to tactile stimulation) at 300ms. Performance impairment on accuracy was also observed when the right PPC was stimulated at 600ms. These results indicate that SI and PPC play distinct roles in sequential neural processes of cross-modal associations and working memory.

B131

READING BRAILLE BY TOUCH AND BY SIGHT: THE PRELIMINARY RESULTS OF A LONGITUDINAL FMRI STUDY ON MULTIMODAL READING IN SIGHTED SUBJECTS. Katarzyna Siuda[1], Łukasz Bola[2], Małgorzata Papli ska[3], Ewa Sumera[4], Marcin Szwed[1]; [1]Jagiellonian University, [2]University of Warsaw, [3]The Maria Grzegorzewska Academy of Special Education, [4]Institue for the Blind and Partially Sighted Children, Cracow — Reading Braille in congenitally blind subjects activates the Visual Word Form Area, a ventral visual stream area known to develop expertise for reading in sighted (Reich et al., 2011). This surprising finding challenges the canonical, sensory-based (visual, tactile...) division-of-labour in the brain. To further investigate this issue, we sought to determine which brain regions are activated by Braille reading in sighted readers who lack the large-scale plasticity that appears in blind's visual system. The subjects were 34 sighted Braille students and teachers. Some already learned how to read visually presented Braille (VisualBraille), e.g. through correcting blind children's homework, but no one read it tactilely. All performed a Lexical Decision Task on words in latin alphabet and VisualBraille. Next, the subjects underwent an fMRI experiment involving reading latin, VisualBraille and TactileBraille, scrambled controls, and touching and imagining objects. Currently, the subjects are enrolled in an intensive TactileBraille course, to be followed by an identical fMRI. Here we describe only the results of the first fMRI. Behavioural data revealed a strong word length effect in VisualBraille, suggesting that it was read sequentially. fMRI showed that VisualBraille strongly activates the VWFA relative both to scrambled control and to latin reading. Major VisualBraille activations in the left Inferior Frontal Gyrus and Inferior Parietal Sulci suggested an important attentional component in this process. Additionally, the Lateral Occipital Tactile Visual area was activated by touching objects vs. imaging objects, replicating the results of Amedi et al., 2001. These results first describe VisualBraille reading mechanisms.

B132

COMPENSATORY CROSS-MODAL PLASTICITY AND CORTICAL RESOURCE RE-ALLOCATION IN EARLY-STAGE HEARING LOSS Julia Campbell[1], Anu Sharma[1]; [1]University of Colorado at Boulder — Auditory deprivation is associated with re-organization of the cortex. For example, in deafness, cross-modal re-organization has been shown to take place where intact sensory modalities, such as vision, recruit auditory cortical regions for enhanced visual processing. Additionally, in hearing loss, atypical cortical networks are often utilized for auditory processing. This resource re-allocation increases cognitive load, which has recently been associated with an increased risk for dementia in older adults with hearing loss. However, it remains unclear whether cortical re-organization is caused only by near-total auditory deprivation, as in deafness, or whether individuals with early-stage hearing loss also exhibit this compensatory plasticity. With this in mind, we used high-density EEG to record visual and auditory evoked potentials (VEP and AEPs) in 17 adults, 9 with early-stage hearing loss. Results for the hearing loss group indicated that decreased VEP latency correlated well with poor speech perception in background noise on a clinical

test (r = -0.7, p = 0.001). Source localization (sLORETA) showed evidence of cross-modal plasticity, with auditory cortical areas activated by visual stimulation (Campbell and Sharma, 2013, submitted). Furthermore, source localization during auditory processing revealed decreased temporal cortical activation and increased frontal network activity in early-stage hearing loss (Campbell and Sharma, 2013, Frontiers in Systems Neuroscience). Overall, our findings provide the first evidence that cross-modal plasticity and cortical resource re-allocation occur in early-stage hearing loss, and may be an important factor in clinical outcomes. Supported by NIDCD F31DC011970 to JC and NIDCD R01DC0625 to AS

PERCEPTION & ACTION: Vision

B133

DYNAMIC SHIFTS IN CONNECTIVITY BETWEEN FRONTAL, OCCIPITAL, HIPPOCAMPAL AND STRIATAL REGIONS CHARACTERIZE STATISTICAL LEARNING OF SPATIAL PATTERNS

Elisabeth A. Karuza[1], Lauren L. Emberson[1], Matthew E. Roser[2], Michael Gazzaniga[3], Daniel Cole[1], Richard N. Aslin[1], Jozsef Fiser[4]; [1]University of Rochester, [2]University of Plymouth, [3]UC Santa Barbara, [4]Central European University — Extensive behavioral evidence has revealed that humans automatically develop internal representations that are adapted to the temporal and spatial statistics of the environment. However, the neural systems underlying this statistical learning process are not fully understood. Recently, various neuroimaging methods have been employed to examine this topic, but these studies have focused exclusively on temporally ordered stimuli. Since spatial structure is a hallmark of object and scene perception in vision, the present functional magnetic resonance imaging (fMRI) study investigated the substrates and processes underlying complex spatial pattern learning. Neuroimaging data were obtained while 20 subjects passively viewed artificially created scenes with a pre-specified pair-based statistical structure. After three runs of exposure to 144 different 6-element scenes, subjects performed a yes/no task on base-pairs and cross-pairs. Using seed regions defined by relating magnitude of activation to this post-exposure behavioral learning performance, we examined changes in functional connectivity over the course of learning. In addition to a general increase in connectivity throughout exposure, we find a specific connectivity relationship between frontal, occipital, hippocampal and subcortical areas that was dynamically reconfigured as learning progressed. Specifically, we show that connectivity with frontal regions shifted from early visual areas to subcortical areas when comparing early and late phases of exposure. These results suggest that learning is not fully captured by a single, fixed "learning" network, but is reflected at least partially in dynamic shifts in connectivity across numerous cortical and subcortical areas.

B134

THE NOTION OF THE MOTION: THE NEUROCOGNITION OF MOTION LINES IN VISUAL NARRATIVES

Neil Cohn[1], Stephen Maher[2]; [1]University of California, San Diego, [2]McLean Hospital, Harvard Medical School — Motion lines appear ubiquitously in drawings to depict the path of a moving object, most popularly in comics. Some researchers argue that these lines tie to the "streaks" appearing in the visual system when a viewer tracks an object (1). However, previous studies do not use motion lines' natural context of comics, only depict limited actions (usually just running), and only use offline measurements of behavior like recall or subjective ratings. Here, we directly examined the cognition of motion lines by comparing images in comic strips that depicted normal motion lines with images that either had no lines or reversed, anomalous lines. In Experiment 1, participants' self-paced viewing times were faster to images with normal lines than no lines, which were faster than to anomalous lines. In Experiment 2, using event-related panels (ERPs), we found a posterior positivity to the absence of normal lines (anomalous and no lines), consistent with positivities to event comprehension in language and visual actions (2). This effect differed from the frontal positivity evoked by the presence of anomalous lines, resembling a P300a. These results suggested that normal motion lines do not just facilitate comprehension, but the absence of lines impairs the understanding of depicted events. Furthermore, participants' "comic reading expertise" modulated the magnitude of effects in both experiments, suggesting motion lines are not tied to aspects of the visual system, but rather are conventionalized parts of the "visual language" of comics. 1. D.C. Burr, Current Biology 10,12 (2000) 2. G. Kuperberg, Brain Research 1146 (2007)

B135

DISTINGUISHING THREE PREFRONTAL PROCESSES IN PERCEPTUAL DECISION-MAKING: A TMS-FMRI STUDY

Dobromir Rahnev[1], Alina Larson[1], Mark D'Esposito[1]; [1]UC Berkeley — The prefrontal cortex (PFC) is thought to control several aspects of perceptual decision-making including attentional, decisional, and metacognitive processes. Based on previous research, we hypothesized that these control mechanisms are performed by separate regions along the lateral PFC. We tested this hypothesis by applying, on different days, theta-burst transcranial magnetic stimulation (TBS) to the frontal eye fields (FEF), dorsolateral PFC (DLPFC), and anterior PFC (aPFC), as well as to somatosensory cortex that served as a control region. These regions were functionally identified for each individual (N = 17) on a separate day in which subjects performed our psychophysical task in the MRI scanner. The task combined spatial attention, speed-accuracy manipulation, and confidence ratings. The results confirmed our hypothesis about differential involvement of the three PFC regions in our task. First, TBS to FEF impaired attentional processes: it decreased the difference in response times between invalidly and validly cued stimuli. Second, TBS to DLPFC affected the decisional mechanisms in that it led to decreased ability to follow speed/accuracy instructions. Indeed a diffusion model fit to the data showed that after TBS to DLPFC subjects were impaired in adjusting the decision threshold in trials in which they were asked to emphasize speed or accuracy. Third, TBS to aPFC affected metacognitive processes such that it altered the extent to which subjects' confidence ratings predicted their accuracy on a trial-by-trail basis. Overall, our study provides causal evidence for a mapping of separate control processes related to perceptual decision-making to regions the lateral PFC.

B136

PHOBIC RESPONSES TO MASKED STIMULI: A DISSOCIATION BETWEEN PHYLOGENETIC AND ONTOGENETIC PHOBIAS

Nicholas Root[1], Kelsey Baron[1], Zubin Shah[1], Vilayanur Ramachandran[1]; [1]Center for Brain and Cognition, University of California San Diego — Although past studies have shown that masked images of phobic objects elicit skin conductance responses (SCRs) in phobic subjects, the phobias in the study - snake and spider - were both phylogenetic in origin. We wondered if subjects with ontogenetic phobias, such as a needle phobia, would show a similar pattern of SCRs. We recruited subjects with snake, spider, and needle phobias, and measured their SCR while they viewed images of their phobias that were sometimes masked using Continuous Flash Suppression. We found an interaction between phobia type and conscious awareness: in the unconscious case, SCR to phylogenetic and ontogenetic phobic objects differed. We suggest that the physiological responses to phylogenetic and ontogenetic phobias might be driven by different brain mechanisms.

B137

EXPLORING THE NEURAL DYNAMICS OF OCCIPITAL AND PARIETAL PHOSPHENES WITH COMBINED TMS-EEG

Jason Samaha[1], Olivia Gosseries[1], Bradley R. Postle[1]; [1]University of Wisconsin - Madison — One promising approach to mapping the neural dynamics of consciousness is to stimulate brain regions that give rise to conscious percepts while simultaneously recording brain activity. Applying transcranial magnetic stimulation (TMS) to early visual cortex can induce brief visual percepts called phosphenes. Several groups have also reported phosphenes resulting from a posterior parietal stimulation site, but the neural signatures of these percepts are poorly understood. We investigated the neural dynamics associated with awareness of phosphenes by finding stimulation thresholds for each participant such that approximately 50% of trials gave rise to conscious percepts while the other half did not. This was done for both occipital and parietal stimulation sites. Concurrently recording electroencephalography (EEG) allowed us to contrast activity in phosphene-absent from phosphene-present trials, while holding all stimulus parameters constant. Preliminary analyses of the TMS-evoked response reveal a relatively late (>300ms) event-related potential component at the site of stimulation (O2 and P4) that differentiates the phosphene-present from phosphene-absent trials. Additionally, pre-stimulus oscillatory activity in the alpha

and theta bands at these parietal and occipital sensors was predictive of whether or not stimulation would result in report of a conscious percept. These findings are in line with theoretical accounts of consciousness involving late, re-entrant processing, and support previous findings indicating that low-frequency oscillatory dynamics can index the moment-to-moment excitability of cortical areas.

B138

ONLINE CORRECTIVE HAND MOTIONS TO SUPPRESSED VISUAL INFORMATION DURING SACCADES Elon Gaffin-Cahn[1], Bradford Mahon[1,2]; [1]Department of Brain and Cognitive Sciences, University of Rochester, [2]Department of Neurosurgery, University of Rochester Medical Center — Navigating the environment frequently necessitates the online correction of a body movement. In humans, these updates are most often mediated through vision. Even when the environment is stable, producing a fast and accurate updated motor plan has an added dimension of complexity because our eyes are repeatedly moving to fixate on different parts of the environment. Previous research shows that online visuomotor corrections can be made during a saccade, despite individuals being perceptually unaware of any environmental disturbance to high contrast, broadband targets due to saccadic suppression. However, the fate of stimuli that are subject to intra-saccadic suppression is unknown. For example, are low spatial frequency gratings which are presented during a saccade suppressed entirely, or are they only suppressed to visual perception but still available to influence the motor system? We tested this across a series of experiments in which participants saccaded and pointed to low contrast, spatial frequency-filtered images and isoluminant images. During the saccades, the stimuli were displaced. We found that visual information suppressed to perception retains a powerful influence over the motor system. We further explored the timing and spatial frequency characteristics of stimuli in order to define the range within which stimuli do not break through to perceptual awareness, but nevertheless contribute to be available to visuomotor processes. Our findings promote the idea that the visuomotor system acts in an optimal manner and is not limited by constraints on perception.

B139

FEMALE SUPERIORITY IN RED COLOR PERCEPTION Soyeon Kim[1], Marisa Carrasco[2], Samantha Chen[1], Mohamed Al-Haj[1], Stuart Fuller[2], Rosemary Tannock[1]; [1]University of Toronto, [2]New York University — Objectives: Females may be superior to males in perception of the color red. This sexual dimorphism may have its origin in hunter-gather societies in which females needed to hone their skills in gathering ripe red fruits or edible leaves to enhance survival of their clan. We hypothesized that if red color perception had been advantageous for females, traces of that sexual dimorphism should still be discernible. However, findings to date are equivocal, in part because most studies have focused solely on discrimination of hue rather than color saturation, which influences the vividness of a color and so highly relevant for spotting edible fruit. In the present study, we investigated sex differences in hue and color saturation discrimination. Methods: We examines color perception in 30 healthy adults (50% male; Mean age: 24) using a novel psychophysical paradigm to measure the perceived color saturation (intensity) of red versus blue, with contrast sensitivity as a control condition. Participants were required to determine whether the more colourful stimulus (or that with higher contrast) is tilted to the left or right. We also used an established measure of hue perception (Farnsworth-Munsell 100 Hue Test). Results: We found that females were more accurate in discriminating red saturation than males ($p = .02$; ES =.95), but there were no sex differences in accuracy in discriminating blue saturation, contrast sensitivity, or perception of hue. Conclusion: The robust superiority in Red saturation discrimination in females demonstrated in this study supports evolutionary hunter-gatherer theories which posit sex-specific functional specializations.

THINKING: Decision making

B140

MID-FRONTAL ORIGIN OF DOPAMINE TEMPORAL DIFFERENCE DYNAMICS Massimo Silvetti[1], Tom Verguts[1]; [1]Ghent University — The majority of dopaminergic neurons in the ventral tegmental area (VTA) respond initially to unconditioned rewarding stimuli, but after conditional training, to arbitrary stimuli that are predictive of incoming reward (Schultz et al., 1986). This dynamics is typically interpreted in terms of a specific class of reinforcement learning algorithms, called temporal difference (TD) learning (Schultz et al., 1997). This approach suggested that VTA computes TD signals to formulate reward expectations. Nonetheless several empirical findings challenged the classical TD-related explanation of VTA dynamics (Pan et al., 2005). Moreover, it remained unclear whether such a temporal dynamics was computed directly by the VTA or originated from other brain structures. Here we propose a novel neuro-computational account of VTA dopaminergic dynamics. Our findings are based on an already existent neural model concerning reinforcement learning operations in the anterior cingulate cortex, the VTA and their interactions: the Reward Value Prediction Model (RVPM, Silvetti et al., 2011). We propose that VTA dynamics derives from processing of signals afferent from the ACC, with the purpose of training yet other brain areas. To test this hypothesis, we ran four computer simulations where we administered to the RVPM several sessions of classical conditioning. Through the ACC-VTA interaction, we successfully managed to reproduce the most relevant findings on dopamine dynamics, like dopamine shifting from reward period to cue period, summation and overshadowing effects, blocking, and dopamine dynamics in paradigms with multiple cues. These results allowed us to provide a comprehensive set of simulations about dopaminergic activity of mammalian brainstem.

B141

BASAL GANGLIA RELOADED: A MODEL OF TONIC DOPAMINE EFFECTS ON SELECTIONS IN A CHANGING ENVIRONMENT Vincenzo G. Fiore[1], Francesco Rigoli[1], Rick Adams[1], Raymond J. Dolan[1]; [1]Functional Imaging Laboratory, Wellcome Trust Centre for Neuroimaging at UCL — Two major families of models have described the neural dynamics and mechanisms characterising the striato-thalamo-cortical loops and the associated selection performed within the basal ganglia (Gurney et al. 2001a,b, Frank et al. 2004, and subsequent). We assess key features of these models under different conditions of dopaminergic release and concentrations of either D1 and D2 dopamine receptors. Simulations show the main role played by tonic dopamine within the striatum is to alter the gain of channels present in the basal ganglia: increased dopamine release enhances the gain of the most salient stimuli (via D1) clearing the signal from noise and -if strongly increased- causing maintenance of selection despite changes in the environment, resembling compulsive behaviour or addiction (distractors are ignored and selection of weakened/vanished stimuli can be preserved). Decreased dopamine enhances the gain of the least salient stimuli (via D2) favouring a switch to competing options and behaviour that adapts to changes in the environment (in healthy agents it favours exploration, in pathological agents it causes ambitendency). Thus selection -of actions, attention or goals- is determined by a balance among direct, indirect and hyperdirect (via the subthalamic nucleus) pathways. Although D1 and D2 activities contribute to GO and NoGO effects, changes in their activity ratio lead to more complex effects. In particular, higher D2 activity (as postulated in schizophrenia) dramatically increases the system's sensitivity to small changes in dopaminergic transmission, causing instability of response selection or simultaneous selection of competing responses. Behavioural tests of these predictions are ongoing.

B142

DOPAMINERGIC INTERVENTION IMPROVES PROBABILISTIC REWARD-LEARNING IN PARKINSON'S DISEASE. Joseph Kim[1], Scott Wylie[1], David Zald[1], Daniel Claassen[1]; [1]Vanderbilt University — In the current study, we sought to examine the effect of levodopa on probabilistic reward-learning in Parkinson's disease (PD). Specifically, we investigated: (i) whether levodopa monotherapy improves reward-learning in PD patients, (ii) whether the magnitude of levodopa-dependent changes in reward-learning is mediated by PD patient's disease severity, and (iii)

whether and how levodopa alters choice-behavior patterns over the course of the task, as compared to age-matched healthy controls and patients at baseline. We used a dynamic foraging task in which participants must choose between two locations based on probabilistic differences in reward feedback that reverse over time. We fit 19 PD patients' choice-behavior from this task using a reinforcement-learning model. Results indicated that Off-medication motor symptom severity positively correlated with the magnitude of improvement in reinforcement-learning on medication ($r=.58$, $p < 0.01$). Secondly, while healthy controls exhibited a pattern of increased improvement (more frequently choosing the side associated with greater reward probability) as the task progressed, PD patients Off-levodopa showed the opposite pattern, reflecting a "deterioration" of choice-behavior over time (i.e., significant Time by Group interaction, $p < 0.05$). In contrast, PD patients On-levodopa showed a trend toward improved performance as the task progressed, which suggested that levodopa-dependent improvement in reward-learning may be partly due to a dopamine-based restoration of improved learning over time. These results highlight the importance of dopamine functioning in probabilistic reward-learning, with levodopa monotherapy producing improvements proportional to baseline motor deficits, and suggest that these improvements are related to modulation of reward-learning circuitry affected in PD.

B143

PROCESSING OF POSITIVE AND NEGATIVE FEEDBACK IN HEALTHY AGING

Martina Rustemeier[1], Christian Bellebaum[2]; [1]Ruhr University Bochum, Germany, [2]Heinrich Heine University Düsseldorf, Germany — The basal ganglia and the anterior cingulate cortex (ACC) both belong to the so-called reward system. They receive dopaminergic projections and are critically involved in reward feedback processing. Probably due to an age-associated decline of the dopamine level, aging is associated with altered processing of feedback stimuli. In young adults, a bias for better learning from negative feedback is reflected in processing differences between positive and negative feedback. The present study compared feedback processing in older (mean age 65 years) and younger (mean age 25 years) healthy positive and negative learners. Participants performed a probabilistic feedback learning task with monetary rewards, while event-related potentials (ERPs) were recorded. We expected that older, as younger, negative learners show stronger responses to negative feedback, as reflected in their amplitudes of the feedback-related negativity (FRN), an ACC-driven ERP component, despite a general attenuation of the FRN. An interaction between age and feedback type emerged. Younger subjects showed higher FRN amplitudes for negative feedback than older participants. In contrast to the seniors, the younger subjects differentiated between feedback types with higher FRN amplitudes for negative than positive feedback. Besides, an interaction between learning group and feedback type was found. Across age groups, only positive learners differentiated between positive and negative feedback. This effect was driven by reduced FRN amplitudes for positive feedback in positive learners. Our results indicate age-associated differences in feedback processing. But independent of age, the individual learning bias is reflected by the way how different feedback types are processed.

B144

INDIVIDUAL DIFFERENCES IN TEMPORAL DISCOUNTING AMONG OLDER ADULTS: A FUNCTIONAL MRI STUDY

Kameko Halfmann[1], William Hedgcock[1], Joseph Kable[2], Natalie L. Denburg[1]; [1]University of Iowa, [2]University of Pennsylvania — Temporal discounting refers to the tendency to value immediate gains more than distant gains. The subjective value of an immediate compared to distant gain varies substantially from one person to the next. In the last decade, a corpus of research has been conducted to understand the neural correlates of temporal discounting and subjective value. In fact, research in young adults has shown that there is a network of neural regions reliably associated with the subjective valuation of rewards. This network of regions includes areas such as the ventromedial prefrontal cortex and striatum, both of which are also linked to age-related decline. Contradictory to intuition, advancing age is associated with lower discount rates. However, to date, little work has investigated whether the same network observed in young adults is linked to subjective value among older adults. We aimed to fill this gap. We used an incentive-compatible intertemporal choice task to measure individual discount rates in twenty-nine healthy older adults (aged 56-90). Participants completed this task while undergoing BOLD-fMRI. Results are not fully consistent with previous work in younger adults. In other words, among older adults, subjective value was not associated with the typical pattern of activation. Further analysis demonstrated that individual differences in complex decision-making modify the relationship between activation and subjective value. This occurred in the absence of differences in intellectual or cognitive abilities. This is consistent with the view that there are deviations in affective processing among older adults, which impact the neural instantiation of subjective value.

B145

THE INFLUENCE OF MOTIVATION ON COGNITIVE FATIGUE IN INDIVIDUALS WITH MULTIPLE SCLEROSIS: AN FMRI STUDY.

Ekaterina Dobryakova[1], John DeLuca[1], Helen Genova[1], Nancy Chiaravalloti[1], Glenn Wylie[1]; [1]Neuropsychology and Neuroscience Laboratory, Kessler Foundation Research Center — Large numbers of individuals with multiple sclerosis (MS) experience cognitive fatigue. Cognitive fatigue has been associated with impairment of a fronto-striatal network that has also been shown to be involved in affective and cognitive processes (e.g. effort calculation and reward valuation), suggesting a possible link between cognitive fatigue and reward processes. Here, we explored this link in persons with MS. We hypothesized that an inflated perception of effort requirements to perform an action and underestimation of the reward value leads to cognitive fatigue that arises when the functioning of the these regions is disrupted (Dobryakova et al., 2013). Manipulating motivational salience during a task may modulate the expression of cognitive fatigue in individuals with MS. We recruited individuals with MS who experience cognitive fatigue and healthy subjects (HC). While performing a task in an MRI scanner they were presented with a reward and a no reward condition where they were able to win a monetary reward or were not presented with such opportunity. Self-reported fatigue ratings were also acquired during the scan. Data showed that striatal activity in MS group is less robust relative to HCs, who showed significantly increased striatal activation when winning money. MS subjects reported a 20% decrease in cognitive fatigue during the task when switching from the reward to a no reward condition. This suggests that MS subjects with fatigue may judge a given reward amount differently from HCs and that motivation can modulate

B146

RAPID INTERMITTENT DEEP BRAIN STIMULATION BIASES BEHAVIOR IN FINANCIAL DECISION-MAKING TASK

Shaun Patel[1,2], Sameer Sheth[1], Matthew Mian[1], Sarah Bourne[1], Jimmy Yang[1], Alice Flaherty[1], Emad Eskandar[1]; [1]Harvard Medical School, [2]Boston University School of Medicine — We report single-unit responses recorded from the human subthalamic nucleus (STN) in patients undergoing deep brain stimulation while engaged in a financial decision-making task. The task is modeled as a simplified version of the classic card game "war". The subject is dealt a card and asked to make a high or low wager ($5 or $20). Immediately following their choice they are shown their opponent's card––the player with the highest card wins. We recorded 20 individual neurons from 5 patients. We found that during the go-cue period, neuronal activity in the STN predicted whether the subject would ultimately bet high or low on trials where the probability of a positive or negative outcome were equal (6-card trials, two-tailed t-test, $p = 0.03$). To explore this further, we used intermittent electrical stimulation to assess changes in financial decision-making. Using modified stimulator we applied one of three stimulation conditions during 6-card trials: no stimulation, 1 sec of stimulation at the fixation, or 1 sec of stimulation at the go-cue epoch. We found that intermittent stimulation at the go-cue epoch––the same period STN neurons encode the upcoming decision––biases subject to make a low wager (binomial proportion, 95% c.i.). Fixation and no stimulation categories had no effect on decision-making. In this study, we demonstrated that neuronal activity in the dorsal STN predicts financial decisions. We then showed that we could apply intermittent electrical stimulation through the implanted electrode to bias the decision signal and ultimately alter the subject's behavior.

THINKING: Problem solving

B147

SOURCES OF INDIVIDUAL VARIABILITY IN MATH PROBLEM SOLVING SKILLS IN CHILDREN WITH AUTISM SPECTRUM DISORDER

Teresa Iuculano[1], Kaustubh Supekar[1], Katherine Cheng[1], Vinod Menon[1]; [1]Stanford University — Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by a complex phenotype including social, communication and sensorimotor processing deficits. Yet, recent evidence suggests that some individuals with ASD might exhibit cognitive strengths in various domains. One domain in which individuals with ASD often seem to succeed is mathematics, yet heterogeneity has been largely reported in the population. Here we use psychometric as well as neurobiological measures to investigate sources of individual variability in math problem solving skills in a population of 17 children with ASD (mean age = 9.85, SD = 1.7). We found no correlations between ASD's calculation abilities and intelligence scores, nor symptoms severity scores (all ps = n.s). Individual variability in math problem solving was instead significantly explained by neurobiological factors. Specifically, analyses of functional Magnetic Resonance Imaging (fMRI) signal - acquired during math problem solving - showed that activation levels as well as multivariate activation patterns of activity of the fusiform gyrus in the ventral temporal-occipital cortex (VTOC) uniquely predicted individual math problem solving abilities in ASD. Moreover, the strength of the functional coupling between the same region in the VTOC and the medial temporal lobe (MTL) significantly correlated with better math problem solving abilities in ASD. These results suggest that sources of individual variability in ASD's math problem solving skills arise from a unique pattern of brain organization characterized by greater recruitment of posterior regions of the ventral stream and their functional coupling with memory systems.

B148

NEUROMYTHOLOGY OF EINSTEIN'S BRAIN

Terence Hines[1]; [1]Pace University — The idea that Einstein's brain was different from normal brains in both cellular structure and external morphology is based on studies that are chock-a-block with statistical, methodological and conceptual errors. These will be explored in detail in this poster. Diamond et al. (1985) claimed that Einstein's brain had more glial cells than control brains. This study used inappropriate control brains, incorrect statistics and probably selectively reported positive results. Anderson and Harvey (1996) found greater neuron density, but not more neurons, in one small area of Einstein's right frontal lobe. Studies of the patterns of sulci and gyri in Einstein's brain found differences found differences between Einstein's brain and control brains in the details of the gyral patterns. Falk et al. (2012) performed an excruciatingly detailed analysis that did,in fact, demonstrate that the gyral pattern of Einstein's brain wasn't the same as that of control brains. But who would have expected anything else? Human brains differ. The differences that were found were hardly ones that would suggest superior intelligence, although the authors desperately tried to spin their results to make it appear so. Similar problems exist for the recent claim by Men et al. (2013) that Einstein's corpus callosum was different from that of control brains.

B149

NEURAL BASIS OF NOVELTY AND USEFULNESS IN INSIGHTFUL CHUNK DECOMPOSITION

Jing Luo[1], Furong Huang[1], Xiaoping Ying[2]; [1]Department of Psychology, College of Education, Capital Normal University, [2]Institute of Sociology, Chinese Academy of Social Sciences — Although it has been widely recognized that the novelty and usefulness are two key features of creative thinking, the cognitive brain mechanism underlying these two processes are still unknown. This study tried to separate these two processes through insightful or non-insightful chunk decomposition task. In the study, the novelty was defined as the way of chunk decomposition was novel or not, while the usefulness was defined as the results of chunk decomposition was valid or not. We found: (1) the brain was most ready to process the "familiar and useful" type of chunk decomposition, then the "familiar and useless" and "novel and useful" one, and finally the "novel and useless" one. This was not only manifested in the difference in response time (RT) across the four types of decomposition, but also in the difference in the degree of suppression on the default mode network (DMN) activity. (2) The key area for the declarative and episodic memory system, the hippocampus, was found to be responsive to the usefulness of chunk decomposition, whereas the key area for the non-declarative or procedural memory system, the caudate in basal ganglia, was found to be responsive to the novelty of chunk decomposition. These findings reveal insight is not only a declarative learning process as usually proposed, but also a non-declarative process accompanying robust incremental learning and re-chunking of habit.

B150

HORMONAL CONTRACEPTIVES SHOULD, BUT MAY NOT, INFLUENCE COGNITION

Lena Ficco[1], Brittany J. Lewis[1], Neil Berthier[1]; [1]University of Massachusetts Amherst — The present study explores the cognitive effects of ethinyl estradiol (EE2), a common hormonal contraceptive. As an estradiol superagonist (Blair et al., 2000), EE2 has the potential to influence estrogen-sensitive cognitive processes, such as verbal (Mordecai, Rubin, & Maki, 2008) and spatial abilities (Zurkovsky, Serio, & Korol, 2011). To test this hypothesis, three groups of healthy young women completed a battery of estrogen-sensitive and -insensitive tasks. Subjects included naturally cycling females, tested near menses when estrogens are low, and two groups of hormonal contraceptive users. Hormonal contraceptive users were tested during either their hormone-free interval phase when endogenous estrogens and EE2 are low or active pill phase when endogenous estrogens are low and EE2 levels are high. Salivary estradiol levels were assayed. Results from a pilot study suggested significant differences in estradiol levels and navigation abilities favoring naturally cycling females over sugar pill phase females only; however, this study was underpowered (N = 30) and these findings were not replicated in a follow-up study which was sufficiently powered (N = 65). It is possible that the cognitive effects of EE2 are small enough to be detected only by very large sample sizes (in the thousands); however, this is not likely considering the high affinity of EE2 for estrogen receptors and the documented moderate to large effects of sex on spatial and verbal tasks (effect sizes of nearly 1.0 and 0.5, respectively, for review see Kimura, 2004). The present study does not provide evidence of cognitive EE2 effects.

LANGUAGE: Other

B151

NATIVE AND NON-NATIVE PERCEPTION OF NARRATIVE SPEECH

Hia Datta[1,2], Jason Zevin[2,3]; [1]Speech Language Pathology, Molloy College, [2]Sackler Institute of Developmental Psychobiology, Weill Cornell Medical College, [3]Department of Psychology, University of Southern California — Studies of the neural mechanisms of second language (L2) processing often focus on specific "components" of language such as speech sounds, words or grammar. However, understanding real-world L2 processing involving simultaneous demands across multiple levels of language processing requires use of naturalistic stimuli. Here, we applied cross-correlation analyses to compare response reliability between native and non-native listeners while listening to a continuous spoken narrative. Data were acquired from 11 native English and 11 native Japanese speakers while they listened to a recording of the "Pie Man" story used in Lerner et al.'s (2011) in a Functional Magnetic Resonance Imaging (fMRI) scanner. The preprocessed timeseries for each individual was correlated against the averaged timeseries for the 10 other individuals in their language group, permitting direct comparisons between groups. Significant correlations were observed in the Superior Temporal Gyrus, Middle Temporal Gyrus and Precuneus regions for English listeners. The activations of these brain regions, also reported by Lerner et al. 2011, suggest that the English listeners' processing of narrative discourse includes low level auditory processing of sounds (STG), semantic processing of words (MTG) as well as cognitive processes such as perceptual monitoring, memory retrieval and imagery. Significant correlations for the Japanese listeners were limited to bilateral STG and middle Frontal Gyrus. Differences between groups surfaced in a broad network, plausibly related to deeper processing of the story by the English compared to the Japanese listeners.

Poster Session C

ATTENTION: Other

C1

REWARD ASSOCIATIONS MEDIATE UNCONSCIOUS ATTENTIONAL CAPTURE DURING -SUBSTITUTION MASKING. Joseph A. Harris[1], Sarah E. Donohue[1], M. Ariel Schoenfeld[1], Hans-Jochen Heinze[1], Marty G. Woldorff[1,2]; [1]Otto-von-Guericke Universität Magdeburg, [2]Duke University — It has previously been reported that visual stimuli associated with reward are more likely to capture attention. As yet unknown is whether such reward associations are necessarily consciously detected and how such detection may modulate visual processing. Here we examined the influence of reward associations in the awareness-disrupting paradigm of object-substitution masking (OSM). In OSM, a visual-image array is briefly presented that includes a parafoveal target cued by surrounding dots. When the dot-cue offset is delayed relative to the image array, a striking perceptual reduction of the dot-surrounded target image is observed. The current study consisted of two stages: (1) a reward-association induction stage involving location discrimination of targets of either monetarily rewarded or unrewarded colors, and (2) an OSM stage involving orientation discrimination of OSM-cued elliptical targets of either the previously rewarded or unrewarded color. Neural measures of lateralized attentional shifts were recorded with MEG. Reward associations were successfully achieved in the induction phase (faster and more accurate for rewarded than unrewarded targets, along with enhanced attention-shift-related N2pc MEG responses). This reward association appeared to transfer to the OSM phase, with better target-orientation discrimination in the unmasked condition for ellipses of the previously rewarded versus unrewarded color. In the masked condition, however, targets of the previously rewarded versus unrewarded color did not differ in their susceptibility to masking. Nevertheless, masked ellipses of the previously rewarded color evoked an enhanced N2pc whether they were detected or not, suggesting that reward associations facilitate attentional capture even when not consciously detected.

C2

ERP EVIDENCE OF COGNITIVE DEFICITS IN BREAST CANCER SURVIVORS WITH CANCER-ASSOCIATED COGNITIVE CHANGES Julia Kam[1], Todd C. Handy[1], Lara A. Boyd[1], Teresa Liu-Ambrose[1], Sherri Hayden[1], Kristin L. Campbell[1]; [1]University of British Columbia — Many breast cancer survivors (BCS) have reported cognitive changes following chemotherapy treatment. However, standard neuropsychological tests have been challenged in identifying a reliable cognitive profile to reflect these reported symptoms, highlighting the need to develop outcome measures in the laboratory that are more sensitive to these changes experienced in daily life. One cognitive domain that is relatively difficult to measure in neuropsychological assessments but is crucial to daily function is the ability to maintain attention over longer periods of time. Accordingly, we examined whether BCS who self-reported cognitive issues up to 3 years following cancer treatment (n=17) performed differently from healthy controls (HC) (n=12) in a task that required sustained attention. Participants performed a target detection task at fixation while event-related potentials (ERPs) were recorded. Interspersed between each visual stimulus was a task-irrelevant tone. The ERPs to the auditory tones and visual targets were then compared between BCS and HC. We found that the visual-evoked P3 ERP component elicited by visual targets was smaller in BCS relative to HC. Nevertheless, auditory sensory-evoked N1 ERP components did not seem to differ between groups. This indicates that BCS showed attenuation in cognitive processing of task-relevant visual stimuli compared to HS. Our data thus suggests objective cognitive deficits can be observed in breast cancer survivors who self-report cognitive changes, underscoring the value of a less traditional measure of performance as a sensitive measure of daily functioning.

C3

NEURAL NETWORKS INVOLVED IN ORIENTING ATTENTION TO REPRESENTATIONS IN SHORT-TERM MEMORY Kristina C. Backer[1,2], Bradley R. Buchsbaum[1,2], Claude Alain[1,2]; [1]University of Toronto, [2]Rotman Research Institute — A current trend in attention research aims to understand the neural substrates and behavioral consequences of orienting attention to representations in short-term memory (STM). Yet it remains largely unknown if this process can be modulated by the particular feature used to gain access to a particular representation. Thus, the goal of this study was to examine the brain regions involved in orienting attention to STM representations, on the basis of their sensory modality or semantic category. During fMRI scanning, participants heard two sounds and saw two pictures (i.e., four unique, unimodal items) simultaneously. After a brief delay, a symbolic visual retro-cue, representing a particular Modality (Auditory or Visual), a particular Category (Animal or Music, corresponding to two of the four items), or all four items (Neutral), was shown. During the following delay, participants rehearsed the cued items, until making a Present/Absent response about a single probe (picture or sound) stimulus. Generally, participants responded faster to the probe on modality and category retro-cue trials, relative to Neutral trials, with no differences in accuracy across retro-cue conditions. We conducted a univariate analysis on the fMRI data, time-locked to retro-cue onset. We found modality-specific activation in the sensory cortex congruent with the sensory modality of the retro-cued representations. Furthermore, a contrast between Modality and Category retro-cues exposed distinct neural networks, illustrating that the type of feature used to access STM representations indeed substantially modulates the brain regions involved.

C4

ATTENTIONAL PROCESSES UNDERLYING THREAT AND RELIEF SIGNALS Andreatta Marta[1], Wieser Matthias[1], Glotzbach-Schoon Evelyn[1], Wiemer Julian[1], Pauli Paul[1]; [1]Department of Psychology, University of Würzburg — Termination of threat induces relief which is followed by a safety period, both characterized by positive feelings. Threat and cues signaling threat drive attention, but whether relief drives attention remains unclear. Notably, impaired processes of danger and safety have been implicated in anxiety disorders. Goal of the study was to investigate attentional processes underlying a relief-associated cue. To this purpose, forty-eight participants underwent a discriminative learning, in which a blast of white noise (unconditioned stimulus, US) was associated with a visual cue (conditioned stimulus, CS+) but not with another cue (CS-). In the aversive group, CS+ preceded and signaled US, whereas in the relief group, CS+ followed US and was associated with the relief. Ratings for CSs valence and arousal as well as steady-state visual evoked potentials (ssVEPs) to the flickering cues (15Hz) were collected. After conditioning, both aversive- and relief-CS+ were rated as more negative and arousing than CSs-. ssVEP amplitude to the aversive-CS+ was significantly larger compared to CS- suggesting greater allocation of attentional resources. Interestingly, ssVEP amplitude was lower to the relief-CS+ compared to CS- (although marginally) and aversive-CS+. In summary, on explicit level threat and relief signals were reported as equally aversive, possibly because of their temporal proximity to the threat. However, as indicated by the ssVEPs, these two signals have different effects in reflexive attention. Thus, threat signal requires attentional resources in order to prompt appropriate avoidance responses, whereas threat termination allows individuals to relax and there is no need to monitor the cue.

C5

VULNERABILITY TO DISTRACTION IN PATIENTS WITH PARKINSON'S DISEASE IS LINKED TO LOW CORTICAL CHOLINERGIC FUNCTION Kamin Kim[1], Martijn Müller[1], Nicolaas Bohnen[1], Martin Sarter[1], Cindy Lustig[1]; [1]University of Michigan — Positron emission tomography (PET) studies show that in addition to dopaminergic deficits, a subset of patients with Parkinson's disease (PD) also exhibit low cholinergic function. Human studies and rodent models of PD show that in combination with dopa-

minergic lesions, cortical cholinergic cell loss is associated with reduced executive and attention function (Bohnen et al., 2012; Kucinski et al., 2013). The present study explores the specific nature of attentional impairment in low-cholinergic PD patients, testing the hypothesis that low cortical cholinergic activity is associated with increased vulnerability to distraction. 18 PD patients previously assessed using cholinergic [11C]PMP and striatal dopaminergic [11C]DTBZ PET and 13 age, gender, and education-matched healthy controls (HC; data collection ongoing) completed two attention tasks with distractor manipulations. The first task, the human analogue of the rodent distractor condition sustained attention task (Demeter et al., 2008; McGaughy & Sarter, 1995), is a signal detection task with either a static or rapidly-changing background. The second is a duration-discrimination task (Continuous Temporal Expectancy Task, O'Connelll et al., 2009) that shows rapid performance declines over time, to which we added a video distractor (Berry et al., 2013). Low cortical cholinergic function but not thalamic cholinergic or striatal dopaminergic activity was associated with more severe distractor impairment on both tasks in PD. These similar findings from two different task paradigms provide converging evidence that increased distractibility in PD patients is linked to decreased cortical cholinergic function.

C6

DISRUPTED CONSCIOUS AWARENESS CAUSED BY DAMAGE TO CORTICAL WHITE MATTER IN ACUTE STROKE PATIENTS AND ITS RELATIONSHIP WITH LONG-TERM COGNITIVE IMPAIRMENTS

Kelly L. Brandstatt[1], Andrew M. Naidech[1], Michael D. Berman[1], Joel L. Voss[1]; [1]Northwestern University Feinberg School of Medicine — Disruptions of conscious awareness occur during periods of delirium following acute brain injury. We localized brain damage associated with these disruptions using acute CT scans from 80 patients with intracerebral hemorrhage (ICH) who were scored for delirium using the Confusion Assessment Method during hospitalization. Voxel-based lesion-symptom mapping was performed using delirium scores and hematoma locations. Hematomas occupied the thalamus and basal ganglia in the majority of patients, irrespective of delirium scores. Hematoma of the right cortical white matter, including superior longitudinal fasciculus and anterior cingulum bundle, was uniquely associated with delirium (statistical maps used a corrected $P<0.05$ threshold). Damage to long-range cortical white-matter connections due to the neurotoxic effects of hematoma was therefore likely responsible for disruptions of conscious awareness. This finding is consistent with theories proposing that distributed cortical networks are necessary for normal conscious awareness. Acute delirium was also associated with poorer life quality due to disrupted cognition at 12-month follow-up, suggesting that disruptions of cortical connectivity persistently disrupts cognition in addition to producing acutely impaired conscious awareness.

C7

NEUROBEHAVIORAL MECHANISMS OF ATTENTION NETWORKS IN TBI

Sudhin, A Shah[1], Mary, M Conte[1], Andrew, M Goldfine[2], Yelena Goldin[3], Keith Cicerone[3], Nicholas, D Schiff[1]; [1]Weill Cornell Medical College, [2]Burke Rehabilitation Center, [3]JFK Johnson Rehabilitation Center — Severe traumatic brain injury (TBI) leads to persistent debilitating neurocognitive and functional impairments that limit quality of life in a significant proportion of patients. There is currently insufficient data regarding the precise nature of attentional deficits in TBI, which limits diagnostic precision and optimal treatment delivery. We assessed the Attention Network Test (ANT) in 13 TBI patients tested 6 months post-injury and 25 healthy controls with simultaneously recorded electroencephalography (EEG). The ANT is a time-efficient and simple task developed for the neuropsychological study of the alerting, orienting and executive attention networks (Fan et al., 2002). The procedure is a combination of a cued reaction time task and the flanker task and assesses the efficiency of attentional networks by measuring how response times are influenced by alerting cues, spatial orienting cues, and congruent versus incongruent flankers. The TBI patients in our population all suffered a moderate-severe injury with loss of consciousness or post-traumatic amnesia and were atleast 6 months post-injury (medically stable for atleast 2 months). Consistent with prior research, efficiency of the executive network is reduced compared to the healthy controls. Power spectral analysis of the EEG revealed re-organization of brain activation patterns generated during the ANT task in individuals with TBI. These results demonstrate the sensitivity of EEG to altered attentional function in TBI. Improving our understanding of the underlying architecture of attention deficits in individuals with TBI will advance the development and selection of accurate diagnostic techniques and effective treatments.

C8

INCREASED CAPACITY FOR TIME PERCEPTION IN AUTISM SPECTRUM DISORDER

Anna Remington[1], Nilli Lavie[2]; [1]Centre for Research in Autism and Education, Institute of Education, University of London, UK, [2]Institute of Cognitive Neuroscience, University College London — Autism Spectrum Disorder (ASD) research portrays a mixed picture of attentional abilities with demonstrations of enhancements (superior visual search performance) and deficits (higher distractibility). Using Load Theory of Attention and Cognitive Control (e.g. Lavie, 2005), our previous work suggests that ASD is characterised by an increase in visual perceptual capacity. This enhanced capacity enables the processing of additional stimuli, which can manifest both as increased distractibility and higher detection sensitivity (Remington et al 2009; 2012). Thus far, increased perceptual capacity associated with ASD has only been established in the visual domain. Here we examine what effect the enhanced capacity has on time perception. Specifically, would time perception in ASD be less affected by increased visual load than in neurotypicals? High-functioning adults with ASD and matched neurotypical controls were asked to attend to a rapid stream of crosses and detect any red cross (low load condition) or upright yellow and inverted green crosses (high load condition). The duration of each stream was 6 or 12 seconds. Following each stream, participants were required to reproduce the time duration of the stream. High perceptual load led to shortening of the perceived time in the controls, but not in the ASD group. In the 6 second trials the ASD participants were more accurate than controls across the load conditions. This suggests that increased visual perceptual capacity in ASD confers an advantage in time perception, and provides a new line of support for our hypothesis of increased perceptual processing capacity in ASD.

C9

DECREASES IN OSCILLATORY ALPHA POWER VERSUS INCREASES IN SLOW NEGATIVE WAVES: REWARD-PROSPECT REVEALS DIFFERENTIAL ROLES IN ATTENTIONAL PREPARATION FOR COGNITIVE TASK PERFORMANCE

Berry van den Berg[1,3], Ruth M. Krebs[2], Monicque M. Lorist[3,4], Marty G. Woldorff[1]; [1]Center for Cognitive Neuroscience, Duke University, [2]Department of Experimental Psychology, Ghent University, [3]BCN Neuroimaging Center, University of Groningen, Groningen, [4]Department of Experimental Psychology, University of Groningen — Task performance is influenced by our ability to prepare for upcoming information, which is especially helpful if the cognitive system is challenged, such as in the presence of conflicting stimuli. Here we used event-related potentials (ERPs) as well as event-related spectral perturbations (ERSPs) to study how motivation, induced by the prospect of monetary reward, influences the neural processes related to attentional preparation and cognitive task performance. In a cued-reward Stroop paradigm, participants had to discriminate the font color of color-words. Prior to each target, a cue indicated whether there was the prospect of reward on that trial for fast and accurate performance. Behaviorally, we found improved task performance on trials with reward prospect, as indicated by faster response times (RTs) to the target Stroop stimuli. We also found that two different measures of cue-triggered preparatory brain activity that have been associated with attention varied systematically. More specifically, we observed larger amplitudes of the front-central slow-wave contingent negative variation (CNV) ERP wave and reduced occipital and fronto-central alpha power on reward-prospect (versus no-reward-prospect) trials and on fast-RT (versus slow-RT) targets. There was a striking dissociation, however, in the interaction of reward prospect and task performance for the alpha and CNV effects: CNV amplitude was predictive of the performance level on no-reward- prospect trials but not on reward-prospect ones, whereas decreased alpha amplitude was predictive of performance on reward-prospect trials but not on no-reward-prospect ones. These results indicate that CNV activation and alpha decreases reflect different aspects of preparatory attentional processes.

ATTENTION: Spatial

C10

COGNITIVE CONTROL NETWORK CONTRIBUTIONS TO LONG-TERM MEMORY GUIDANCE OF VISUAL SPATIAL ATTENTION. Maya L. Rosen[1], Chantal E. Stern[1], Samantha W. Michalka[1], Kathryn J. Devaney[1], Lingqiang Kong[1], David C. Somers[1]; [1]Boston University — Recent studies have focused on the competitive interactions between the Default Mode Network (DMN), involved in long-term memory retrieval, and the Dorsal Attention Network (DAN), involved in top-down attention. Although the two networks may interact competitively, evidence suggests that long-term memory can help to guide spatial attention more efficiently than visual cues (Jiang and Chun, 1998; Summerfield et al., 2006, 2011), suggesting cooperation between these networks under certain conditions. Because there is little evidence for direct communication between the DMN and DAN, we hypothesize that a third network, the Cognitive Control Network (CCN), is recruited when long-term memory is used to guide spatial attention. Participants (n=23) performed a one-shot change detection task on visual scenes using long-term memory (LTM) or a visual stimulus cue (STIM) to guide attention while undergoing fMRI scanning. ROIs from three networks were mapped onto individual subjects from a cluster-based analysis of intrinsic functional connectivity of 1000 brains (Yeo et al., 2011). The univariate fMRI results demonstrate that in the LTM-guided attention condition compared to the STIM-guided condition three nodes of the CCN are recruited: dorsal inferior parietal lobule, posterior callosal sulcus, and dorsal medial superior parietal lobule. The intrinsic functional connectivity results demonstrate that nodes of the CCN are significantly positively correlated with nodes of both the DMN and DAN, while there is no positive correlation between the DMN and DAN. Taken together, these findings suggest that posterior nodes of the CCN are positioned to govern the flow of information between the DMN and DAN.

C11

INDIVIDUAL DIFFERENCES IN DISTRACTIBILITY PREDICT INTRINSIC FUNCTIONAL CONNECTIVITY IN ATTENTION NETWORKS Omar Singleton[1,2,3], Meghan Robinson[1], David Salat[1,2,3], Joseph DeGutis[1,3], William Milberg[1,3], Regina McGlinchey[1,3], Michael Esterman[1,3,4]; [1]VA Boston Healthcare System, Boston, MA, [2]MGH/MIT/HMS Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, [3]Massachusetts General Hospital, Harvard Medical School, Boston, MA, [4]Boston University School of Medicine, Boston, MA — A wealth of task-based neuroimaging studies has implicated both task-negative and task-positive brain networks in attention control, including the default mode network (DMN) and the ventral and dorsal attention networks (VAN, DAN). However, less work has investigated whether attentional abilities, such as resisting external visual distraction, are predictive of intrinsic resting functional connectivity or structural integrity of these networks. In order to address this question, the current study first recruited 33 participants to complete a resting functional and a structural MRI scan. In a follow-up session, individuals completed a visual search task with salient distractors. Specifically, during visual search for a unique shape, the presence of intermittent task-irrelevant but salient color singletons disrupted search efficiency, a measure of distraction known as "attentional capture." Resting state analyses of DMN, VAN, and DAN were conducted in FreeSurfer FSFAST using seed-based connectivity. These analyses revealed that individual differences in attentional capture were related to VAN-DMN connectivity, such that greater capture was associated with greater coupling between VAN and the DMN. The structural analyses were performed using well-validated cortical thickness techniques in FreeSurfer. These analyses revealed that greater attentional capture was associated with thinner cortical surfaces in multiple regions across both VAN and DMN. Together, these results suggest that that the VAN, associated with exogenous attentional control, functions optimally when it is more differentiated from the DMN in its intrinsic fluctuations. In addition, the structural integrity of these networks likely also contributes to their optimal functioning.

C12

SALIENT DISTRACTOR EXPERIENCE REDUCES PD AMPLITUDE Daniel Vatterott[1], William Bush[1], Shaun Vecera[1]; [1]University of Iowa — Salient, irrelevant distractors often capture observers' attention, but experience enables observers to efficiently ignore distracting items (Vatterott & Vecera, 2012). This behavioral work posited that observers must initially attend to salient stimuli in order to effectively reject them (i.e., experience-dependent distractor rejection). In the current study, we used electrophysiological measures (ERPs) to investigate the brain responses that occur when observers select (N2pc) or inhibit items (Pd; Luck & Hillyard, 1994; Hickey, Di Lollo, & McDonald, 2009). Observers saw four briefly appearing letters and responded as to whether a target letter was present. On 50% of the trials, one non-target item was a salient color singleton distractor. Observers were slower to report target presence when the salient distractor was present compared to absent. Importantly, distractor related slowing was greater in the first half of blocks compared to the second half of blocks. For target absent trials, salient distractors evoked a negative deflection in the N2pc time window. For target present trials, a Pd was observed contralateral to salient distractors. The primary impact of experience was a reduction in the amplitude of the distractor related Pd in the second half of trials. These results suggest that distractor experience changes distractor rejection from an active, time-consuming process to a more passive, less time-consuming form of distractor rejection.

C13

THE NEURAL CORRELATES OF RE-CANCELLATION BEHAVIORS IN UNILATERAL NEGLECT Murielle Wansard[1], Christine Bastin[2], Thierry Meulemans[1]; [1]Department of Psychology, Behavior and Cognition, University of Liège, Belgium, [2]Cyclotron Research Centre, University of Liège, Belgium — The present study focused on re-cancellation behaviors in unilateral neglect (i.e., the tendency to search repeatedly items located on the right side in visual search tasks), and used a neuropsychological approach to identify the cerebral correlates of this deficit. Fourteen patients suffering from left neglect and 14 elderly age-matched controls performed a cancellation task without visual feedback. Neglect patients cancelled fewer targets than controls, and re-cancelled an abnormally high number of targets. Lesion maps were used to compare the location of brain damage in neglect patients with the highest versus the lowest percentage of re-cancellations. Anatomical data revealed that the right insula is commonly damaged in 5 out of 6 patients with the highest re-cancellation percentage, but is spared in the subgroup of patients with the lowest re-cancellation percentage. These results suggest that damage to the right insula may contribute to pathological visual search in spatial neglect, possibly by reducing interaction between the ventral and dorsal attention network (the latter being more directly involved in spatial processes).

EMOTION & SOCIAL: Emotion-cognition interactions

C14

BEHAVIORAL AND NEURAL CORRELATES OF AFFECTIVE INTERFERENCE DURING WORKING MEMORY Madison L. Stroup[1], David A.S. Kaufman[1], William M. Perlstein[2,3]; [1]Saint Louis University, Saint Louis, MO, [2]University of Florida, Gainesville, FL, [3]Malcom Randall VAMC, Gainesville, FL — Affective interference has been shown to differentially impact higher-order cognitive functions. However, the mechanisms by which the valence of emotionally salient information impact cognitive processes remain unclear. The current study investigated whether affective interference differentially affects the maintenance of task-relevant representations in working memory (WM). We acquired high-density event-related potentials (ERPs) from 19 participants while they completed low and high "oad" conditions of a delayed matching-to-sample task with emotionally valenced (pleasant and unpleasant) and neutral interfering pictures. Behaviorally, results indicated that the emotional valence of interfering pictures differentially affected task performance. Positively valenced distracters were associated with significantly faster WM probe reaction times than negatively valenced distracters ($p < .02$). There was also a significant interaction between valence and load such that emotionally valenced (i.e., arousing) distract-

ers were associated with significantly faster WM probe reaction times in comparison to neutral distracters in the high working memory load condition ($p < .003$). P3 amplitudes to WM probes were significantly greater following positively valenced distracters. Furthermore, positive frontal slow wave components of WM probe-related ERPs were enhanced for positively valenced relative to negatively valenced distracters in the high WM load condition ($p < .04$). These findings suggest that emotional valence may differentially affect interference resolution during cognitive processes. Positively valenced stimuli may promote enhanced interference resolution, particularly with increased cognitive load, resulting in stronger attentional control over task-relevant stimuli. Thus, competition for resources between cognitive and affective processes may resolve discriminately as a function of recent affective context.

C15

THE TEMPORAL DYNAMICS OF MOTIVATED COGNITIVE CONTROL: RELATIONSHIPS TO SOCIAL ANHEDONIA

Yu Sun Chung[1], Deanna Barch[1,2,3]; [1]Department of Psychology, Washington University in Saint Louis, St. Louis, MO, [2]Department of Psychiatry, Washington University in Saint Louis, MO, [3]Department of Radiology, Washington University in Saint Louis, MO — Recent evidence suggests that reward incentives improve cognitive control function in motivationally salient situations, potentially via enhancing internal representations of goal supported by the dorsolateral prefrontal cortex (DLPFC) (e.g., Jimura et al., 2010). This effect is referred to as motivated cognitive control. However, relatively little known about the individual difference characteristics that influence this effect. Here we examined the hypothesis that variability in reward-related traits such as anhedonia (reduced pleasure from potentially rewarding social or physical stimuli) would modulate either or both sustained and/or cue-related transient aspects of motivated cognitive control. 27 individuals performed a response conflict task developed by Padmala et al. (2011) during scanning, where participants were asked to categorize images as either houses or buildings with either congruent or incongruent overlaid words. Participants performed a baseline condition without knowledge of monetary incentives, followed by reward blocks with monetary incentives on some cued trials (reward cues) for fast and correct responses. Using a state-item design, we examined the temporal dynamics of motivated cognitive control through both the sustained context-dependent and transient cue-related components of reward processing. We replicated previous work by showing both increased sustained activity during reward vs. baseline blocks in the bilateral DLPFC and transient cue-related activity in the striatum. Importantly, individuals with higher social anhedonia showed less of an increase in transient trial-by-trial activity as a function of reward in the putamen. Together, our results suggest that reduced social hedonic experience may be related to reduced transient reward cue-related activity in the striatum.

C16

NEGATIVE MOOD DIMINISHES REAPPRAISAL SUCCESS

Seth Kallman[1], Noam Zerubavel[1], Kevin Ochsner[1]; [1]Columbia University — The connection between negative affect and increased alcohol consumption has been well established both in popular culture and the scientific literature. This dysregulated behavior, sometimes referred to as "drinking to cope," might occur for several reasons. On one hand, negative affect may increase the bottom-up incentive salience of alcohol cues. Alternatively, it may decrease peoples' ability to exercise effective top-down self-regulation. To shed light on these possibilities, we had healthy college students view pictures of alcohol and rate their urge to drink the depicted beverages. They were asked to do this while either looking naturally or using cognitive reappraisal to reinterpret the stimuli in terms of their negative consequences. Critically, they made these judgments following either a neutral or a negative mood induction. This design allowed us to examine the effects of negative mood on natural responses, regulated responses, and the difference between them (operationalized as "regulation success"). The results showed that participants were able to successfully use reappraisal to reduce their reported desire to drink the alcoholic beverages. However, there was a significant interaction with mood, such that regulation success significantly declined in the negative mood condition. Interestingly, the majority of participants held the metacognitive belief that the negative mood increased their ability to think of negative consequences. While this could have conceivably aided reappraisal, our results suggested otherwise. Overall, this study provides experimental evidence that negative affect can impair cognitive reappraisal.

C17

PERSONALITY TRAITS MEDIATE THE EFFECT OF TASK-IRRELEVANT EMOTIONS ON WORKING MEMORY

Alessandra Galli[1], Jan Derrfuss[1,4], Christian J. Fiebach[1,2,3]; [1]Radboud University Nijmegen, Donders Institute for Brain, Cognition, and Behaviour, The Netherlands, [2]Department of Psychology, Goethe University Frankfurt am Main, Germany, [3]IDeA Center for Individual Development and Adaptive Education, Frankfurt am Main, Germany, [4]School of Psychology, University of Nottingham, United Kingdom — It has been suggested that emotions will enhance performance only when the emotional information is task-relevant. Yet, studies investigating the impact of task-irrelevant emotional stimuli on working memory found heterogeneous results, including reports of performance enhancements after emotional distraction. This variability may result from inter-individual differences in personality traits, which may mediate the emotion effect on working memory. We used a delayed-match-to-sample task where participants (n = 44) encoded an abstract shape, followed, during the maintenance period, by a task-irrelevant positive, negative, or neutral vocalization (Study 1). Another group (Study 2; n = 33) heard the irrelevant emotional vocalization right before the sample onset. In both tasks, participants could be split into individuals whose performance was enhanced (Study 1: 50%; Study 2: 63,6%) vs. impaired by task-irrelevant emotions (Study 1: 50%; Study 2: 36,4%), relative to neutral distractors. Individuals whose performance was enhanced had high depression scores (BDI), low positive affect (Dutch PANAS equivalent), and low scores on the behavioural inhibition/approach scales (BIS/BAS). The opposite was true for individuals whose performance was impaired. These predictors classified the two groups with 71% accuracy. Study 2 replicated these findings, with a greater emphasis on the BAS-Drive sub-scale (classification accuracy 63%). These differential effects on performance were reliably observed for d-prime as well as for parameters of the diffusion model, e.g., drift rate. Our results suggest that task-irrelevant emotions have similar effects on working memory encoding and maintenance and highlight the importance of taking into account individual psychological characteristics when studying emotion-cognition interactions.

C18

EFFECTS OF REM SLEEP ON NEURAL ACTIVITY DURING EMOTIONAL AND NEUTRAL MEMORY RETRIEVAL

Kelly Bennion[1], Jessica Payne[2], Elizabeth Kensinger[1]; [1]Boston College, [2]The University of Notre Dame — Sleep has a profound effect on memory consolidation, conferring a preferential benefit to emotional relative to neutral stimuli. Behavioral and neuroimaging evidence suggest that this selective benefit may stem from rapid eye movement (REM) sleep. However, it is not fully understood how REM sleep during a consolidation interval influences neural activity during the subsequent retrieval of emotional versus neutral stimuli. In the present study, participants viewed images composed of a negative or neutral object superimposed on a neutral background. After a twelve-hour delay including a full night of sleep (recorded via polysomnography), participants underwent a recognition task during fMRI in which they viewed negative and neutral objects and backgrounds separately, distinguishing new objects and backgrounds from those previously studied. Confirming the emotional memory enhancement effect, memory was enhanced for negative relative to neutral objects following sleep. Activity during successful object retrieval (hits > misses) was assessed, inputting each participant's percentage of REM sleep as a regressor. REM percentage correlated with increased activity in the precuneus, precentral gyrus, lingual gyrus, insula, and cerebellum during the retrieval of negative objects, but only the thalamus during the retrieval of neutral objects ($p < .001$, 9 voxels). This suggests that for emotional stimuli in particular, REM sleep during consolidation may lead to a retrieval network that is similar to the network that is active during REM sleep (e.g., Maquet et al., 2000) and that REM sleep is linked to retrieval-related activity in regions that typically support emotional memory (e.g., Sterpenich et al., 2007, 2009).

C19

DEPRESSIVE MOOD AND INTENTIONALITY OF EMOTION PROCESSING: AN EVENT-RELATED POTENTIAL STUDY Stephanie Bastidas[1], Lucy J. Troup[1]; [1]Colorado State University — Depressive disorders have been associated with altered patterns of emotion processing. It is unclear whether these differences occur independently from intentionality during emotion processing. The current study aimed to examine the effect of implicit and explicit processing on the relationship between depressive mood and event-related brain potentials to emotional facial expressions. Electroencephalogram was recorded from 19 electrodes (10-20 International System) while participants performed sex discrimination (implicit) and emotion discrimination (explicit) judgments of faces showing happy, sad, and neutral expressions. Explicit processing was associated with greater mean P1 (80-140ms) and N170 (140-200ms) amplitudes for sad and neutral than happy faces in depressed but not in control individuals. These differences were also reflected as greater P1 and N170 amplitude to happy faces in controls than in depressed individuals. No effects of group or emotion were found during implicit processing or for P3 and late positive potential (LPP) latency and amplitude in either condition. Results suggest depressive mood is associated with early differences in processing of happy facial expressions when attention is directed to emotional features of the stimuli but not during incidental processing of facial expression.

C20

DELAY AND TRACE CONDITIONING DIFFERENTIALLY INFLUENCE THE PERCEPTION OF TIME DURING THREAT ANTICIPATION Jessica I. Lake[1], Warren H. Meck[1], Kevin S. LaBar[1]; [1]Duke University — Conditioning procedures serve as important examples of learning and memory which have informed the study of fear and anxiety. Delay and trace conditioning are associated with distinct neural correlates, with trace conditioning notably dependent on hippocampal processes. Given recent evidence implicating the hippocampus in temporal processing, in conjunction with substantial evidence that emotional stimuli distort time perception, we hypothesized that delay versus trace conditioning might differentially distort time perception during threat anticipation. To address this question, participants were sequentially presented with two squares and instructed to discriminate whether the second square, which varied in duration (600-1000ms), was longer or shorter in duration than the first square (800 ms). In a between-subjects design, we manipulated whether the color of the first or second square signaled the possibility (50% probability) for aversive electrical stimulation to co-terminate with the second square, creating trace and delay interval conditions, respectively. During delay conditioning, durations were overestimated on threat versus neutral trials, supporting previous evidence that threat-related stimuli are overestimated in duration. Alternatively, during trace conditioning, durations were underestimated on threat versus neutral trials as a function of subjective arousal ratings of the aversive stimulation. These findings suggest that delay and trace conditioning distort time through distinct mechanisms, even when the overall task structure was matched. This mechanistic dissociation may have important implications for our understanding of the functional roles of neural substrates underlying the conditioning of aversive events and for informing the study of threat anticipation processes in healthy and anxiety-related populations.

C21

NEURAL BASIS OF VERBAL MORAL PROCESSING IN INCARCERATED FEMALES WITH PSYCHOPATHIC TRAITS Samantha Fede[1,2], Jana Schaich Borg[3], Carla Harenski[2], Lora Cope[4], Vikram Rao[2], Prashanth Nyalakanti[2], Walter Sinnott-Armstrong[3], Kent Kiehl[1,2]; [1]University of New Mexico, [2]Mind Research Network and Lovelace Biomedical and Environmental Research Institute, [3]Duke University, [4]University of Michigan — Psychopathy is notorious for profound moral insensitivity and widespread antisocial behavior. Prior studies of psychopathy have found abnormal brain structure across paralimbic regions and aberrant engagement during moral processing in the amygdala, insula, temporoparietal junction (TPJ), anterior cingulate (ACC), and posterior cingulate (PCC). Despite potential sex differences in psychopathy, these studies largely focused on male samples. Methods: Incarcerated adult females (N = 191) were scanned on a 1.5T mobile magnetic resonance imaging system. Psychopathy was assessed using the Hare Psychopathy Checklist-Revised (PCL-R). Participants were shown words and phrases describing 50 morally wrong (e.g., incest) and 50 morally not wrong (e.g., sharing) concepts and asked to identify them as "wrong" or "not wrong." Results: During the processing of wrong versus not wrong stimuli, PCL-R scores were negatively related to activity in the caudal ACC, PCC, and caudate. When examining not wrong stimuli, these regions plus the insula were positively related to psychopathy; for wrong stimuli, the putamen and TPJ were negatively related to psychopathy scores. Discussion: The negative association between psychopathy scores and hemodynamic response in regions associated with moral processing is consistent with previous studies. Similarly, the positive association between psychopathy scores and neural engagement during the viewing of not wrong stimuli in the ACC, PCC, and caudate replicates results from an adult male sample, where increased engagement of caudal ACC may indicate a conflict or error detection process. Overall, these results reinforce that psychopaths demonstrate an abnormal hemodynamic response during moral processing, regardless of sex.

C22

REPRESENTATIONAL SIMILARITY OF SOCIAL AND VALENCE INFORMATION IN THE MEDIAL PREFRONTAL CORTEX Robert Chavez[1], Todd Heatherton[1]; [1]Dartmouth College — A widely held belief in cognitive neuroscience is that certain cortical areas can serve multiple functions. This may be particularly characteristic of areas such as the medial prefrontal cortex (MPFC) where several types of complex information integration are thought to occur. However, it remains an open question as to whether or not this region serves multiple kinds of cognitive representations simultaneously when stimuli contain a diverse set of high-level information. In the current study, we employed a large-scale automated meta-analysis tool (NeuroSynth) together with multi-voxel pattern analysis to investigate the representational similarity of social and valence information in the MPFC. During functional magnetic resonance imaging scanning, participants (N=48) were shown a series of photos matched for arousal and basic visual properties from the International Affective Picture System. Each picture's content varied on both sociality (social, non-social) and valence (negative, neutral, positive) dimensions. Using NeuroSynth, we isolated areas within the MPFC in which social and valence information share overlapping spatial activations in the neuroimaging literature. These areas were then used as regions of interest for a representational similarity analysis and multi-dimensional scaling across social and valence categories. Our results showed a high degree of representational similarity coherence both within sociality categories and within valence categories, but not across them (e.g., positive social pictures were highly dissimilar to negative non-social pictures). These results suggest that the MPFC may encode both social and valence information within the same stimuli, allowing this area to serve multiple types of cognitive processes simultaneously.

C23

EMOTION REGULATION FOR NONVERBAL AUDITORY STIMULI: COGNITIVE, AFFECTIVE, AND PSYCHOPHYSIOLOGICAL CORRELATES. Anais Stenson[1], Stephan Hamann[1]; [1]Emory University — Individuals can regulate or modify their emotional reactions to stimuli by using cognitive emotion regulation strategies such as reappraisal, where evaluations of stimuli are altered to modify their affective meaning. Reappraisal can be highly effective in altering subjective, physiological, and neural correlates of emotional responses. However, because most reappraisal studies have used visual stimuli, little is known about reappraisal processes associated with auditory or other nonvisual stimuli. We investigated individuals' ability to decrease their emotional responses to emotionally negative and neutral nonverbal sounds, as measured by subjective arousal ratings and concurrent physiological measures of emotion. On each trial, subjects listened to short (3 second) emotionally negative (e.g., snarling dogs) and neutral (e.g., brushing teeth) nonverbal sounds twice, while either reappraising the sounds to decrease their emotional reactions or not regulating their reactions. Stimuli were adapted from normed auditory emotion stimuli and adjusted for low-level perceptual properties. Emotional responses were assessed by online ratings of emotional arousal and psychophysiology (skin conductance, electrocardiogram, and respiration), and memory for the stimuli was later tested. Consistent with studies of emotion regulation for visual stimuli, reappraisal was successful in decreasing affective responses. Reappraisal significantly decreased online ratings of emotional

arousal for negative sounds. These preliminary findings suggest that cognitive emotion regulation strategies usually studied in the context of visual stimuli are also effective in modulating responses to emotional stimuli in the auditory modality, possibly via similar neural mechanisms.

C24

GENDER DIFFERENCES OF PREFRONTAL ACTIVITY IN PROCESSING FACE AND VOICE Ming-Chun Lee[1,2], Shih-tseng Tina Huang[1,2]; [1]Department of Psychology, National Chung-Cheng University, Taiwan, [2]Center for research in Cognitive Science, National Chung-Cheng University, Taiwan — The present study investigated the integration of emotional face and voice. Twenty young adults participated. Congruous and incongruous faces and voices of angry and sad emotion were presented. In a congruous angry (or sad) pair, an angry (or sad) face was presented with an angry (or sad) tone. The incongruous angry pairs contained an angry face presented with a neutral tone, or a neutral face with an angry tone. Similarly, the incongruous sad pairs contained sad face with neutral tone or neutral face with sad tone. In the event-related potential procedure, congruous emotional pairs were presented in 80% and the incongruous pairs were in 20% of the trials. The results found the latency of P120 and N170 were greater at Pz than at Fz and Cz. Results also found higher mean amplitudes (MAs) of P300-500 on sad than on angry pairs. Similarly, the MAs at F3 and F4 found greater on sad than on angry pairs. It was also found a significant interaction of emotion and sex on P3 at F3 and F4, suggesting male participants performed higher activation on the sad pairs than on the angry pairs. The results suggested a greater activation at the parietal lobe at the initial phase and male tended to perform higher activation in the integration of sad pairs of face and tone than angry pairs.

EMOTION & SOCIAL: Emotional responding

C25

VISUAL AWARENESS OF EMOTIONAL STIMULI CHANGES THE BEHAVIORAL FATE OF AMYGDALAR RESPONSES AND AMYGDALAR-PFC COUPLING Regina C Lapate[1], Bas Rokers[1,2], Do Tromp[1], Nadia Orfali[1], Samuel Doran[1], Nagesh Adluru[1], Andrew L Alexander[1], Richard J Davidson[1]; [1]University of Wisconsin-Madison, [2]Utrecht University — How does conscious awareness influence the processing of affective information? Non-conscious processing of emotional stimuli has been associated with increased affective coloring of subsequently presented neutral stimuli (e.g., Murphy & Zajonc, 1993), but the neural mechanisms for this effect remain unclear. Here, we examined the neural correlates of conscious awareness of emotional stimuli using functional and structural neuroimaging. While in the scanner, we manipulated the visibility of fearful faces and flowers using continuous flash suppression. To index affective coloring, participants rated the likeability of neutral faces presented seconds later. To estimate the integrity of participants' white matter fibers, we acquired diffusion-weighted images. The fMRI results indicated that BOLD responses in the right amygdala increased to fearful faces (relative to flowers) independently of awareness. However, the behavioral consequences of right-amygdalar responses to fearful faces differed by awareness, correlating with greater affective coloring of neutral faces only in the unaware condition. Replicating prior work, prefrontal-cortical (PFC) activation increased with awareness, but it was the (inverse) coupling between the amygdala and medial and lateral PFC that predicted a reduction of affective coloring in the aware condition. Accordingly, in the aware condition, participants with greater structural integrity in the uncinate fasciculus, a major white matter pathway connecting amygdala and PFC, showed less affective coloring, and greater inverse coupling between the amygdala and medial PFC. Collectively, these results suggest that while emotional encoding by the amygdala does not require awareness of emotional stimuli, function of a critical emotion-regulatory network depends on awareness to impact behavior.

C26

MAOA GENE ALLELES AFFECT FUNCTIONAL CONNECTIVITY IN EMOTIONAL BRAIN NETWORKS Martin Klasen[1,2], Dhana Wolf[1,2], Patrick Schelenz[1,2], Ute Habel[1,2], Jonathan Repple[1,2], Thomas Eggermann[3], Klaus Zerres[3], Florian Zepf[2,4], Klaus Mathiak[1,2,5]; [1]Department of Psychiatry, Psychotherapy, and Psychosomatics, Medical School, RWTH Aachen University, Germany, [2]JARA-Translational Brain Medicine, RWTH Aachen University, Germany, [3]Institute of Human Genetics, Medical School, RWTH Aachen University, Germany, [4]Department of Child and Adolescent Psychiatry, Psychotherapy, and Psychosomatics, Medical School, RWTH Aachen University, Germany, [5]Institute of Psychiatry, King's College London, London, UK — Low expressing alleles of the monoamine oxidase A gene (MAOA-L) have been associated with affective dysregulation and impulsive aggression. Recent models associate MAOA-L with an excess in brain serotonin, which may modulate the functional coupling of the amygdala with other emotional brain regions and lead to an affective vulnerability, characterized by a negative bias in emotional appraisal and experience. This may be reflected by habitually increased functional and effective connectivity in brain networks supporting emotional appraisal and experience. In an fMRI experiment, we measured brain activity of 66 male subjects during resting state and assessed blood samples to determine MAOA expression. Functional and effective connectivity analyses (Granger Causality Mapping) were performed with bilateral amygdala as seed region. Compared to high expressing allele carriers, MAOA-L individuals showed higher functional connectivity of the amygdala with emotion processing nodes in the anterior and posterior cingulate cortex as well as in the anterior insula, along with networks supporting social evaluation, memory retrieval, and visual imagery. Accordingly, the effective connectivity analysis revealed a higher directed influence of the dorsal anterior cingulate cortex on amygdala activity for the MAOA-L carriers. The observed neural network patterns show habitually enhanced functional coupling in the low expressing allele carriers. They indicate a negative emotional bias during self-referential processes, memory retrieval, and scene imagination. The results of our study thus support the notion of an emotional dysregulation associated with the MAOA-L genotype. We suggest the modulated amygdala connectivity as an endophenotype of altered emotional processing in male MAOA-L carriers.

C27

EFFECT OF PARTIAL SLEEP DEPRIVATION ON EMPATHY FOR PAIN IN AN FMRI EXPERIMENT Gustav Nilsonne[1,2], Sandra Tamm[1,2], Paolo d'Onofrio[1], Hanna Thuné[1,3], Johanna Schwarz[1], Predrag Petrovic[2], Håkan Fischer[1], Göran Kecklund[1], Torbjörn Åkerstedt[1,2], Mats Lekander[1,2]; [1]Stockholm University, [2]Karolinska Insitutet, [3]The University of Nottingham — Disturbed sleep affects emotional responding. It is however unknown whether disturbed sleep affects empathy for pain. We have investigated the effect of partial sleep deprivation on empathic responding. Predefined regions of interest were the bilateral anterior insulae and the medial cingulate cortex, which is postulated to form a core network for empathy. 16 healthy volunteers (mean age 24, SD 3, 6 female) participated in a trial of partial sleep deprivation (3h sleep) using a cross-over design, monitored by polysomnography at home. During fMRI, participants viewed pictures of hands being stung by needles or poked with a Q-tip. Across sleep conditions, pain stimuli caused significantly increased activity in the anterior insulae ($p < 0.005$) and medial cingulate cortex ($p < 0.001$), using region-of-interest analyses. In addition, whole-brain analyses showed significant activation in the left inferior parietal ($p < 0.001$) and left primary sensorimotor cortices ($p < 0.001$). Partial sleep deprivation caused participants to report increased levels of unpleasantness ($p < 0.01$) when viewing pain stimuli and caused non-significantly decreased activity in the left inferior parietal cortex ($p = 0.07$) in response to pain stimuli. These findings suggest that sleep deprivation affects empathic processing in the brain.

C28

EFFECTS OF SOCIAL SUPPORT ON BRAIN RESPONSES TO PAINFUL STIMULATION IN ROMANTIC COUPLES Marina Lopez-Sola[1], Luka Ruzic[1], Jason T. Buhle[2], Jacob M. Parelman[1], Tor D. Wager[1]; [1]University of Colorado Boulder, [2]Columbia University — Social attachment and romantic bonding are powerful reinforcers, associated with approach behaviors, openness and exploration, and increased wellbeing while reducing nega-

tive affect and arousal. Social support can have important effects on physical and emotional pain in real-life settings such as during childbirth, where it has shown to significantly reduce the duration of labor and the rates of labor-related complications and to significantly improve mother-infant bonding. However, the neural correlates of such distress-alleviating effects during pain perception remain to be elucidated. This fMRI study assesses the effects of social support from the romantic partner on brain responses to acute thermal pain in healthy women (N=30), using a hand-holding paradigm. We compared pain-related responses during runs in which female participants held the hands of their romantic partner vs. runs in which they held a pneumatic squeezable device. Receiving social support from the romantic partner significantly reduced pain-related intensity and, to a greater extent, pain unpleasantness. Importantly, it also reduced anxiety associated with the pain anticipation cue while increasing perceived comfort during the pain experience. Preliminary fMRI results show significant reduction of acute pain responses during partner hand-holding in a number of pain-processing regions including somatosensory cortices, thalamus, insula/basal ganglia, and regions of the medial frontal cortex and anterior cingulate cortex. Overall, these results suggest that receiving social support from the romantic partner in a pain-related context exerts a protective effect both at the subjective and neural levels.

C29

TRAIT GUILT IS ASSOCIATED WITH INCREASED ACTIVITY IN VENTROLATERAL AND VENTROMEDIAL PREFRONTAL CORTEX DURING ACTS OF RESTITUTION. Ambrose Ty[1], Derek Mitchell[1], Elizabeth Finger[1]; [1]Western University, Schulich School of Medicine and Dentistry — Guilt is a social emotion that promotes prosocial and moral behaviours. Guilt arises from harming an individual and may lead the guilty individual to attempt to repair the harmed relationship, a process known as restitution. Currently, the neural regions prompting feelings of guilt and acts of restitution are not known. To identify the neural regions supporting feelings of guilt and prompting acts of restitution, we employed a novel social decision-making fMRI paradigm involving donations to charities along with measures of guilt following each decision and indices of trait guilt. Whole brain, voxel-wise analysis demonstrated that acts of restitution (helping someone after harming them) were associated with increased BOLD signal in right ventrolateral prefrontal cortex (vlPFC) and medial prefrontal cortex (mPFC) BOLD signal compared to acts of harm (harming someone after previously harming them) ($p<0.005$). Furthermore, there was a significant positive correlation between trait guilt as indexed by the Guilt Inventory and BOLD signal in vlPFC and mPFC during such decisions of restitution ($R = 0.782$, $p<0.001$ and $R = 0.593$, $p<0.025$, respectively). The present results are consistent with past studies indicating that vlPFC and dmPFC are important for processing aversive social cues (angry faces) and to resolve decision conflict (reversal learning), and suggest that individual differences in trait guilt and related prosocial behavior may be mediated by these regions of prefrontal cortex.

C30

EMOTIONAL FACIAL EXPRESSION EVALUATION IN A STRESS INDUCTION TASK Hedwig Eisenbarth[1], Luke Chang[1], Julie Spicer[2], Helena Yardley[1], Tor Wager[1]; [1]University of Colorado Boulder, [2]Columbia University — Social stress elicits several physiological and psychological reactions that have been documented with the use of the Trier Social Stress Test (TSST). It has been shown that more fearful expressions are predictive of higher cortisol responses as well as with a higher cardiovascular response. We compared two groups that underwent the TSST procedure (n = 39) and a control group (n = 22) for facial expressions during the different stages of the task. A subsample of the stress group (n = 20) received a brief gratitude writing intervention before the TSST. A machine learning-algorithm-based program (CERT) was used to evaluate facial expressions (anger, contempt, disgust, fear, joy, sadness, surprise and neutral) for emotional content, based on the videos taken of the participants during the TSST. The most prominent emotional facial expressions detected throughout the task were contempt and sadness. During the course of the task, contempt does not significantly change, whereas fear, sadness and surprise are more pronounced during providing a speech or doing a math task and a more reduced directly after the tasks. The two stress groups show significantly less joy and more sadness compared to controls in the phase of the instruction for the speech (anticipation), the stress group with intervention shows more joy in the phase directly after the speech compared to the stress group without intervention. If facial expressions can be diagnostic of actual stress and successful coping due to a brief intervention, these differences should also be reflected to a BOLD stress response.

C31

A REPLICATION AND EXTENSION OF THE AFFECTIVE NEUROSCIENCE PERSONALITY SCALE (ANPS 2.4) Laura Feren[1], Ken Davis[2]; [1]Brandman University/ Chapman University System, Irvine, CA, [2]Pegasus International, Greensboro, NC — Based on evidence for brain emotion systems, parsed into six distinct groups (Panksepp, 1998), the Affective Neuroscience Personality Scales (ANPS) were constructed (Davis, Panksepp & Normansell, 2003) to estimate self-reported influences of six neurally-based brain emotion networks, which were labeled PLAY, SEEKING, CARE, FEAR, ANGER, and SADNESS and which were validated against a Big Five (BF) adjective-based personality tool. A replication of that work is reported here using a slightly revised ANPS 2.4 and a more extensive list of 164 adjectives (SPE 2). The data from 84 Northern California community college students who responded to all items on both instruments (requiring about 30 minutes) replicated the strong correlations between ANPS scales and BF scales reinforcing the link between affect and personality. This data provided further evidence for the emotional and physiological bases of personality and that a great deal of personality variability would be related to strengths and weaknesses found in these six brain systems. In addition, adjectives were identified that could be used by observers -- such as therapists, care givers, family members, and other colleagues -- to estimate the strengths and weaknesses in these six brain emotions. Exploratory factor analysis supported previous findings linking the ANPS 2.4 to the BF model of personality as well as supporting Positive and Negative Affect as two higher-order personality themes. The relationship between the self-report ANPS 2.4 and BF adjective scales and observer-rated adjective scales are discussed in terms of primary and tertiary personality elaborations previously discussed by Davis & Panksepp (2011).

C32

EARLY POSTERIOR NEGATIVITY FOR DETECTING EMOTIONAL FACIAL EXPRESSIONS: AN ERP STUDY Reiko Sawada[1], Wataru Sato[1], Shota Uono[1], Takanori Kochiyama[2], Motomi Toichi[1]; [1]Kyoto University, [2]Advanced Telecommunications Research Institute International — Previous behavioral studies have shown that emotional facial expressions are detected faster than are neutral expressions. However, the neural mechanisms underlying rapid detection of emotional facial expressions remain unclear. Moreover, no research has investigated the contribution of emotional significance by comparing detection of emotional with that of neutral targets embedded within neutral distractors. Thus, we measured ERPs during a visual search task in which participants detected emotional facial expressions or control stimuli, “anti-expressions”, within crowds of neutral expressions. Anti-expressions were created by computer-morphing techniques contain equivalent amounts of visual change as emotional facial expressions, compared with neutral facial expressions, but they were categorized as neutral expressions. Twenty volunteers participated in the ERP experiment, engaging in visual search tasks in which they were presented with an array of faces and were asked to answer whether all faces were the same or a discrepant face was exist. After the ERP experiment, they evaluated all stimuli in terms of subjective experiences of emotional arousal and valence. Behavioral results indicated that emotional expressions were detected faster and rated as more emotionally arousing than were anti-expressions. ERP results showed that emotional expressions elicited larger early posterior negativity (EPN), at 200-400 ms, compared with anti-expressions. Furthermore, the larger EPN was related to faster detection and higher arousal. These results suggest that faster detection of emotional versus neutral facial expressions is implemented via activation of the posterior visual cortices at 200-400 ms, which is involved in processing emotional significance.

EMOTION & SOCIAL: Other

C33

TESTING THE ROLE OF ORBITOFRONTAL CORTEX IN POLITICAL "FIRST IMPRESSIONS"

Chenjie Xia[1,2], Kaitlyn Shannon[1], Dietlind Stolle[1], Elisabeth Gidengil[1], Lesley Fellows[1]; [1]McGill University, [2]Harvard University — Recent studies in the emerging field of neuropolitics suggest that voters' decisions can be influenced by automatic evaluations of social traits. Perceived competence based on candidates' appearance is an important predictor of voting behavior when no other information is supplied. Lesion and neuroimaging studies have implicated orbitofrontal cortex (OFC) in judgments of social traits on the one hand, and in economic decision-making on the other. We asked whether lesions affecting lateral OFC disrupt the ability to judge pertinent social traits of political candidates, change the influence of these judgments on voting decisions, or both. A simulated election paradigm was administered to 9 patients with LOFC lesions, 16 patients with frontal lobe lesions sparing the LOFC, and 30 healthy participants. Participants were shown head-and-shoulder photographs of real (but unknown to the participants) political candidates and asked to choose the winner among pairs of candidates. They then judged the competence and attractiveness of each candidate based on the same photographs. Patients with LOFC lesions did not differ from the other groups in their ability to detect these social traits. Consistent with prior work, the appearance of competence was an important predictor of voting behavior amongst healthy participants and patients with lesions sparing the LOFC. This relationship between social trait assessment and voting behavior was much weaker in patients with LOFC lesions. LOFC may not be necessary for judgment of social traits based on physical appearance, but it seems to play a crucial role in how these judgments modulate electoral decisions.

C34

MEASURING THE EFFECTS OF TRANSCRANIAL DIRECT CURRENT STIMULATION ON FRONTAL CORTICAL EXCITABILITY WITH CONCURRENT FUNCTIONAL MAGNETIC RESONANCE IMAGING IN UNIPOLAR DEPRESSION

Evangelia G. Chrysikou[1], Gavin K. Hanson[1], Christopher H. Ramey[1], W. Jake Thompson[1], Laura E. Martin[2,3], Rick E. Ingram[1]; [1]University of Kansas, [2]University of Kansas Medical Center, [3]Hoglund Brain Imaging Center — Transcranial direct current stimulation (tDCS) is a non-invasive, painless neuromodulation method, involving the application of weak direct currents (1-2 mA) through electrodes on the scalp. A limited but growing number of studies suggest that tDCS holds promise for the treatment of depression, particularly for patients who fail to respond to pharmacological or psychological interventions alone. However, despite its advantageous characteristics such as low cost, ease of use, and reliable sham methodology, tDCS treatment has not progressed from such proof-of-concept investigations to routine clinical use. This shortcoming is largely due to lack of knowledge on the precise effects of tDCS on cortical excitability, connectivity, and metabolic function for different patient groups. The goal of this study was to establish the specific and direct effects of tDCS on brain plasticity using functional magnetic resonance imaging (fMRI) concurrently with tDCS in patients diagnosed with unipolar depression and healthy control subjects during cognitive and emotion regulation tasks. Participants completed one run of a cognitive and two runs of an emotion regulation task while undergoing fMRI, first without receiving concurrent tDCS and then after receiving either excitatory (anodal) tDCS at 1.5mA over left prefrontal cortex or sham stimulation. Results of whole-brain and region-of-interest analyses, as well participants' task performance, contribute to our understanding of the efficacy of tDCS as a possible treatment for depression and can guide future studies that will focus on the optimization of tDCS treatment approaches for individual patients.

C35

A TWIN STUDY IDENTIFYING THE ORIGIN OF ABNORMAL AUTOMATIC RESPONSES TO THREAT-RELATED STIMULI IN PTSD

F. Caroline Davis[1,2], Michael B. VanElzakker[1,3], Lindsay K. Staples[1,4], Natasha B. Lasko[1,2], Scott Orr[1,2], Roger K. Pitman[1,2], Lisa M. Shin[1,3]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Tufts University, [4]UCLA — Posttraumatic stress disorder (PTSD) is a common and often debilitating psychiatric condition that can occur after experiencing highly stressful events. Research is beginning to identify biologic abnormalities, or "markers," found in PTSD, but one key challenge is determining whether such markers are acquired characteristics of the disorder or familial vulnerability factors that increase risk for developing PTSD after trauma exposure. One brain region that has been consistently implicated in the pathophysiology of PTSD is the dorsal anterior cingulate cortex (dACC), which shows hyperactivity both at rest and during cognitive processing. Here, we used a masked faces paradigm to characterize automatic dACC responses to threat-related stimuli. Using a unique design employing monozygotic (MZ) twins discordant for combat exposure (some of whom have since developed PTSD), we also aimed to characterize the origin of any observed functional brain abnormalities. During fMRI scanning, 19 male MZ twin pairs (eight PTSD) viewed alternating blocks of masked fearful and happy faces. Participants with PTSD and their combat-unexposed cotwins without PTSD showed heightened dACC activation while viewing masked fearful faces; consistent with the idea that dACC hyperreactivity to potential threat is a familial risk factor for developing PTSD. We also observed a main effect of combat exposure, in which dACC responses to masked fearful faces were elevated in the combat exposed twins, irrespective of diagnosis. Thus, while combat exposure appears to generally amplify dACC responses to threat-related stimuli, individuals with PTSD and their identical combat-unexposed cotwins have exaggerated dACC responses, consistent with a familial vulnerability factor.

C36

NEURAL CORRELATES OF INDIVIDUAL DIFFERENCES IN GENEROUS PREFERENCES

Andrew Fox[1], Nathan Vack[1], Abigail Freeman[1], Richard Davidson[1]; [1]University of Wisconsin-Madison — Acts of generosity are critical for building and maintaining successful societies. Although quantifying and increasing generous behavior, as opposed to selfish behavior, is of great societal interest, little is known about the mechanisms that give rise to generous preferences. We examined the neural underpinnings of generous preferences using a novel revealed preference economic game in combination with functional MRI. During their MRI, each of 28 participants made 100 forced-choice decisions between money for themselves and money for anonymous strangers. Behavior in this task has convergent and face validity and is moderately stable over time (Fox et al., in prep). The value of a dollar for a stranger compared to a dollar they get to keep was estimated for each subject using logistic regression across choices. In-scanner behavior was highly correlated with behavior outside of the scanner ($r=.97$, $p<.001$). In the scanner, self- and other-offers were presented sequentially and counterbalanced to facilitate separation of the neural signals specific to other-valuation. Brain regions that tracked self- and other-amounts were separately identified using parametric modulation analyses. On average, activation in the anterior insula tracked the amount offered to the other person more than the self ($p<.05$, FWE-corrected), but this was not reflected in individual differences in other-oriented valuation. Individual differences in other-oriented-valuation were negatively correlated with variation in self vs. other amount tracking in the lateral pfc ($p<.05$, FWE-corrected), such that more generous individuals showed decreased tracking of other-amounts and increased tracking of self-amounts in the lateral pfc.

C37

ELECTROPHYSIOLOGICAL CORRELATES OF SEXUALLY EVOCATIVE SPEECH

Simon Rigoulot[1], Marc D. Pell[1]; [1]School of Communication Sciences and Disorders, McGill University — During social communication, speech prosody helps to infer the true intentions of the speaker in reference to what is actually said. We investigated here what brain processes allow listeners to detect sexual innuendos, when speakers intentionally play on a possible sexual interpretation of an otherwise innocent utterance. We recorded the electroencephalogram of 25 participants while they were hearing sentences that were innocent or could have a sexual meaning ("she inspected his letter/package this morning"). For each type of sentences, half was spoken with a neutral tone and the other half was spoken with a sexual intonation. At the end of each sentence, participants were asked if they heard a specific word, to ensure that they attentively listened to the sentences. We found two positive components sensitive to the nature of sentences (innocent/sexual) and the tone in which they were uttered (neutral/sexual). The amplitude of the first component, peaking at 150 ms in bilateral temporo-parietal areas, was larger in the left than in the right area

in response to sentences that could have a sexual meaning. For the second component, peaking at 250 ms in central area, analyses revealed an effect of interaction between the nature of the sentences and the prosody of the voice with larger amplitudes when innocent sentences were spoken with a sexual prosody, suggesting an effect of incongruency for these sentences. These data extend knowledge of the brain mechanisms involved in the decoding of the real intentions of speakers during interpersonal communication.

C38

PLACEBO-INDUCED CHANGES IN THE NEUROLOGICAL PAIN SIGNATURE ARE DISSOCIABLE FROM EXPECTANCIES Scott Schafer[1], Tor D. Wager[1]; [1]University of Colorado Boulder — The goal of this study was to determine whether placebo-induced reductions in pain-related fMRI activity depend on conditioned experience, belief, or a combination of the two. We induced placebo analgesia in 40 subjects using standard conditioning procedures. Experience was manipulated between subjects, such that half received four conditioning sessions (LONG group), while the other half received a single session (SHORT group). We tested effects on thermal pain under Control (C) and Placebo (P) conditions. After an initial test, we reversed placebo expectancies by revealing that the placebo was inert, and re-tested participants. We focused on responses in the Neurological Pain Signature (NPS, Wager et al. 2013), an fMRI-based activity pattern that is sensitive (90+%) and specific in discriminating the intensity of thermal pain within individual participants. Prior to the reveal, neither SHORT nor LONG groups showed a [C - P] difference in NPS responses during pain. However, NPS responses were reduced overall [C + P] in the LONG vs. SHORT groups, and the effects of temperature (46 vs. 45.5 degrees) on NPS responses were abolished in the LONG group. Following the reveal, NPS responses were reduced by placebo [C > P] in the LONG group, in spite of almost complete reversal of expectancies, whereas the SHORT group showed an increase in NPS pattern expression [P > C]. These findings suggest that prior conditioning experience is crucial in shaping placebo-responses on pain-related fMRI responses, and its effects may persist when belief in the placebo treatment is reduced or eliminated.

C39

SOCIAL PROBLEM SOLVING AND EMPATHY IN ALCOHOL DEPENDENCE Tobias Schmidt[1], Patrizia Thoma[1], Patrik Roser[2], Georg Juckel[2], Boris Suchan[1]; [1]Department of Neuropsychology, Institute of Cognitive Neuroscience, Ruhr-University Bochum, Universitätsstraße 150, D-44780 Bochum, Germany, [2]Department of Psychiatry, Ruhr-University Bochum, LWL University Hospital, Alexandrinenstraße 1-3, D-44791 Bochum, Germany — Social problem solving abilities and empathy are fundamental for everyday functioning. Presently, little is known about specific changes of these aspects of social cognition in alcohol dependence. Our study investigates distinct components of empathy and social problem solving in patients with alcohol dependence and depression in comparison with healthy controls. Forty-nine recently detoxified patients with alcohol dependence (ALC), twenty patients hospitalized for depression (DEP) and fifty-one healthy controls (HC) completed a computerized task assessing different components of empathy (emotion recognition, personal concern and affective perspective taking) and a scenario-based test of the ability to understand and solve interpersonal problems. Response accuracy was impaired in both the ALC and the DEP group relative to the HC group on the emotion recognition task, while only ALC patients made significantly more errors than the HC group during the affective perspective taking task. ALC patients, but not the DEP group were also significantly impaired relative to healthy controls with regard to the generation and selection of both socially acceptable and practical solutions for interpersonal problems and they also perceived problematic social situations as significantly more awkward. Furthermore, ALC patients made significantly more errors with regard to the interpretation of sarcastic stories relative to healthy controls. Our data provide evidence of specific patterns of altered empathic responding and social problem solving in alcohol-dependent individuals in comparison with depressed patients and healthy controls.

C40

INTER- AND INTRA-SUBJECT SYNCHRONIZATION OF ELECTROMAGNETIC BRAIN ACTIVATIONS DURING NATURALISTIC STIMULATION CONDITIONS Wei-Tang Chang[1], Iiro P. Jääskeläinen[2], John W. Belliveau[1], Samantha Huang[1], An-Yi Hung[1], Stephanie Rossi[1], Jyrki Ahveninen[1]; [1]Harvard Medical School/Massachusetts General Hospital, Charlestown, MA, United States, [2]Aalto University School of Science, Espoo, Finland — An increasing number of fMRI studies use naturalistic stimuli such as movies to trigger cognitive and emotional processes that would be difficult to elicit with more simplified stimuli. Naturalistic stimulation has been much more scarcely utilized during magnetoencephalography (MEG) and EEG, which (unlike fMRI) provide high-resolution spatiotemporal estimates of population-level neuronal activity instead of its metabolic correlates. It is, consequently, still uncertain whether reliable and replicable patterns of MEG/EEG activity can indeed be observed during free viewing of a movie stimulus. Here, right-handed healthy subjects watched a 17-min video clip from movie "Crash" (Lionsgate Films, 2004) twice during simultaneous MEG and EEG recordings. Physiological noise components, such as ocular and cardiac artifacts, were removed from the recorded data using the DRIFTER algorithm. The MEG/EEG raw time series were multiplied with a minimum norm estimate (MNE) inverse operator to yield a dynamic estimate of cortical activity during movie viewing. We then calculated within-subject between-run correlations (WSBRC) of cortical activity over 1030-s windows at every 200 ms, and analyzed inter-subject synchronization patterns by averaging the resulting 45 pairs of correlation coefficients between the WSBRC time series. The most significant ISC-WSBRC occurred in occipital/inferior temporal visual and superior temporal auditory cortices, and in the posterior cingulate, precuneus, pre- and postcentral gyri, and right inferior and middle frontal gyri. Our results show that reliable patterns of broadband MEG/EEG activity can be measured during free movie viewing, and that the most replicable activations are consistent with previous fMRI studies using the same stimuli.

C41

HOW DOES THE BRAIN REPRESENT DIFFERENT WAYS OF UNDERSTANDING THE SAME STORY? Yaara Yeshurun[1], Janice Chen[1], Erez Simony[1], Christopher J Honey[1], Uri Hasson[1]; [1]Princeton University — Different listeners can interpret the same story in starkly different ways, depending on their prior views of the world and the characters' goals and beliefs. In this functional magnetic resonance imaging study we investigated how different interpretations of the same narrative are represented in the brain. Forty subjects listened to an auditory story whose depiction of character relationships and mental states was highly ambiguous. Subjects were randomly assigned to receive one of two possible pre-story "introductions", which cued radically different interpretations of the subsequent story. Behavioral results suggested comparable levels of comprehension between the two groups ($p = 0.8$), but significant differences ($p < 10\text{-}9$) in the interpretation of the narrative. Next, to track neural representations of the story interpretation: we used a temporal-based classifier to identify regions whose activity could differentiate between subjects presented with one introduction or the other. Most brain areas responded in similar manner across both groups. However, different response time-courses to the identical auditory input were detected within the bilateral posterior temporal-parietal junction, the precuneus, bilateral inferior frontal gyrus and the right hippocampus. Prior studies have shown that many of these regions, linked to the default mode network and language systems, are sensitive to the absence or presence of a meaningful interpretation for incoming information. Here we show that activity in these regions is different even for two plausible interpretations of the same incoming information.

C42

RELATION BETWEEN AN OXYTOCIN RECEPTOR GENE VARIANT, FACE RECOGNITION AND AMYGDALA ACTIVATION Hakan Fischer[1,2], Anna Zettergren[3], Johanna Lovén[2], Joakim Svärd[2], Johan Milding[3], David Johansson[3], Natalie C Ebner[4], Lars Westberg[3]; [1]Stockholm University, [2]Karolinska Institutet, [3]University of Gothenburg, [4]University of Florida — The ability to recognize faces of persons we encounter is crucial for most social interactions. The neuropeptide oxytocin has been shown to be essential for social recognition in mice, by actions on oxytocin receptors in medial

amygdala. In line with these results, recent studies indicate that oxytocin treatment increases face recognition abilities also in humans. Furthermore, several studies have shown associations between oxytocin receptor gene (OXTR) variants and various aspects of social behaviors as well as risk for autism. The aim of the current study is to explore if OXTR variants may be associated with the ability to recognize faces and related amygdala activity. Eleven single nucleotide polymorphisms (SNPs) in the OXTR were genotyped in about 60 subjects who had performed a face memory task when scanned with functional magnetic resonance imaging (fMRI). One of the OXTR variants, rs7632287, - located downstream of the gene and previously associated with risk of autism spectrum disorders - was associated with the ability to recognize faces (p=0.01) as well as with amygdala activation during the encoding phase (p=0.004) of the face memory paradigm. In conclusion, our results provide support for the notion that oxytocin may regulate social recognition in humans using similar neural mechanisms as previously described in rodents.

EXECUTIVE PROCESSES: Monitoring & inhibitory control

C43

THE NEURAL BASIS OF MONITORING GOAL PROGRESS- AN FMRI STUDY Yael Benn[1], Thomas L. Webb[1], Betty Chang[1], Yu-Hsuan Sun[1], Iain D. Wilkinson[1], Tom F.D. Farrow[1]; [1]University of Sheffield, UK — The neural basis of goal progress monitoring has received little attention relative to other processes involved in goal directed behavior (e.g., attention, motor control, and response inhibition). Studies of error monitoring have identified the anterior cingulate cortex (ACC) as being sensitive to conflict detection, and involved in triggering corrective action. However, conflict detection does not capture several important aspects of progress monitoring, such as monitoring progress over time (e.g., toward losing weight), or monitoring where there is no discrepancy (e.g., when progress is good). In the present research, 20 healthy participants underwent fMRI while playing a computer game involving monitoring progress toward either a numerical or a visuo-spatial target. Activation in the ACC was observed only when participants monitored their progress with respect to a clear reference value, implying that progress towards more general goals, such as "being a good person", are less likely to result in a conflict. Activations were also observed in the dorsolateral prefrontal cortex (DLPFC), and several parietal regions. The DLPFC is likely to be activated due to its role in updating working memory as well as control actions. Results further suggest that DLPFC activations are likely to be partially modulated and fedback to and from regions of the parietal cortex, to support processes such as periodically attending to information, calculation, and magnitude processing. These findings are important for understanding the processes involved in monitoring progress over time, and how these overlap with, but also distinct from, the processes involved in monitoring for conflict or errors.

C44

HUMAN STRIATAL RESPONSES DURING SELF-COMMITTED AND OBSERVED ERRORS Iiro P. Jääskeläinen[1], Hanna-Leena Halme[1], Yigal Agam[2], Enrico Glerean[1], Juha M. Lahnakoski[1], Mikko Sams[1], Karoliina Tapani[1], Jyrki Ahveninen[2], Dara S. Manoach[2]; [1]Aalto University School of Science, Espoo, Finland, [2]Massachusetts General Hospital — Human striatum has been implicated in error processing. Here, we compared striatal responses during self-committed errors and observation of errors committed by others. During 3-Tesla functional magnetic resonance imaging, twenty healthy participants played a computer game in which moles and rabbits emerged from two holes in a garden. Their task was to club any moles that emerged but if a rabbit emerged, to club the other, empty, hole. Failing to club the mole and clubbing the rabbit both counted as errors. Correct actions were indicated with green "%" and errors with red "X". Next, participants passively observed a recording of another person's game play. Finally, participants watched movie clips depicting errors in naturalistic settings such as figure skaters falling down. The putamen exhibited significantly stronger responses bilaterally during both self-committed errors and observed errors in the naturalistic video clips than during observed errors in the recorded game play. Further, right putamen showed significantly stronger responses during self-committed errors than when observing errors in the naturalistic videos. Significantly stronger responses were also observed in bilateral globus pallidus and right caudate nucleus, during self-committed errors than during observed errors in the recorded game play. In conclusion, the strongest striatal responses arose during self-committed errors while observing errors by others in naturalistic free viewing conditions activated the putamen. In contrast, we failed to see any putamen activation when observing errors committed by others during the cartoon game. Thus, ecological validity of stimuli seems to be important when investigating how striatum processes observed errors.

C45

HYPERACTIVE ERROR MONITORING IN OCD CAN BE MODULATED BY TASK DEMANDS Julia Klawohn[1], Julia Preuss[1], Anja Riesel[1], Rosa Grützmann[1], Tanja Endrass[1,2], Norbert Kathmann[1]; [1]Humboldt-Universität zu Berlin, [2]Otto-von-Guericke-Universität Magdeburg — Performance monitoring has repeatedly been shown to be hyperactive in patients with obsessive-compulsive disorder (OCD), as indexed by an enhancement of the error-related negativity (ERN) of the event-related brain potential (ERP). Evidence suggests that this hyperactivity is independent of current symptom state in OCD. It is unclear, however, whether performance monitoring can still be modulated in patients with OCD in order to meet situational demands. The present study investigated whether ERN amplitudes can be reduced in OCD patients by manipulating attentional demands and monitoring capacity. Patients and matched control participants were examined in a dual-task paradigm, combining a response conflict flanker task and a working memory n-back task with two difficulty levels. We hypothesized that error monitoring in the flanker task would be reduced with increasing difficulty of the concurrent n-back task. Analysis of behavioral data showed increased reaction times and decreased response correctness with increasing n-back difficulty, confirming the manipulation of experimental task load. ERP results revealed significant decreases of ERN amplitudes with dual task difficulty in both groups. These results indicate that both patients with OCD as well as healthy controls are able to modulate performance monitoring according to task demands and that changing the attentional focus can modifiy hyperactive action monitoring in OCD. On the basis of such findings new treatment approaches for OCD, e.g. attentional trainings, may be developed.

C46

NEURAL MECHANISMS OF TIME-BASED PROSPECTIVE MEMORY Kevin Oksanen[1], Emily Waldum[1], Todd Braver[1], Mark McDaniel[1]; [1]Washington University in St. Louis — In daily life, we often need to remember to perform an action after, or at, a specific period of time (e.g., take pizza out of oven in 15 minutes). Surprisingly, little is known about the neural mechanisms that support this memory, termed time-based prospective memory (PM). Here we pioneered a paradigm that enabled examination of both sustained and transient processes engaged during time-based PM. Participants (N=20) performed a demanding on-going task during fMRI scanning, with and without an additional time-based PM demand. During the PM condition participants could access a hidden clock with a specific response (in the control condition, pseudo-clocks randomly appeared and their presentations were removed via the same response). Analyses tested for sustained activation associated with the PM condition, and transient activation associated with clock-checks and the execution of PM responses. Contrary to prior findings with event-based PM (i.e., remembering to perform a future action when a specific event occurs; McDaniel et al, 2013), no sustained PM-related activity was observed in anterior prefrontal cortex (PFC) or elsewhere in the brain; instead, transient clock-related activity was observed in this region. Critically, the activation was anticipatory, increasing before clock-check responses. Anticipatory activity prior to PM response execution was weaker in aPFC, but strong in pre-SMA (relative to clock-check responses), suggesting a functional double dissociation related to volitional decision-making. Together, the results suggest aPFC activity dynamics during time-based PM reflect a distinct transient monitoring process, enabling integration of PM intention with current temporal information to optimally schedule upcoming PM-related actions.

C47

THE BRAIN CARES ABOUT QUALITATIVE RATHER THAN QUANTITATIVE SURPRISE: THE P3 REFLECTS MISMATCH BETWEEN PREDICTED AND ACTUAL VALENCE OF ACTION OUTCOMES IN A REWARD CONTEXT

Denise Janssen[1], Edita Poljac[1], Harold Bekkering[1]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, the Netherlands — Whether reward prediction errors are of a qualitative or quantitative nature remains a matter of debate. The current electroencephalography study addressed this debate by examining how the valence and magnitude of prediction errors interact in modulating the outcome-evoked response. In each trial, participants were primed with a cue that predicted the outcome of that trial with 75% validity. Possible outcomes were a win or a loss of 30 or 10 points. In 25% of the trials, the actual outcome deviated from the predictive cue. The P2 component was independently modulated by the valence and the magnitude of the outcome, for both predicted and unpredicted outcomes. In contrast, the P3 was selectively sensitive to mismatch between the predicted and actual valence of the outcome, meaning that the actual size of the prediction error did not modulate the P3. Furthermore, the P3 effect did not differentiate between positive and negative prediction errors. Satisfaction ratings however showed that participants did differentiate between positive and negative prediction errors at a conscious level. Losses were overall rated as less satisfactory than wins, with negative prediction errors resulting in an additional lowering of satisfaction. Interestingly, the way that valence mismatch affected subjective experience correlated positively with the way it modulated the P3. To conclude, the P3 reflects a special class of prediction error - namely a mismatch between predicted and actual valence of the outcome, which suggests that the brain cares about qualitative rather than quantitative surprise in a reward context.

C48

RIGHT DORSAL LATERAL PREFRONTAL CORTEX AND THE CONFLICT ADAPTATION PROBED WITH TRANSCRANIAL DIRECT-CURRENT STIMULATION

I-Wen Huang[1], Chi-Fu Chang[1], Chi-Hung Juan[1]; [1]Institute of Cognitive Neuroscience, National Central University, Jhongli, Taiwan — To survive in the complex and dynamic environment, it is important that we have to detect and resolve the conflict situations. According to the conflict monitoring theory (Botvinick et al., 2001), the anterior cingulate cortex (ACC) detects the conflict and conveys this information to right dorsal lateral prefrontal cortex (rDLPFC) or other brain areas, which would then adjust the level of cognitive control to adapt the next oncoming conflict circumstance. The conflict adaptation effect is one of the outcomes reflects such cognitive control adjustment which can be observed the reduced reaction time (RT) of incongruent trial when the previous trial type is also incongruent (I-I) in conflict tasks. In this experiment, we used a color flanker task combined with non-invasive transcranial direct current stimulation (tDCS) over rDLPFC to test its role in conflict adaptation. To avoid a priming effect, we excluded all the stimulus and response repetitions. Behavioral result revealed the conflict adaptation effect that was driven by the reduced RT in I-I condition. Most importantly, anodal tDCS eliminated such behavioral effects. Furthermore, cathodal tDCS decreased the RT of current congruent trial after the previous incongruent trial. These data suggested a causal role of rDLPFC in cognitive control adjustments. In addition, the results showed dissociation between different stimulation especially for the better performance in the low-conflict condition after preceding high-conflict situation when we applied cathodal tDCS.

C49

BRAIN NETWORK ACTIVITY DURING SELF CONTROL OF SMOKING BEHAVIOR

Andrew Melrose[1], Louise Cosand[1], Isabel Woyke[2], John Monterosso[1]; [1]University of Southern California, [2]Radboud University — Traditional conceptions of self-control involve competition between appetitive urges (analogous to a gas pedal), and executive functioning (analogous to a brake pedal). We had 36 nicotine dependent individuals in acute withdrawal complete an fMRI self-control challenge in which they were given several opportunities to smoke, but were encouraged to resist, "on as many trials as you can manage" Participants self-reported urge to smoke, and their faegerstrom score (severity of dependence) were both negatively associated with self-control performance. In contrast with the tradition gas vs. brake conception, we did not observe a relationship between executive function scores (e.g., Stroop, CPT, Stop-Signal Task) and self-control success. The only cognitive measure that was related to performance on the task was estimated IQ, which was associated with better performance (though not significantly so with correction for multiple comparisons). An independent component analysis identified three network components that were more active when participants were not smoking (but could smoke) relative to periods when smoke was unavailable. Of note, individual differences in the prominence of one of these networks significantly predicted task performance. Specifically, better self-control performance was observed among participants who had greater signal within a network that included visual cortex, bilateral fronto-parietal (sectors typically observed in executive function tasks), and bilateral anterior insula and ventral striatum (sectors typically associated with appetitive response). Taken together, our results hint that integration between regions supporting appetite, and regions supporting executive control (rather than isolated executive function capacity) may be predictive of self-control success.

C50

ALPHA SUPPRESSION AND ACTION MONITORING IN YOUNG CHILDREN

Jennifer McDermott[1], Sarah Jo Torgrimson[1], Kathryn Anzuoni[1], Phillip Desrochers[1]; [1]University of Massachusetts-Amherst — EEG alpha suppression is associated with imitation and motor learning. Currently little is known about this dynamic process in early childhood, including whether alpha suppression fluctuates over the course of task performance. Using a multi-step motor sequence task presented across multiple blocks, variance in EEG alpha suppression was assessed in young children (n=18, 11 female, M= 5.6 years olds) as they repeatedly "watched" and then "copied" the actions of an experimenter. Baseline EEG to a fixation mark was collected prior to the start of each block. Reactivity to action observation and execution differed in the left hemisphere at the frontocentral region (FC3) over the course of the task ($F(2,16)=3.86$, $p=0.04$). Specifically, children showed enhanced alpha suppression during action observation as compared to action execution in the first block of the motor sequence paradigm ($t(17)=2.96$, $p=.009$). As the task progressed, differences in alpha suppression between action observation and action execution diminished, suggesting decreased need for neural resources as task familiarity was achieved. Moreover, reduced alpha suppression during action observation was associated with impaired self-monitoring skills ($r(16)=.75$, $p=.000$) assessed via maternal report on the Behavior Rating Inventory of Executive Function (BRIEF). Altogether, these results highlight two sets of novel findings: 1) in early childhood the magnitude of alpha suppression to action observation varies across task performance, whereas alpha suppression to action execution remains stable and 2) the ability to attend to the actions of others is associated with the meta-cognitive ability to monitor one's own actions and self-regulate across settings.

C51

INHIBITION-INDUCED FORGETTING: WHEN MORE CONTROL LEADS TO LESS MEMORY

Yu-Chin Chiu[1], Tobias Egner[1]; [1]Center for Cognitive Neuroscience, Duke University, Durham, NC — The ability to inhibit pre-potent responses is considered a key aspect of executive function, but the relation of response inhibition to other cognitive operations is poorly understood. Here we examined the effects of inhibitory control on stimulus processing through the lens of incidental memory encoding. In a face-gender go/no-go task, participants responded to go cues (e.g., male faces) and withheld responses to no-go cues (e.g., female faces, counter-balanced across participants) over 4 (Experiment 1) or 6 (Experiment 2) repetitions of 120 unique face identities. Consistent with prior studies, go/no-go performance indicated that participants learned to associate inhibition with no-go cues, as the probability of responding to these cues decreased with the number of cue exposures (both experiments, p's $< .05$). After a short filler task (~5 min.), participants received a surprise recognition memory test involving the "old" task stimuli intermixed with a set of new faces. In both experiments, recognition memory for no-go items was worse than for go items (Exp 1: 55% vs. 63%; Exp 2: 64% vs. 71%, p's $<.01$). In Experiment 3, we inserted occasional dot probes during the same go/no-go task to test whether this memory effect may be due to response inhibition sapping attention away from stimulus processing. As expected, we found inferior probe detection for no-go trials than for go trials (92% vs. 96%, $p < .01$).

Together, these results suggest that exerting inhibitory control impairs memory encoding, possibly due to shifting attention resources away from external stimuli to motor inhibition processes.

EXECUTIVE PROCESSES: Other

C52

MIND WANDERING IMPAIRS TEXTBOOK READING COMPREHENSION AND RETENTION

Amishi Jha[1], Lisa Cameron[1], Alexendra Morrison[1], John Kounios[2]; [1]University of Miami, [2]Drexel University — Recent work suggests that the occurrence of mind wandering has important implications for classroom learning. Here, we examine the inverse relationship between mind wandering and both reading comprehension and retention in a task contextualized for students. University students (N=57) read a chapter from an introductory psychology textbook sentence-by-sentence on a computer screen. Readers advanced to the next sentence via button press. Sentences from another chapter of the book were embedded intermittently as mind wandering probes. For each sentence, participants were instructed to indicate whether it was in-context or out-of-context. Mind wandering was measured subjectively by asking participants to key-press when they noticed off-task thinking, and objectively by examining failure to notice out-of-context sentences. Retention was measured by quiz performance following the reading task. Results were compared to established measures of mind wandering and sustained attention (Cognitive Failures Questionnaire, CFQ; and the sustained attention to response task, SART). Correlations revealed that higher quiz performance was accompanied by a better ability to notice out-of-context sentences, and a lower incidence of self-reported mind wandering. Reading quiz performance was also positively correlated with the ability to sustain attention on the SART. Also, self-reported mind wandering during the reading task was positively correlated with the CFQ and mind wandering probes during the SART. These results indicate that mind wandering may be a stable feature across tasks, and even outside of the laboratory environment. Further, mind wandering has a detrimental effect on reading comprehension and retention.

C53

PREDICTION ERRORS AND RESTART COSTS: EVIDENCE FOR A GENERIC LEARNING SYSTEM WITHIN THE MEDIAL-FRONTAL CORTEX

Olave Krigolson[1]; [1]Department of Psychology and Neuroscience, Dalhousie University — A growing body of evidence supports the notion that within the medial-frontal cortex there is a generic reinforcement learning system tasked with the adaptive modification of behavior. Indeed, studies using event-related brain potentials have demonstrated that the error-related negativity (ERN) is modulated in a manner reflective of a reward prediction error. Having said that, the evidence supporting this contention is not completely clear. Here, we had participants perform a learnable task in which they acquired the ability to categorize "blobs" over the course of five training sessions. We made two specific predictions: one, that the reward positivity (RP) - the positive going aspect of the fERN would diminish over time as predicted by a computational task model that used a temporal difference learning algorithm. Two, that increases in the amplitude of the RP would reflect neural restart costs that we would observe at the start of the second, third, fourth, and fifth training sessions. Our data supports both of these hypotheses. First, we found that a contrast of correct and incorrect feedback early in learning yielded a feedback ERN. Second, we found that the amplitude of the RP diminished with learning as predicted by our computational model. Third, at the start of each day after the first day of training we observed a brief increase in the amplitude of the RP that went away with further practice. In sum, our results provide further support for the hypothesis that a generic reinforcement learning system within the medial-frontal cortex drives human learning.

C54

INDIVIDUAL DIFFERENCES IN THE BALANCE OF GABA TO GLUTAMATE IN PREFRONTAL CORTEX PREDICTS THE ABILITY TO SELECT AMONG COMPETING OPTIONS

Alejandro De La Vega[1], Mark Brown[2], Hannah Snyder[3], Debra Singel[2], Yuko Munakata[1], Marie Banich[1]; [1]Department of Psychology & Neuroscience, University of Colorado Boulder, [2]Department of Psychiatry, University of Colorado Denver, [3]Department of Psychology, University of Denver — Individuals vary greatly in their ability to make a choice when presented with a multitude of options. Here we investigate the neural underpinnings of these individual differences. Using magnetic resonance spectroscopy, we found that the balance of inhibitory versus excitatory neurotransmitters in prefrontal cortex influences the ability to select among task-relevant options in two language production tasks. The greater an individual's concentration of GABA relative to glutamate in prefrontal cortex, the faster they were able to select a relevant word. This outcome is consistent with our computational modeling of this task, which predicts that greater net inhibition in prefrontal cortex increases the efficiency of resolving competition among task-relevant options. Moreover, the association with the GABA/glutamate ratio was specific to selection, and was not observed for executive function ability in general. These findings are the first to link the balance of excitatory and inhibitory neural transmission in prefrontal cortex to specific aspects of executive function.

C55

LONGITUDINAL CHANGES IN STRUCTURAL CONNECTIVITY RELATED TO GREY MATTER VOLUME IN BREAST CANCER PATIENTS TREATED WITH CHEMOTHERAPY

Carole Scherling[1], Barbara Collins[2,3], Joyce MacKenzie[3], Andra Smith[2]; [1]Memory and Aging Center, Neurology, UCSF, Sandler Neuroscience Center, San Francisco, CA, [2]School of Psychology, University of Ottawa, Vanier Hall, Ottawa, Canada, [3]3Ottawa Hospital, Civic Campus, Ottawa, Canada — Purpose: Cognitive impairment after chemotherapy have been reported in the literature. Working memory impairments are most commonly reported- frequently studied using neuropsychological assessments and imaging. However, functional deficits likely have structural explanations. Changes in neural network connectivity have been revealed in chemotherapy-treated cancer patients (Hosseini, 2012). The current study extends this investigation with a prospective longitudinal analysis. Methods: Female breast cancer patients and individually-matched healthy controls (n=20 each; age/education matched) underwent magnetic resonance imaging. Baseline was prior to chemotherapy but after surgery, time2 was one month following treatment, and time3 was one year after treatment. Controls followed a similar scanning protocol. Data were segmented into grey matter volumes using voxel-based-morphometry (VBM8) and entered into the Graph-Analysis Toolbox (GAT) pipeline. Results: From baseline to time2, patients reveal reduced graph theory metrics, consistent with previous reports of reduced small-world network properties (Hosseini, 2012), with a partial recuperation at time3. Following the same pattern, frontal networks become less associated at time2 compared to baseline, with another partial recovery at time3. Neuropsychological tests reveal slowest processing speed at time2, with some increases at time3. Conclusions: This is the first prospective study to investigate structural connectivity in a chemotherapy-treated sample. Results support previous conclusions, revealing volumetric decreases and functional deficits after treatment, with partial recuperation with time. Further investigations are required to understand how chemotherapy affects brain structure, identify long-term functional deficits, and uncover vulnerability factors aiding deficit creation/recuperation. Survivorship has increased with recent medical advances- hence post-treatment quality-of-life issues should be a medical focus.

C56

SAVINGS IN VISUOMOTOR ADAPTATION FOLLOWING AN UNLEARNING SESSION WITH OR WITHOUT VISUAL FEEDBACK

Jinsung Wang[1], Shancheng Bao[1], Yuming Lei[1]; [1]University of Wisconsin - Milwaukee — Individuals can adapt their movements to various conditions in which visual and proprioceptive (motor) information are dissociated with each other. Following adaptation to such a condition, a neural representation associated with the visual-motor dissociation is thought to be stored in the nervous system. One way to investigate the nature of this neural representation is to examine savings, that is, the extent to which the adaptation is retained following a period of unlearning. In this study, we examined the amount of savings in visuomotor adaptation following an unlearning period in which online visual feedback of targeted reaching movements was either provided or removed. Brain activity following the two types of unlearning sessions was also examined using functional MRI. The experiment consisted of 6 sessions: familiarization, visuomotor adaptation, unlearning, visuomotor re-adaptation, unlearning, visuomo-

tor re-adaptation. During the adaptation/readaptation sessions, subjects adapted to a rotated display while performing reaching movements with a joystick device in a 3.0 T MRI scanner. During the two unlearning sessions, they performed reaching movements under a normal display condition first with, then without, visual feedback, or vice versa. Our behavioral data demonstrated that the savings observed in the re-adaptation sessions was greater following the unlearning session with visual feedback. Our imaging data showed that the brain regions activated during the two re-adaptation sessions were the same, although the intensity of activity in these regions differed between the two sessions. These findings suggest that the availability of visual feedback during visuomotor adaptation can influence the neural substrates of unlearning.

C57

DOMAIN SPECIFICITY IN TWO SCORING PROTOCOLS FOR THE REY OSTERRIETH COMPLEX FIGURE Emily Sharp[1,2,3], Elizabeth Lertiz[1,3], William Milberg[1,3], Regina McGlinchey[1,3], Laura Grande[1,2]; [1]VA Boston Healthcare System, [2]Boston University School of Medicine, [3]Harvard Medical School — The Rey Osterrieth Complex Figure (ROCF) is a measure of non-verbal memory and visuospatial functioning. Given the role of planning and organization required to accurately complete the copy, the ROCF Copy subtest has been suggested as a sensitive indicator of executive function (EF). The current study investigated the relationship between ROCF copy and EF. We compared two ROCF scoring protocols, one assessing learning and memory (Myers & Meyers; 1995) and another assessing organization, the Planning Subscale of the Boston Qualitative Scoring System (BQSS). We hypothesized the BQSS would be associated with performance on EF tasks, whereas the Myers & Myers (MM) would not. A sample of 31 community dwelling African Americans completed a standard battery of neuropsychological measures. Results indicated that the BQSS scores predicted performance on standardized measures of EF (Trails B and Digit Span Backwards), but not memory performance (CVLT-II). In contrast, MM scores predicted performance on memory, but not EF measures . Results suggest that the scoring protocols may assess for different underlying cognitive processes, and the use of the BQSS in assessing ROCF copy performance may provide additional important information regarding executive function abilities.

C58

DECREASE OF DEFAULT MODE NETWORK DEACTIVATION IN RULE-BASED CATEGORIZATION DURING THE DEVELOPMENT OF AUTOMATICITY Farzin Shamloo[1], F. Gregory Ashby[2], Sebastien Helie[1]; [1]Purdue University, [2]University of California Santa Barbara — The default mode network (DMN) is a set of brain regions in which BOLD signal is suppressed during attentional focus on tasks or the external environment. Because automatic task processing requires less attention, development of automaticity in a rule-based categorization task may result in less deactivation of the DMN. We tested this hypothesis by analyzing the functional magnetic resonance imaging (fMRI) data of 15 participants that were each trained in rule-based categorization for 20 sessions on consecutive workdays (Helie, Roeder, & Ashby, 2010). Each participant was scanned on its 1st day (with no previous practice), 4th day (after 1,680 trials of practice), 10th day (after 5,160 trials of practice) and 20th day (after 11,040 trials of practice). The results show deactivation of the following DMN regions: orbitomedial prefrontal cortex (days 1, 4, 10), inferior parietal lobule (day 4), and middle temporal gyrus (day 20). In addition, analysis of variance shows a statistically significant decrease in orbitomedial prefrontal cortex deactivation between days 1 and 20 (the most robust DMN region), suggesting that automatic rule-based categorization does not inhibit DMN regions as much as rule-based category learning. These results provide preliminary evidence that DMN inhibition is reduced when the rule-based categorization task becomes more automatic, consistent with the hypothesis that automatic task processing requires less attentional focus. Keywords: Default Mode Network; Rule-based Categorization; Automaticity; fMRI;

C59

COGNITIVE CONTROL OF INFORMATION PROCESSING IN AUTISM SPECTRUM DISORDER Melissa-Ann Mackie[1,2], Jin Fan[2,3]; [1]The Graduate Center, City University of New York, [2]Queens College, City University of New York, [3]Icahn School of Medicine at Mount Sinai — Incoming information to the brain vastly exceeds its information processing capacity. Cognitive control is one mechanism that flexibly constrains information processing, aiding to prioritize information reaching conscious awareness. This flexible, purposeful allocation of mental resources is essential to adaptive behavior, but can be compromised by neurological disorder. Individuals with autism spectrum disorder (ASD) comprise one such group demonstrating a rigid, inflexible cognitive style, suggesting possible cognitive control deficits, and inefficient information processing. Although prior investigations have attempted to elucidate the nature of these deficits in individuals with ASD, whether there is an underlying general information processing deficit associated with cognitive control performance remains unclear. The present study aimed to challenge the cognitive control of information processing in 15 adult individuals with ASD and 15 healthy controls using three tasks that systematically manipulate information processing load. The tasks allowed investigation of the efficiency of simple information processing; information processing across a range of values of cognitive load; and rapid information processing capacity. Efficient performance on these tasks requires cognitive control to prioritize information processing according to task demands. Results demonstrated that individuals with ASD performed significantly less efficiently under low cognitive load, across a range of values of cognitive load, and had reduced rapid information processing capacity relative to controls. Further, task performance was related to reported ASD symptom domains. These findings suggest that individuals with ASD may have a core deficit in information processing underlying inefficient cognitive control, contributing to the clinical presentation of the disorder.

EXECUTIVE PROCESSES: Working memory

C60

ACTIVE CONVERSION OF SENSORY INFORMATION TO ABSTRACT REPRESENTATION Kara J. Blacker[1], Akiko Ikkai[1], Balaji M. Lakshmanan[2], Joshua B. Ewen[2,3], Susan M. Courtney[1,2,3]; [1]Johns Hopkins University, [2]Kennedy Krieger Institute, [3]Johns Hopkins University School of Medicine — Extensive research has demonstrated that working memory (WM) for sensory-based information relies on interactions between sensory and prefrontal cortices; however, we also maintain non-sensory information in WM and the neural mechanisms for creating and storing such abstract representations are poorly understood. The current study used electroencephalography (EEG) to investigate the process by which concrete, sensory information is converted into abstract, relational WM representations. Previous studies that focused on sensory information storage demonstrated that increased alpha (8-13Hz) power corresponds to suppression of task-irrelevant sensory information. We hypothesized that the conversion of concrete information to relational information in WM would be marked by an increase in alpha power at posterior electrode sites, as all sensory information becomes task-irrelevant. Participants encoded two colored circles into WM, then after an initial maintenance period, a cue indicated whether they were to convert those items to another concrete representation (i.e., egocentric vertical spatial location) or to a relational representation (i.e., relative vertical location between the two items). A time-frequency analysis, allowing for visualization of the dynamics of the power spectra in both the frequency and time dimensions, revealed that alpha power increased over posterior electrodes when concrete information was converted to a relational representation, but not when the information was converted to another sensory representation. This active conversion occurs approximately 1000-ms after the cue. These findings suggest that abstract representations are stored in WM independent of sensory representations and that posterior regions are suppressed during this process of conversion because these regions become task-irrelevant.

C61

THE WORKING MEMORY STROOP EFFECT: WHEN INTERNAL REPRESENTATIONS CLASH WITH EXTERNAL STIMULI Anastasia Kiyonaga[1], Tobias Egner[1]; [1]Duke University — If working memory (WM) can be thought of as attention directed at internal representations, then maintaining an item in WM should impact behavior comparably to visually attending that item. It is well-known that the meaning of a color-word stimulus

can interfere with naming its ink color when the two are incompatible (i.e., the Stroop effect). In a series of experiments, we test whether holding a word internally in WM, rather than attending to it externally, can produce analogous interference effects in a perceptual color-discrimination task. Participants remembered a word shown in black ink ("red", "blue", "green", or "yellow") for a delayed match-to-sample task. During the delay, they indicated the color of a rectangular patch drawn in red, blue, green or yellow ink. Participants were slower to perform this perceptual judgment - as well as the later WM probe - when the internally maintained word meaning was incompatible with the ink color of the visually displayed patch. Moreover, the size of this "working memory Stroop effect" was equivalent to the classic "attentional" Stroop effect. In additional experiments we show that, just like the classic Stroop, this WM Stroop effect was also susceptible to manipulations of the degree of conflict in the stimulus vs. response dimensions, as well as the proportions of compatible vs. incompatible trials. These results indicate that WM maintenance and external attention likely activate the same representations - causing a tradeoff between attention to internal content and external stimuli - consistent with models that conceptualize WM as internal attention.

C62

ASSESSMENT OF WORKING MEMORY LOAD ON TEMPORAL EXPECTATION PROCESSES DURING VISUAL DISCRIMINATION

Theodore Zanto[1], Helen Liu[1], Peter Pan[1], Adam Gazzaley[1]; [1]University of California San Francisco — Visual discrimination ability is enhanced by cues to when the target will appear. This cue-based advantage diminishes with age and has contributed to the hypothesis that age-related cognitive decline might in part stem from deficient expectation processes. Here, we address whether a concurrent working memory load adversely affects expectation processes. Twenty-three young adults (19-33 years) participated in a temporally-cued, visual target discrimination task while electroencephalography (EEG) data were recorded. During the task, participants were instructed to hold zero, three, or six numbers in working memory and were probed on each trial following the discrimination response. Temporal cues enhanced discrimination performance. Neural activity prior to target onset was modulated based on cued information, as indexed by the contingent negative variation, alpha band (8-12 Hz), and beta band (12-30 Hz) activity. However, only beta band activity increased with working memory load. Importantly, the magnitude of anticipatory beta band modulation decreased with a high working memory load and this magnitude of beta band modulation predicted cue-based performance changes. These data were compared to previously collected data from older adults (62-82 years) engaged in the same discrimination task without a concurrent working memory load. Interestingly, older adults' performance did not benefit from cued information nor did they modulate pre-target beta band activity. Moreover, older adults exhibited an overall increase in beta band activity, similar to younger adults with a high working memory load. Together, these results suggest that expectation processing declines in older adults may be related to limitations in available cognitive resources.

C63

TEMPORAL PREDICTABILITY ATTENUATES DECAY IN SENSORY MEMORY

Anna Wilsch[1], Molly J Henry[1], Björn Herrmann[1], Jonas Obleser[1]; [1]Max Planck Research Group "Auditory Cognition", Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Increased alpha power (8-13 Hz) during attentionally demanding tasks has been associated with improved performance. Temporal predictability of the occurrence of sensory information can also enhance stimulus encoding and thus improve performance, but the joint influence of both factors on the processes of sensory memory is unclear. Using magnetoencephalography (N=20) during a demanding delayed matching-to-sample task, we manipulated stimulus encoding by varying the temporal predictability (fixed vs. jittered cue-stimulus time interval) for a pair of pure-tone patterns (S1-S2; discriminability individually adjusted) embedded in white noise and varied the retention delay (1, 2, 4 s in-between S1 and S2). We hypothesized that longer retention delays in sensory memory would impair performance (using signal detection theory and area under the ROC-curve) and modulate alpha power (as assessed using spectral analysis), but expected both effects to benefit from temporally predictable S1 onsets (fixed condition). Neural and behavioral data support these hypotheses: Task performance parametrically declined with longer retention delays, but this decline was less steep for fixed than for jittered S1 onset-time. During S1 retention, alpha power at posterior sensors decreased with longer retention delays, most likely reflecting attentional processes directly linked to the sensory memory decay. However, alpha decreased less with retention delay after temporally predictable S1 onsets. Across participants, individual modulation of posterior alpha power predicted individual performance modulation. The results show that temporal predictability yields benefits that outlast improved sensory encoding, and attenuate the decay of alpha power as an indirect indicator for sensory memory.

C64

MODELING OUTPUT GATING DURING SELECTION FROM WORKING MEMORY: BEHAVIOR, DOPAMINE AND NEUROSTIMULATION

Christopher Chatham[1], David Badre[1]; [1]Brown University — Corticostriatal interactions are though to act as a gate to select the input to working memory (WM). However, not all information in WM is relevant for behavior simultaneously. For this reason, a second "output gate" might advantageously govern which contents of WM influence behavior. A previous fMRI study showed that frontostriatal input gating circuits may also support output gating, with contextual representations in prefrontal cortex (PFC) influencing striatum to select which items in WM will drive responding (Chatham et al., Neuron, 2013). Here, we assess whether a computational model of output gating can account for the full array of data by extending an existing model of hierarchical corticostriatal interactions (Collins & Frank, Psych. Review 2013). The model learns our task efficiently, using only simulated dopaminergic reinforcement learning signals within a biologically-plausible corticostriatal circuit. The model not only reproduces the mean reaction time patterns of our task, but also the distributional characteristics of reaction time in the two conditions requiring output gating. Two further features of this model will be discussed. First, the performance of the model during the conditions requiring input gating indicates the need for a global manipulation of response threshold, through pooling of conflict signals across independent levels of hierarchical tasks. Second, the model predicts the effects of stimulation and dopaminergic manipulation of PFC during selection from working memory.

C65

DORSOLATERAL PREFRONTAL CORTEX BOTH REPRESENTS AND MANIPULATES MENTAL IMAGES

Alexander Schlegel[1], Prescott Alexander[1], Peter Tse[1]; [1]Dartmouth College — In Baddeley's (1986) model of working memory, the brain manipulates mental representations via a central executive system that directs activity in subsystems like the visuospatial sketchpad. Many neuroimaging studies implicate a network including dorsolateral prefrontal cortex (DLPFC) and posterior parietal cortex (PPC) as the neural correlate of this model (e.g. Schlegel, et al., 2013). Current understanding suggests that DLPFC acts as Baddeley's central executive, directing transformations of mental representations in other regions rather than storing representations directly. For instance, Crowe and colleagues (2013) showed that neurons in monkey prefrontal cortex transmit executive control signals to parietal neurons. In the current functional magnetic resonance imaging study, we asked whether DLPFC merely directs the manipulation of mental imagery or if it is also involved in representing mental images themselves. We developed a hierarchy of abstract shapes and an orthogonal hierarchy of mental operations that could be performed on those shapes. In each of a series of trials, human participants performed a particular mental operation on a particular shape. Using multivariate pattern classification methods on neural activity in DLPFC, we could decode both the shape that participants imagined and the operation that they performed. Representational similarity analyses showed that the informational structures of both DLPFC and PPC correlated significantly with both the shape and the operation hierarchies, although DLPFC correlated more with the operation hierarchy and PPC correlated more with the shape hierarchy. Our results suggest that information is distributed throughout specialized nodes of the frontoparietal network rather than localized to particular regions.

C66

EFFECTS OF SPORT-RELATED CONCUSSION AND FOOTBALL EXPOSURE ON THE NEURAL MECHANISMS OF WORKING MEMORY Eleanna Varangis[1], Kelly Giovanello[1], Chris Foster[1], Zachary Kerr[1], J. D. DeFreese[1], Kevin Guskiewicz[1]; [1]University of North Carolina at Chapel Hill — Sport-related concussions have been linked with an increased likelihood of memory complaints, dementia, and early-onset Alzheimer's disease. Aside from concussions, football players have also been shown to receive sub-concussive hits that are not captured by their concussion history but may be reflected by their overall football exposure. Currently it is unclear whether such memory impairments later in life reflect discrete concussive events or are a function of exposure to sub-concussive hits. In this study, participants between the ages of 50-65 (N=63) were stratified based on football exposure (college or NFL; weighted hours of contact sport) and concussion history (0-2 or 3+ concussions; actual number of concussions sustained). All participants completed an fMRI-adapted N-back task as a measure of working memory (WM) at three different WM loads: 0-back, 1-back, and 2-back. Behavioral results showed no group differences in N-back accuracy or reaction time. However, univariate fMRI analyses revealed that concussion history explained more functional recruitment differences than did exposure. Parametric fMRI analyses indicated that with increasing load, functional neural differences during WM were explained more by concussion history than by exposure or by the interaction between concussion history and exposure. These findings suggest that both football exposure and concussion history may contribute to differential neural recruitment in WM, but that concussion history plays a larger role than does exposure alone.

LANGUAGE: Lexicon

C67

LEXICAL ENHANCEMENT DURING PRIME-TARGET INTEGRATION: ERP EVIDENCE FROM MATCHED-CASE IDENTITY PRIMING Marta Vergara-Martinez[1], María Jiménez[1], Pablo Gómez[2], Manuel Perea[1]; [1]Universitat de València, Spain, [2]DePaul University, Chicago — In lexical decision, masked repetition priming is robust for words, but not for nonwords. What is the reason for this dissociation? At the behavioral level, a number of experiments (e.g., Jacobs et al., 1995) have revealed that matched-case identity PRIME-TARGET pairs are responded to faster than mismatched-case identity prime-TARGET pairs for nonwords (e.g., JUDPE-JUDPE < judpe-JUDPE), but not for words (JUDGE-JUDGE = judge-JUDGE). These findings suggest that prime-target integration processes are enhanced when the stimuli tap onto lexical representations, overriding physical differences between the stimuli (e.g., case). For pseudowords, the absence of an (abstract) lexical level would prevent prime-target from being integrated into the same perceptual object, revealing a behavioral advantage for matched-case identity priming. To examine the time course of this phenomenon, we conducted an ERP masked priming lexical decision experiment that manipulated matched vs. mismatched case identity in words and pseudowords stimuli. Behavioral results replicated previous findings. More importantly, although case identity-priming effects were found at very early time epochs (N/P150 case effects for words and nonwords), they disappeared for words, but not for nonwords, around 200 ms after target onset (N250 case effects for nonwords only). These findings suggest that different-case word forms (lower- and uppercase) tap onto the same abstract representation, leading to prime-target integration very early in processing. In contrast, different-case pseudoword forms are processed as two different entries. The implications of these findings for neural accounts of visual-word recognition are examined.

C68

CHARACTERIZING PREOPERATIVE HEMISPHERIC ASYMMETRIES OF CORTICAL STRUCTURES AND LANGUAGE FUNCTIONS IN LEFT-HEMISPHERE TUMOR PATIENTS VIA NAVIGATED TRANSCRANIAL MAGNETIC STIMULATION Noriko Tanigawa[1], Nico Sollmann[2], Theresa Hauck[2], Sebastian Ille[2], Bernhard Meyer[2], Florian Ringel[2], Sandro M. Krieg[2]; [1]University of Oxford, [2]Technical University of Munich — The present study quantifies the volumetric asymmetry of gray matter of language-related cortical structures and investigates in what ways these structural indices were associated with perisylvian tumor locations and object-naming performance in preoperative language mapping via navigated transcranial magnetic stimulation (nTMS). Data from 10 right-handed, German-speaking, left-hemisphere perisylvian tumor patients were analyzed (3 frontal, 3 parietal, 4 temporal). For each patient, anatomical magnetic resonance (MR) images were taken. These imaging data were processed in FreeSurfer v.5.1.0 for automatic measurement of the structural indices. The gray matter volume asymmetry quotient (GMAQ) was calculated as (L-R)/(L+R). The same set of MR images were used for the preoperative nTMS language mapping. Patients were asked to name familiar objects presented on a computer screen. Only the correctly responded pictures without nTMS were presented in the nTMS condition. All object-naming error types were collapsed. The GMAQ rightward asymmetry in the supramarginal gyrus (SMG) and the superior temporal gyrus (STG) were associated with tumor locations, such that with these two structural measures, a support vector machine classifier (R e1071 package) correctly categorized patients into the three tumor location groups 80% of the times in cross-validation, where the baseline classification accuracy was 40%. The error rate of the left STG increased from the frontal to parietal to temporal tumor groups. By adding this functional measure, the classification accuracy increased to 90%. Gray matter volume asymmetry in STG and SMG and the associated gradient difference in naming deficit may jointly suggest the importance of STG in word production.

C69

RESOLVING PAPIAMENTO-DUTCH CONFLICTS Niels Schiller[1,2], Leticia Pablos[1,2], Maria del Carmen Parafita Couto[1,2]; [1]Leiden University Center for Linguistics, [2]Leiden Institute for Brain and Cognition — In Papiamento-Dutch bilingual speech, the nominal construction is a potential 'conflict site' if there is an adjective from one language and a noun from the other. Do we expect e.g. rode biña (red wine) or biña rode, and còrá wijn or wijn còrá? Cantone and MacSwan (2009) argue that the language of the adjective determines word order, so that wijn còrá and rode biña would be possible, but not biña rode or còrá wijn. Myers-Scotton (2002), on the other hand, expects the word order to follow that of the morphosyntax in the rest of the sentence, so that wijn còrá and biña rode would be expected where the rest of the sentence is in Papiamento, but rode biña and còrá wijn might be expected where the morphosyntax is Dutch. So far, these theoretical differences have not been reconciled, but ERP work on Welsh-English bilinguals points to the fact that the language of the verb is important (Parafita, Boutonnet, Davies, Deuchar & Thierry, 2013). Electrophysiological data using the event-related brain potential (ERP) technique were collected to provide objective measures of the neurocognitive processes underlying code switching in Dutch-Papiamento bilinguals. The results support previous findings with Welsh-English bilinguals, namely, that the relative order of the noun and the adjective is determined by verb inflection (Parafita et al., 2013). In addition to understanding the mechanisms involved in processing languages with conflicting grammars, the use of ERPs generates insights into the validity of theories of code switching.

C70

THE ROLE OF VISUAL REPRESENTATIONS DURING THE LEXICAL ACCESS OF SPOKEN WORDS Gwyneth Lewis[1], David Poeppel[1]; [1]Department of Psychology, New York University — Under strong embodied accounts of language processing, meaning must be grounded in perceptual experience. Pulvermüller (1999) presents evidence that neuronal ensembles in spatially distinct perceptual and language areas become simultaneously activated while processing a word form and perceiving the real world referent. What role (if any) do visual representations associated with words play during lexical access? Spoken word recognition involves phonological access in superior temporal (ST) regions followed by contact with stored lexical representations in the posterior middle temporal gyrus (pMTG) (Hickok & Poeppel, 2007). To determine whether visual representations contribute to speech recognition, we examine, using magnetoencephalography (MEG), effects from phonological and lexical variables on ST and pMTG areas, compared with that of imageability (the ease with which a word links to visual representations) on visual cortices. Embodied accounts predict early modulation of visual areas by imageability - concurrently with or prior to modulation of pMTG by lexical variables. Stimuli were synthetic speech generated from 400 monosyllabic, monomorphemic,

nouns, varying in imageability, and 400 matched nonwords. Participants responded to stimuli in a lexical decision task with simultaneous MEG recording. We employed the lexical, phonological, and perceptual variables in a correlational time course analysis, with trial-by-trial activation assessed in occipital, ST, and pMTG regions of interest. The variables modulated the ROIs during different time windows. Critically, visual regions reflected an imageability effect prior to effects of lexicality on pMTG. This surprising effect supports a view on which sensory aspects of a lexical item are not a consequence of lexical activation.

C71

SECOND LANGUAGE EXPOSURE MODULATES FIRST LANGUAGE LEXICAL PROCESSING: EVIDENCE FROM EVENT-RELATED POTENTIALS AND LINEAR MIXED MODELS Naveed Sheikh[1], Debra Titone[1]; [1]McGill University — The neural organization of first language (L1) knowledge is traditionally thought to be relatively immutable in adulthood. However, recent data show evidence of neuroplasticity in L1 lexical knowledge that is related to L2 experience. For example, word frequency effects in L1 are larger at higher levels of second language (L2) exposure (Whitford & Titone, 2012). Thus, L2 experiences re-organize L1 knowledge. However, neurocognitive data on these L2 exposure-induced re-organizations are sparse. Here, we combined event-related potentials (ERP) and a masked priming paradigm (Holcomb & Grainger, 2006) to examine how L1 frequency effects vary as a function of L2 exposure for 29 bilingual participants. English target words followed masked primes that were either identical to the targets or nonwords. Mean ERP amplitudes for early lexical stages of processing (N1) and late semantic stages of processing (N400) were fit to linear mixed models (LMM), which allowed us to examine how frequency effects across items vary as a function of continuous individual differences in L2 exposure across participants. In the identical prime condition, N1 amplitudes were more negative for low frequency compared to high frequency words. However, N1 amplitudes were more negative overall, without any frequency effect, at higher levels of L2 exposure. N400 amplitudes were also more negative for low compared to high frequency words. However, amplitudes were less negative for low frequency items at higher levels of L2 exposure. Thus, L2 experiences re-organize L1 lexical knowledge, which manifests during early lexical and late semantic stages of word processing.

C72

GREATER EXPECTATIONS: A DEVELOPMENTAL INCREASE IN THE INFLUENCE OF TOP-DOWN INFORMATION ON SPOKEN WORD PROCESSING IN MANDARIN CHINESE Jeffrey Malins[1,2], Danqi Gao[3], Ran Tao[3], James Booth[4], Hua Shu[3,5], Marc Joanisse[1], Li Liu[3,5], Amy Desroches[6]; [1]The University of Western Ontario, London, Canada, [2]Haskins Laboratories, New Haven, CT, [3]State Key Laboratory of Cognitive Neuroscience and Learning & IDG/McGovern Institute for Brain Research, Beijing Normal University, [4]Northwestern University, [5]Center for Collaboration and Innovation in Brain and Learning Sciences, Beijing Normal University, [6]University of Winnipeg, Canada — In recent years, researchers have become increasingly interested in developing models of spoken word processing that account for tonal languages such as Mandarin Chinese. However, to date, most investigations have focused solely on adults. In the current study, we considered the development of Mandarin spoken word processing by examining how typically developing children and adults responded to different types of phonological similarity. A group of children (N = 17, mean age 10;5) and a group of adults (N = 17, mean age 24) performed a picture-word matching task while we recorded ERPs. In each trial, subjects were presented with a picture of an item, which generated an expectation of a spoken form. Subsequently, they heard a Mandarin monosyllabic word that either confirmed or violated this expectation. Subjects were asked to make an active judgment regarding whether or not the spoken word matched the picture. Mismatching items were related to expected word forms in one of several ways: shared onset (tang2-tao2), shared rhyme (tang2-lang2), shared segments (tang2-tang1), shared tone (tang2-niu2), or were completely unrelated (tang2-xia1). Both children and adults showed sensitivity to these different types of phonological similarity; however, the two groups differed in that the adults showed a reduced N400 for rhyming forms compared to the children. This was taken as evidence of a stronger influence of top-down information on spoken word processing in the adults. These results are discussed in the context of current theories of spoken word recognition, as they add an important developmental constraint to these theories.

C73

NETWORK DYNAMICS OF READING AND SPEECH SYSTEMS ACROSS LANGUAGES Pedro M. Paz-Alonso[1], Stephen J. Frost[2], Myriam Oliver[1], Peter J. Molfese[2], Atira Bick[3], Wen-Jui Kuo[4], Denise H. Wu[4], Ovid J. Tzeng[4], Kenneth R. Pugh[2,5], Jay G. Rueckl[5,2], Ram Frost[3], Manuel Carreiras[1]; [1]Basque Center on Cognition, Brain and Language (BCBL), Spain, [2]Haskins Laboratories, USA, [3]Hebrew University, Israel, [4]National Central University, Taiwan, [5]University of Connecticut, USA — Languages differ on how they code speech into print. Each language's solutions may shape how the brain processes speech and print differently, balancing the weight of common and specific brain networks. Here we investigate how readers of Spanish, English, Hebrew and Chinese, four languages with very different coding solutions, process speech and print signals in their native languages. In particular we will address a) to what extent the brain activation of the reading and speech systems depends on the language orthographic depth and b) whether the neural dynamics among brain regions commonly activated during speech and print vary as a function of language characteristics. Healthy native speakers of Spanish (n=17), English (n=17), Hebrew (n=16), and Mandarin Chinese (n=17) were scanned while making animacy judgments about spoken and written words. The results revealed a) a similar pattern of print-speech activation overlap across languages, but also stronger bilateral ventro-occipital engagement for reading in opaque (Chinese, Hebrew, English) relative to transparent (Spanish) orthographies; and b) that while speech and reading evoked similar patterns of functional connectivity across languages, differences in the neural interactions of regions along the ventro-dorsal axis of the temporal cortex for reading and speech were more pronounced for Hebrew and Chinese than for English and Spanish. All together our results suggest that the network dynamics among regions within the speech and reading circuitries are modulated by the statistical properties of the linguistic environment.

LANGUAGE: Other

C74

SPEECH PERCEPTION WITHOUT A MOTOR SYSTEM Alena Stasenko[1], Cory Bonn[1], Alex Teghipco[1], Frank Garcea[1], Bradford Mahon[1]; [1]University of Rochester — The exact role played by the motor system in action recognition is currently debated, both in the domains of language and manual action. Here we report evidence from a neurological patient with dysfunction of the speech motor system, and whose speech is marked by frequent phonological and articulatory errors. The motor dysfunction in the patient was confirmed with ultrasound imaging of the tongue during speech, in which we find high variability in the tongue position across utterances. Using categorical perception tasks, we show that while the patient shows a normal categorical boundary for perception of speech sounds, the patient is unable to label the same stimuli in a follow-up identification task. In addition, functional connectivity, computed over resting functional magnetic resonance imaging data, indicate that the patient's frontal lesion has deregulated the normal pattern of functional connectivity between Perisylvian language areas and the rest of the brain. These data indicate that contrary to motor-type theories of speech perception, motor processes are not constitutive of perceptual processes. However, motor processes may play a role in phoneme identification, a function that may depend on frontal-temporal connectivity.

C75

THE EFFECT OF LANGUAGES ON THE PRODUCTION AND RECOGNITION OF NUMBERS IN GERMAN-FRENCH BILINGUALS Amandine Van Rinsveld[1], Christine Schiltz[1], Sonja Ugen[1]; [1]University of Luxembourg — How do bilinguals produce and recognize two-digit number words? We investigated this question at different language proficiency levels in German-French bilinguals. German two-digit number words indeed follow the unit-decade order, whereas in French the order is decade-unit. Our study was conducted in Luxembourg where pupils learn both languages at primary school. Moreover mathematics are taught in German

at primary school but in French at secondary school. Pupils from grades 5 (primary school), 8 (beginning of secondary school) and 11 (middle of secondary school) performed two numerical tasks: In the number recognition task, participants were presented a spoken number word that they had to recognize among four visually presented Arabic numbers. In the number production task, participants had to pronounce visually presented Arabic numbers. Both tasks were performed in German and in French and we compared language-related performance differences for the 3 levels of language proficiencies. Participants of all levels recognized and produced number-words more efficiently in their dominant language (i.e. German). However, this advantage for the dominant language was especially prominent at the lowest level of language proficiency when mathematics education was implemented in the dominant language (i.e. German). Furthermore, performance levels decreased with increasing number size, but over and above this general trend, participants of all proficiency levels showed specific difficulties with the complex structure of French number words over 60. Taken together, these results support the view that number and language processing are tightly associated, since language proficiency and language structure influence very simple and basic numerical tasks.

C76

EXPECTATION-BASED NEURAL ADAPTATION DEFICITS IN DYSLEXIA

Sara D. Beach[1], Carlos Cardenas-Iniguez[2], Marianna D. Eddy[3,4], John D. E. Gabrieli[1], Tyler K. Perrachione[5]; [1]Massachusetts Institute of Technology, [2]University of Chicago, [3]US Army NSRDEC, [4]Tufts University, [5]Boston University — Repeated presentation of a stimulus results in attenuated neural responses - a phenomenon called "repetition suppression." The magnitude of this suppression is greater when repetition is expected, highlighting the modulatory role top-down mechanisms play in rapid sensory plasticity. Individuals with dyslexia exhibit reduced neurophysiological adaptation to stimulus repetition, and dysfunctional neural adaptation may underlie learning impairments in this disorder. Here, we investigated the effect that top-down neuromodulatory mechanisms have on repetition suppression-indexed sensory plasticity in dyslexia. We recorded EEG from adults with (n=20) and without (n=20) dyslexia. Participants viewed pairs of faces or words. In separate conditions, the probability of the second stimulus being a repeat of the first was either high (expected) or low (unexpected). Both groups exhibited repetition suppression for face-evoked responses over posterior and central sites 250ms after the repeated stimulus. For controls, the magnitude of repetition suppression over central sites was enhanced by expectation of repetition. Expectation did not modulate repetition suppression in individuals with dyslexia. Both groups likewise exhibited repetition suppression for word-evoked responses. The magnitude of repetition suppression was greater in controls for early (N170) and late (P300) components. Expectation of stimulus repetition significantly enhanced the magnitude of repetition suppression for controls, but this effect was more limited in individuals with dyslexia. Overall, individuals with dyslexia appear to exhibit less expectation-mediated enhancement of repetition suppression than controls. This suggests that top-down neuromodulation may be less effective at enhancing sensory processing in this disorder, representing a possible biological mechanism for adaptation-based learning deficits in dyslexia.

C77

PARIETAL AREAS INVOLVED IN SUBTRACTION AND MULTIPLICATION: DOES DEVELOPMENTAL DYSLEXIA MAKE A DIFFERENCE?

Silke M. Goebel[1], Amy Goodwin[1], Mark Hymers[1], Agnieszka Jaroslawska[2], Maggie J. Snowling[3]; [1]University of York, UK, [2]MRC CBU, Cambridge, UK, [3]University of Oxford, UK — Parietal lobe activation during arithmetic tasks depends on the type of arithmetic operation: both intraparietal sulci are typically activated during subtraction, while the left angular gyrus is often recruited during multiplication. Adults with developmental dyslexia (DD), a specific learning disorder that affects the development of reading and spelling, show clear difficulties in arithmetic, in particular in fact retrieval (e.g. multiplication). It has been suggested that those fact retrieval deficits are due to their weaknesses in phonological awareness, the ability to segment and manipulate speech sounds. The left angular gyrus has been suggested to play an important role during verbal fact retrieval. In the current fMRI study, we compared the parietal networks for arithmetic in adults with and without DD. Nine adults with phonological DD (aged 19-27 years) and nine matched controls carried out a multiplication and subtraction task in the fMRI scanner. During multiplication, controls activated a left-lateralised parietal network, including the intraparietal sulcus, inferior and superior parietal lobules. Adults with DD activated a wider bilateral network of parietal areas, suggesting more reliance on quantity-processing during multiplication. Patterns of parietal activity during subtraction were similar in both groups. In a separate ROI analysis, the left angular gyrus showed a greater difference in BOLD signal between multiplication and subtraction for controls than for participants with DD. The results of this study provide preliminary evidence for a possible neural basis of arithmetic fact retrieval deficits in adults with dyslexia.

C78

INVESTIGATING NEURAL CORRELATES OF IMPLICIT MEMORY AND READING ABILITY

Peter Molfese[1], Louisa Bogaerts[3], Stephen Frost[1], Einar Mencl[1], Jay Rueckl[1,2], Nicole Landi[1,2], Ken Pugh[1,2]; [1]Haskins Laboratories, [2]University of Connecticut, [3]Ghent University — Previous reports linking implicit memory and reading ability using the serial reaction time task (SRTT) have shown mixed results. To date, only a handful of studies have explored the neurobiological correlates of the SRTT, identifying significant regions of activation in the medial temporal lobe, hippocampus, and putamen. Our study extends previous work by both 1) treating reading ability as a continuum; 2) investigating the relationship between reading ability and brain activation during implicit motor learning as measured by fMRI. In the current study, 32 individuals representing a full range of reading abilities performed the SRTT in a block-design fMRI paradigm. Behavioral results show consistent reductions in reaction times (RT) in structured (i.e., repeated sequence) compared to random sequence trials. Negative correlations were found between RT and measures of both reading fluency and decoding for both random and structured trials. Brain activations partially replicate previous fMRI SRTT findings with activations in bilateral temporal lobe, hippocampal, and putamen regions. Additionally, brain-behavior analyses of reading ability revealed a correlation between bilateral hippocampal activation and pseudoword decoding for structured trials, which was not present for random trials.

C79

A TEST OF OPEN BIGRAM MODELS: READING OF TRANSPOSED WORDS BY TYPICAL AND POOR READERS

Jackie Liederman[1], Laura Sancho[2]; [1]Boston University, [2]University of California, San Diego — Open bigram (OB) models posit that letter order in a word is coded by left-to-right ordered letter pairs. In contrast, Konisha & Norris (2013) demonstrated that transpositions of non-contiguous bigrams spanning three letters in the target (e.g., BS –aBoliSh) showed robust priming effects, equivalent in size to contiguous bigrams (e.g., BO-aOBlish) with little effect of direction of the displacement. In our study, Poor Readers (PRs), vs. Typical Readers (TRs) were presented with words containing letter transpositions. They were instructed to pronounce the "actual" word by ignoring the typos. Transpositions were counterbalanced in terms of 1) distance (1, 2 or 3 spaces from the point of origin), 2) maintenance of left to right letter order (yes or no), and 3) word length (9-11 letters). At the end of the session, the untransposed versions of the words were presented to provide individualized measures of reading accuracy and rate. "Transposition costs" (for speed/accuracy) were computed as [(untransposed – transposed)/untransposed*100]. For both TRs and PRs, in reading (as opposed to priming), transpositions of three spaces were significantly more disruptive than those of one or two spaces, and reversal of letter order to the left was significantly most disruptive. In addition, separation of digraph bigrams (e.g., "SH" in establiSHment to "estaHbliSment") had no greater transposition costs than separation of two consonants other than the digraph in the same word ("BL") to create eLstaBishment, and there was a significant effect of direction. Reading does not parallel priming data.

C80

NATIVE PHONOLOGICAL RULES MODULATE EARLY AUDITORY BRAIN RESPONSES

Yue Sun[1], Sharon Peperkamp[1], Maria Giavazzi[2], Leonardo Barbosa[1], Sid Kouider[1], Martine Adda-Decker[3], Charlotte Jacquemot[2]; [1]Laboratoire de Sciences Cognitives et Psycholinguistique, Ecole Normale Supérieure, Paris, France, [2]Equipe Neuropsychologie Interventionnelle, Ecole Normale Supérieure, Paris, France, [3]Laboratoire de Phonétique et Phonologie,

Université Paris 3, Paris, France — Perception of speech sounds is influenced by listeners' experience with their native language. Previous behavioral and imaging studies have mostly investigated the perception of non-native speech sounds and demonstrated that exposure to native sound shapes listeners' perceptual space such that non-native sound inputs are perceptually transformed into native sounds. However, in everyday life, listeners have to deal with their own language rather than foreign languages and strikingly, knowledge on their native language may also bias their perception of native sounds. For instance, in French, the sound [g] is perceived as [g] in /igmo/, while the same sound can be perceived as [k] in /igdo/. While the existence of such transformation is known and explained by compensation for French voice assimilation rule, the question of when it occurs during speech processing is still unclear. Here, we investigated this question using EEG recordings. French listeners were asked to detect change between items. In the first condition (/igmo/-/ikmo), the change was well detected; whereas in the second condition (/igdo/-/ikdo/), the change was not detectable because /igdo/ is perceptually transformed into /ikdo/. In particular, our electrophysiological data show an early negative component (MMN) at 130 ms in response to the sound change only in the /igmo/-/ikmo/ condition, but not in the /igdo/-/ikdo/ condition, suggesting that the transformation takes place at early stages of sound perception. In conclusion, our findings demonstrate that native phonological rules impact listeners' perception of native sounds and that the resulting transformation involves early perceptual mechanisms rather than late conscious reconstruction.

C81

FUNCTIONAL BRAIN IMAGING PREDICTS FOREIGN LANGUAGE LEARNING SUCCESS IN THE CLASSROOM

Zhenghan Qi[1], Tyler Perrachione[2], Michelle Han[1], Keri Garel[3], Ee San Chen[1], Amy Finn[1], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Boston University, [3]Massachusetts General Hospital — Foreign language learning is one of the most challenging educational activities for adults, including learning to comprehend and produce a new vocabulary and grammar that are represented by foreign speech sounds. We used functional MRI to measure the neural response to linguistic and nonlinguistic pitch (tones) in adults before and after an intensive, 4-week, classroom-based introductory Mandarin Chinese course. Learning achievement was measured by performance on the HSK (Level I), a standardized test of Mandarin proficiency assessing both aural and written vocabulary and grammar. Activation in bilateral dorsolateral prefrontal cortex (DLPFC) and inferior frontal gyrus (IFG) to linguistic pitch in pre-training brain images significantly predicted students' performance on the post-training HSK (FDR=0.05, $p<0.05$). A behavioral assessment of lexical tone perception also significantly predicted classroom learning achievement ($r=0.52$, $p=0.007$). We also observed that, compared to the pre-training scans, students at the end of the Mandarin course evinced an increase in the neural response of left DLPFC and left IFG to linguistic versus nonlinguistic pitch (FDR = .05, $p < .05$) - a result paralleling behavioral improvement in lexical pitch perception after training. In addition to demonstrating the plasticity of the neural systems for language in adulthood, these results reveal that individual differences in neural responses to foreign-language speech sounds before training can predict learners' holistic attainment of the foreign language, including speech, vocabulary, and grammar.

LANGUAGE: Semantic

C82

RECOVERY OF MEANING DURING READING: AN EVENT-RELATED POTENTIAL STUDY ON THE PROCESSING OF ELLIPTICAL SENTENCES

Bobby Ruijgrok[1], Crit Cremers[1], Lisa L. Cheng[1], Niels O. Schiller[1]; [1]Leiden University — The interpretation of elliptical sentences (e.g. "The man bought a book in Boston and the woman [...] a cd in Houston") requires a process of semantic recovery. Ellipsis may be resolved by inserting a copy of the missing structure (e.g. "bought"). Such a "copy-paste" procedure predicts a low processing cost - regardless of the size of the antecedent. In contrast, a more laborious inferencing mechanism may be required for ellipsis resolution, which predicts the activation of relatively more processing resources. We studied the online processing of a particular type of ellipsis, i.e. "gapping", in Dutch. We recorded event-related brain potentials while Dutch participants read sentences containing gapping constructions interspersed with filler sentences. Three elliptical conditions were compared with their non-gapped counterpart (control condition). The gapped sentences differed with respect to the omitted structure: verb only (as above), verb plus object, or verb plus object and adjunct. The latter structure was replaced by "ook" (too). We observed a broadly distributed early negativity following the occurrence of omitted structures. In addition, the negativity appeared to be more sustained if larger structures are elided. These results suggest that different resolution strategies are involved in the recovery of meaning during gapping resolution. If only a verb is gapped, a copy-paste procedure applies. Recovery of larger structures requires more effort pertaining to broadly distributed processing resources.

C83

N400 PROCESSES INHIBIT INAPPROPRIATELY ACTIVATED LOW-CLOZE PROBABILITY SENTENCE ENDINGS LEARNED AT PRIOR OCCURRENCES.

Ana Lucia Fernandez Cruz[1], Katrina Gong[1], J. Bruno Debruille[1]; [1]McGill University — When a low-cloze probability word ends a sentence frame, their association is stored in working memory. Thus, a second occurrence of that sentence frame will probably automatically activate short-term memory representations corresponding to this word. However, if this sentence frame now ends with another word, activations of the first word's representations are inappropriate and might have to be inhibited. These representations of the first word should then be harder to re-activate. Thus, if the sentence frame is presented a third time and subjects asked to produce the first word that comes to mind, they will less frequently come up with the initial word. The hypothesis that the N400 indexes inhibition predicts that the inhibitions generate additional N400 activity in the event-related brain potentials (ERPs). To test this hypothesis, 3 series of 3 blocks were presented to 26 participants. The first block of each series contained 50 sentences ending with a low-cloze probability word. The second blocks included again these 50 sentences ending now with a new low-cloze probability word. Each third block included only the 50 sentence frames. After each of them, subjects had to verbalize aloud the first word that came to mind. In accordance with the N400 inhibition hypothesis, N400s elicited by new words at second blocks were larger at lateral frontal sites F4 and F3 when first words were not verbalized at third blocks than when they were. We thus propose that these additional frontal N400s activities could index the inhibition of inappropriately activated working memory representations.

C84

ERP CORRELATES OF PREDICTION AND PLAUSIBILITY IN SENTENCE COMPREHENSION

Megan D. Bardolph[1], Cyma Van Petten[2], Dianne Thornhill[2], Seana Coulson[1]; [1]UC San Diego, [2]Binghamton University — We investigated the nature of prediction during reading by manipulating sentence constraint, predictability, semantic relation, and plausibility and examining their impact on ERPs. Previous studies suggest that multiple factors influence the presence and scalp distribution of late positive potentials to less-than-predictable words. A frontal positivity for low-cloze compared to high-cloze sentence completions has been observed in several studies. Thornhill and Van Petten (2012) used high and low constraint sentences ending with either the best completion (highest cloze probability), a word semantically related to the best completion, or an equally plausible word that was semantically unrelated to the best completion and observed that, following the N400, all of the less predictable endings elicited a larger frontal positivity than the high constraint best completion. Other studies have found a parietally distributed positivity for incongruent sentence completions relative to congruent completions, but previous studies have not examined both unpredictable congruent and incongruent completions. We thus expanded the Thornhill and Van Petten stimulus set by adding semantically implausible completions (e.g., "Gary doesn't think a husband should cheat on his... WIFE/SPOUSE/TAXES/CEMENT."). ERPs were recorded while participants read each sentence. Across participants, each sentence frame was paired with all four ending types. N400 amplitude was modulated by cloze probability and semantic relatedness, confirming previous findings. We found a frontally distributed positivity for all ending types relative to the best completion, suggesting that this potential may reflect a failed lexical prediction of any kind. No sentence type elicited a parietally distributed positivity.

C85

THE EFFECT OF ATYPICAL ANTIPSYCHOTICS ON THE FRONTAL N400S OF HIGHLY SCHIZOTYPAL PARTICIPANTS Ola Mohamed Ali[1], Aisha Walker[1], Ana Lucia Fernandez Cruz[1], J. Bruno Debruille; [1]McGill University — The N400 is a negative event-related potential (ERP) elicited by potentially meaningful stimuli. It has been reported to be abnormally large in healthy participants with schizotypal tendencies. This could be due to the contextually inappropriate semantic activations that underlie tendencies for delusions and disorganization. Antipsychotics could alleviate the corresponding symptoms by acting on such activations, as suggested by the reduction of N400 amplitudes reported 15 hours after intake of olanzapine, during a semantic categorization task. Here, we investigate the immediate effect of antipsychotics on the N400 in this population. ERPs were recorded during this task before and 90 minutes after the effect of a placebo (n=24), of 1 mg of risperidone (n=24) or of 2.5 mg of olanzapine (in progress). Reaction times and accuracies were unaffected by placebo. Reaction times were unaffected by risperidone, while accuracies slightly decreased. In the placebo group, an N400 increase was seen only in the later part of the frontal N400 in the mismatch condition, suggesting a possible effect of training on this ERP. With risperidone, larger frontal N400s were observed in both match and mismatch conditions, throughout the N400 time window. The increase in the N400 amplitude could reflect the boosting of inhibitory processes that might be indexed by this ERP. Thus far, these results also suggest that the immediate effects of antipsychotics on the processes indexed by the N400 could differ from their later effect.

C86

GETTING OVER THE HILL: EFFECTS OF VERBAL FLUENCY ON AGE-RELATED CHANGES IN AMBIGUOUS IDIOM COMPREHENSION Nyssa Z. Bulkes[1], Christopher M. Grindrod[1]; [1]University of Illinois at Urbana-Champaign — Although many studies have investigated language comprehension across the lifespan, few age-related declines, other than word-finding difficulty, have been documented. Despite the apparent persistence of many language functions into older adulthood, higher-level language abilities, such as integrating word meanings with the linguistic context, may be subject to age-related changes. Few studies have explored aging effects on semantic integration during figurative language comprehension. The goal of the current study was therefore to address this question by investigating age-related differences in ambiguous idiom comprehension. In this study, younger and older adults listened to idiom- or literal-biased sentences ending in ambiguous idioms (e.g., tie the knot). Participants then decided whether a visual target word was related or unrelated in meaning to the sentence while response time and accuracy were recorded. Younger adults and a subgroup of older adults - those with high verbal fluency - were faster and more accurate only when a target related to the figurative meaning followed an idiom-biased sentence. In contrast, older adults with low verbal fluency did not exhibit any priming of targets following idiom- or literal-biased sentences, indicating they did not activate the figurative meaning. Thus, age-related changes in integrating figurative meanings with the surrounding context appear to be modulated by verbal fluency. Given that verbal fluency has been linked to the integrity of frontal cortical areas and, more specifically, to the efficacy of frontotemporal circuits, the current findings argue that frontal brain regions may contribute to meaning integration during idiom comprehension.

C87

THE IMPORTANCE OF THE IPSI- AND CONTRALESIONAL FRONTAL AND TEMPORAL REGIONS IN LANGUAGE RECOVERY IN APHASIA Jordyn A. Sims[1], Kushal Kapse[1], Peter Glynn[1], Swathi Kiran[1]; [1]Aphasia Research Laboratory, Boston University, Sargent College — While our understanding of the neural basis of language recovery in aphasia has increased tremendously, there is still an ongoing debate regarding the role of the ipsilesional spared tissue and contralesional homologues in facilitating language processing (Turkeltaub et al., 2011). In this project, we systematically examine the relationship between the degree of spared tissue in the ipsilesional cortex and BOLD signal activation in specific ipsilesional and contralesional regions of interest, in 14 patients with chronic post-stroke aphasia. Methods: Structural ROIs were taken from the AAL atlas and spatially normalized lesion maps were subtracted from them to determine the amount of damaged tissue. Percent signal change was calculated within the resulting ROIs for semantic condition (relative to baseline visual processing condition) during a semantic processing fMRI task using Marsbar. The percentage of spared tissue, (calculated as (Anatomical ROI Volume –Lesion Volume)/(Anatomical ROI Volume)) was lowest for IFG pars opercularis (IFGop), IFG pars triangularis (IFGtri), and middle temporal gyrus (MTG). Results/Conclusions: (1) LIFGop is the most lesioned region. (2) Task accuracy is correlated with increased activation in LIFGop and LIFGtri (3) The more the spared tissue in LIFG (op,tri,orb), MTG and Ang/SMG, the less activation in ipsilesional regions (LMFG, LSFG) and contralesional regions (RMTG, RAng/SMG). (4) The more the spared tissue in LSFG and LACC, the more the activation in R frontal regions (RIFG) – these regions appear to work in tandem. References: Turkeltaub, et al. (2011) Are networks for residual language function and recovery consistent across aphasic patients? Neurology, 76, 1726-1734.

LONG-TERM MEMORY: Episodic

C89

BRAIN ACTIVITY DURING TESTING PREDICTS LATER LEARNING SUCCESS Xiaonan Liu[1], Peipeng Liang[2], Kuncheng Li[2], Lynne Reder[1]; [1]Carnegie Mellon University, [2]Capital Medical University — People learn better when re-study opportunities are replaced with tests. While researchers have begun to speculate on why testing is superior to study, few studies have directly examined the neural underpinnings of this effect. In this fMRI study, participants engaged in a study phase to learn arbitrary word pairs, followed by a cued recall test (recall second half of pair when cued with first word of pair), re-study of each pair, and finally another cycle of cued recall tests. Brain activation patterns during the first test (recall) of the studied pairs predicts performance on the second test. Importantly, while subsequent memory analyses of encoding trials also predict later accuracy, the brain regions involved in predicting later memory success are more extensive for activity during retrieval (testing) than during encoding (study). Those additional regions that predict subsequent memory based on their activation at test but not at encoding may be key to understanding the basis of the testing effect.

C90

ALPHA, BUT NOT THETA, OSCILLATIONS EXPLAIN INDIVIDUAL-VARIABILITY IN EVENT-RELATED POTENTIALS LINKED TO MEMORY-OUTCOME Yvonne Y Chen[1], Jeremy B Caplan[1]; [1]University of Alberta — Oscillations and event-related potentials (ERPs) have been linked to memory outcome, when recorded during encoding and retrieval phases of recognition-memory tasks. Jacobs et al. (2006) and Klimesch et al. (2010) suggested alpha-band (8-12 Hz) desynchronization and theta-band (4-8 Hz) synchronization correspond to so-called "dual-processes," familiarity and recollection, which in turn have been proposed for retrieval-related ERPs, the FN400 and the late parietal positivity, respectively. Here we tested this oscillation-ERP mapping by quantifying oscillations and ERPs linked to memory outcome. Rather than attempt to distinguish recollection and familiarity, we tested a pre-condition for the hypothesized mapping: that oscillation- and ERP-measures explain shared variance across participants. Sixty participants performed old/new recognition. We quantified oscillations and ERPs at test by computing the difference between hits and misses. As predicted, the alpha measure (at Oz) correlated with the FN400 measure (at Fz, previously linked to familiarity), $r(59)=0.33$, $p<0.05$. Both the alpha and FN400 measures correlated significantly with hit rates and negatively with response times across participants, supporting their relevance to memory outcome. In contrast, the theta-oscillation measure (at FCz), apart from differentiating hits from misses, did not explain variability in either ERP or behaviour across participants, questioning the hypothesis that theta oscillations support recollection-based recognition-memory. An analogous pattern held during study. Our findings are consistent with alpha oscillations reflecting visual inattention, and with frontal-midline theta oscillations reflecting relational memory processes that are not essential for item-memory tests (Glaholt & Caplan, 2007; Nyhus & Curran, 2010).

C91

FUNCTIONAL NETWORKS ASSOCIATED WITH GENERALIZATION AND DISCRIMINATION UNDERLYING RECOGNITION

Peter Wais[1], Daniel Steiner[1], Adam Gazzaley[1], Craig Stark[2]; [1]University of California, San Francisco, [2]University of California, Irvine — Models based on findings from psychology, neuroscience and/or neuro-computational simulations hold that long-term memory (LTM) is supported by one process that results in generalized awareness of prior experience and by another process that discriminates mnemonic information enabling episodic retrieval. LTM processes depend upon memory regions of the medial temporal lobe (MTL). In order to examine long-range functional neural networks that support memory retrieval in connection with MTL regions, we collected whole-brain fMRI data while 20 young adult participants completed an adaptation of the Stark Behavioral Pattern Separation: Object task. The analysis of task performance used old/new responses to lures, which were quite similar stimuli to the targets, in order to reveal participants' false alarms based on underlying pattern completion and correct rejections based on underlying pattern separation. Our motivation was to compare functional neural results between regions associated with successful retrieval (i.e., activity or connectivity greater for hits than for misses) and regions associated with processes we interpreted as generalization (i.e., underlying pattern completion) and discrimination (i.e., underlying pattern separation). fMRI results associated with a memory contrast (i.e., hits > misses) revealed regions of interest in the MTL, including bilateral hippocampus. Trial-wise functional connectivity analyses based on these MTL seed regions revealed long-range functional networks that supported recognition based on discrimination differentially from recognition based on generalization. The results implicate the key role of cognitive control regions in episodic retrieval.

C92

REDUCED REINSTATEMENT IN MAJOR DEPRESSIVE DISORDER DURING PAIRED-ASSOCIATE RECALL

James Sorenson[1], Ben Levy[2], Ian Gotlib[1]; [1]Stanford University, [2]University of San Francisco — Major Depressive Disorder (MDD) is a prevalent disorder that has been associated with difficulty retrieving detailed, specific episodic memories, and with structural and functional anomalies of the hippocampus, which is crucial for the successful formation and retrieval of episodic memories. The neural substrates of episodic recall, however, are not well characterized in depression. In this study we test the hypothesis that depressed individuals have difficulty reinstating prior experiences during retrieval. Diagnosed depressed (MDD) and healthy control (CTL) community members are scanned as they complete both encoding and retrieval in a paired-associate task. During encoding, participants learn to associate cue words (concrete nouns) with images of either famous people or places. During retrieval, participants are presented with the cue words and are asked to bring the associated images back to mind. Following scanning, participants again see the cue words and are asked to recall the associated stimuli. Analyses indicate that depressed individuals show reduced cortical reinstatement of stimulus-category information during retrieval. Specifically, during retrieval nondepressed individuals recruited the left parahippocampal gyrus - a region that preferentially responded to places during encoding for all participants - but depressed participants failed to reinstate activity in this region even when they were successful at recalling the associated place. Thus, depressed individuals' memory anomalies may be related to difficulty reactivating specific details when given partial memory cues.

C93

SCENE-SELECTIVE PARAHIPPOCAMPAL CORTEX TRACKS TEMPORAL CONTEXTS COMPOSED OF FACES

Adam E. Hasinski[1], Troy A. Smith[1], Per B. Sederberg[1]; [1]The Ohio State University — Recent research has shown that parahippocampal place area (PPA) may selectively process temporal context--the recent experience that precedes an event (Turk-Browne et al., 2012). However, it is unclear whether this context-sensitive processing in the PPA was due to the stimuli being scenes, or whether the activity in the PPA depends more generally on temporal context. To test the scene and context accounts of PPA, we modified the event-related fMRI paradigm used by Turk-Browne and colleagues to show sequences of non-famous faces as stimuli. These faces do not contain any scene information, but they can form the temporal context of an item that follows them. Consequently, any sensitivity in PPA to temporal context would be attributable to the contextual information present, providing strong support to the contextual processing account. Alternatively, if temporal context did not modulate activity in PPA, PPA would most accurately be described as a scene-processing region, with context-based modulation only occurring when scene information is present in temporal context. In support of the contextual processing account of PPA, we found that temporal context modulated activation to face stimuli in PPA. Specifically, PPA showed attenuated activation to repeated faces only when the original temporal context of those faces (i.e. the faces that initially preceded them) were also repeated. This finding implicates PPA in context processing, even in the absence of scene information.

C94

THE EFFECTS OF TYPE 1 DIABETES ON BRAIN ACTIVITY DURING VISUOMOTOR PROCESSING AND INCIDENTAL ENCODING

Brenda A. Kirchhoff[1], Staci E. Scott[2], Jo Ann V. Antenor-Dorsey[3], Jonathan M. Koller[3], Brianna C. Kolody[3], Heather M. Lugar[3], Madison L. Stroup[3], Jason C. Bell[3], Ana Maria Arbelaez[3], Tamara Hershey[3]; [1]Saint Louis University, [2]University of Missouri - St. Louis, [3]Washington University — Prior research has shown that type 1 diabetes mellitus (T1DM) affects cognitive function, including episodic memory, and regional gray and white matter volumes. However, little is currently known regarding the effects of T1DM on brain activity patterns during performance of cognitive tasks. Therefore, this fMRI study compared euglycemic BOLD hemodynamic responses during visuomotor processing and incidental encoding in adolescents and young adults with T1DM versus non-diabetic controls. During fMRI scanning, participants performed 1) a checkerboard task in which they made keypresses to indicate the onset and offset of flickering checkerboard stimuli and 2) two incidental encoding tasks (interacting visual imagery and vowel counting) on unrelated word pairs. After scanning, participants' memory for the individual words and the associations between paired words was tested. Preliminary analyses of brain activity patterns during the checkerboard task demonstrated that the magnitude and shape of the BOLD hemodynamic response in sensorimotor and early visual cortex does not appear to substantially differ between individuals with T1DM and controls. Preliminary analyses of brain activity patterns during the incidental encoding tasks demonstrated that individuals with T1DM have greater activity in select cortical regions than controls. In addition, T1DM individuals' memory for word associations was correlated with their brain activity during encoding in the hippocampus. Interestingly, the results of our prior structural neuroimaging research have suggested that severe hypoglycemia exposure can alter hippocampal volume. These preliminary results suggest that BOLD fMRI can be reliably used to assess brain activity in T1DM and is sensitive to regionally-specific dysfunction in T1DM.

C95

SEX DIFFERENCES IN VOLUME AND STRUCTURAL COVARIANCE OF THE ANTERIOR AND POSTERIOR HIPPOCAMPUS

Jonas Persson[1], Nathan Spreng[2,3], Gary Turner[4], Agneta Herlitz[5], Arvid Morell[6], Eva Stening[1], Lars-Olof Wahlund[7], Johan Wikström[6], Hedvig Söderlund[1]; [1]Department of Psychology, Uppsala University, Uppsala, Sweden, [2]Laboratory of Brain and Cognition, Department of Human Development, Cornell University, Ithaca, NY, [3]Human Neuroscience Institute, Cornell University, Ithaca, NY, [4]Department of Psychology, York University, Toronto, Ontario, Canada, [5]Aging Research Center, Karolinska Institute, Solna, Sweden, [6]Department of Radiology, Uppsala University Hospital, Uppsala University, Uppsala, Sweden, [7]Section for Clinical Geriatrics, NVS Dept., Karolinska Institute, Karolinska University Hospital, Huddinge, Sweden — Sex differences in episodic and spatial memory are frequently observed, suggesting there may be sex-related structural differences in the hippocampus. Earlier findings are inconsistent, possibly due to known variability along the hippocampal longitudinal axis. Here, we assessed potential sex differences in hippocampal volume and structural covariance with the rest of the brain in young men and women (N = 76), considering the posterior (pHC) and anterior (aHC) hippocampus separately. We also investigated potential associations between aHC and pHC structural covariance and episodic and spatial memory performance. Women exhibited a larger pHC than men adjusted for brain size. Using partial least squares, we identified two significant patterns of structural covariance of the aHC and pHC. The first included brain areas that covaried

positively and negatively in volume with both the aHC and pHC in men, but showed greater covariance with the aHC in women. The second pattern revealed distinct structural covariance for the pHC and aHC that differed between men and women: men demonstrated a reliable pattern of structural covariance between pHC and the medial and lateral parietal lobes and the prefrontal cortex, whereas women demonstrated a reliable pattern of structural covariance between aHC and the anterior temporal lobe bilaterally. There were no reliable associations between structural covariance patterns and performance. Our findings identify sex as a potential moderating factor when investigating hippocampal structure and connectivity.

C96

ENHANCEMENT OF HIPPOCAMPAL NETWORKS AND ASSOCIATIVE MEMORY VIA NONINVASIVE STIMULATION

Jane Wang[1], Anthony Ryals[1], Evan Gross[1], Mehmet Dokucu[1], Lynn Rogers[2], Molly Hermiller[1], Kelly Brandstatt[1], Joel Voss[1]; [1]Northwestern University Feinberg School of Medicine, [2]Rehabilitation Institute of Chicago — Few findings substantiate the influential notion that the hippocampus supports associative memory by binding together elements of experience that are individually processed by distributed brain regions. We explored the causal role of hippocampus by using noninvasive electromagnetic stimulation of human hippocampal brain networks to identify changes in associative memory caused by enhancing the interactivity of hippocampus with distributed regions. Individualized measures of intrinsic functional connectivity of hippocampus were used to locate subject-specific stimulation targets. A total of 12 subjects participated in our experimental design that counterbalanced one week of treatment stimulation with one week of sham control stimulation. Target sites and associated hippocampal networks were stimulated with repetitive transcranial magnetic stimulation (rTMS) for a total of five daily sessions. Stimulation increased functional connectivity within hippocampal networks, and this was associated with selective improvements in associative memory performance that outlasted the period of stimulation. Furthermore, the magnitude of the performance increase correlated with the magnitude of the estimated intensity of stimulation, with subjects receiving higher stimulation intensities showing greater improvements in memory performance. No improvements were identified for tests of attention, language, and perceptual functions. These findings demonstrate that hippocampal brain networks can be enhanced in humans using noninvasive stimulation, providing direct evidence that hippocampal interactivity with distributed regions plays a causal role in associative memory.

C97

PROBING MEMORY BEFORE A DELAYED MATCH-TO-SAMPLE CONJUNCTION TASK INDICATES ENHANCED LEARNING

Danying Wang[1], Leun J. Otten[1]; [1]University College London (UCL), UK — Brain activity before an event can affect the likelihood that the event will later be remembered. Such activity may reflect a brain state that supports the encoding of information into episodic memory. Here, we tested this idea by investigating what happens to a memory probe delivered while an episodic task is being anticipated. Scalp-recorded electrical brain activity was obtained while 24 healthy adults performed a delayed match-to-sample task. The task involved the consecutive presentation of three grayscale images of objects in one of nine locations, followed by a comparison stimulus. Participants either had to remember the locations of the objects (feature condition) or the objects in their particular locations (conjunction condition). The conditions were randomly intermixed and signalled with a cue presented 5 s before task onset. In half of the trials, a colour image of an object was presented 3 s into the anticipation interval. Memory for this probe was tested at the end of the experiment with a surprise recognition test. Recognition memory was better for probes from the conjunction than feature condition. These probes also elicited larger retrieval-related activity over frontocentral scalp sites over an extended time period. Surprisingly, however, encoding-related activity for the probes at study was larger in the feature than conjunction condition. The findings generally support the idea that learning can be enhanced by certain brain states. A brain state conducive to episodic memory encoding may be induced by asking individuals to prepare for a task involving the binding of multiple types of information.

C98

POST-RETRIEVAL MONITORING IN EPISODIC MEMORY IS MODULATED BY TRANSCRANIAL DIRECT CURRENT STIMULATIONS OVER THE LEFT POSTERIOR PARIETAL CORTEX

Nai-Feng Chen[1], Chi-Hung Juan[1], Neil G. Muggleton[1], Chien-Ming Lo[1], Shih-kuen Cheng[1]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan — Recent functional neuroimaging studies consistently reported the activation of left lateral parietal cortex (LPPC) during episodic memory retrieval. However, it is unclear how the LPPC is causally related to memory retrieval. The present study employed transcranial direct current stimulation (tDCS) and event-related potentials (ERPs) to investigate the role of LPPC in memory retrieval. Participants engaged in three sessions of source memory task under three stimulation conditions: sham, anodal, and cathodal respectively. In each session, participants studied words that were presented with one of four faces in the first day and performed source memory judgments in the second day. The interval between two stimulation conditions was a week. tDCS was delivered over the P3 site of the 10-20 system for 15 minutes prior to the test phase and ERPs were recorded during the test phase. It was predicted that source memory performance and the left parietal Old/New effect, thought to index recollection process, would be modulated by the tDCS. We did not find the source memory performance and the left parietal old/new effect to be modulated by the tDCS. Nevertheless, there was a greater right frontal effect following the anodal stimulation in comparison to cathodal and sham stimulations. The findings suggest that post-retrieval monitoring might be modulated after LPPC stimulation.

C99

DIFFERENTIAL CONTRIBUTIONS OF MEDIAL PREFRONTAL CORTEX AND HIPPOCAMPUS TO SELF-PROJECTION AND SELF-REFERENTIAL PROCESSING

Jake Kurczek[1], Shreya Ahuja[2], Emily Wechsler[2], Neal Cohen[3], Daniel Tranel[1], Melissa Duff[1]; [1]University of Iowa, [2]The Hockaday School, [3]University of Illinois Urbana-Champaign — Converging evidence points to a shared neural network for self-projection, the ability to remember the past and think about the future. Consistent with neuroimaging findings of hippocampal activation during event construction tasks, patients with hippocampal amnesia are impaired in their ability to (re)construct events of the past and the future. While fMRI studies of constructed experiences implicate the medial prefrontal cortex (mPFC), it remains unknown whether the mPFC is critical for such processes. The current study compares performance of five patients with bilateral mPFC damage medial, six patients with bilateral hippocampal damage, and eleven demographically matched comparison participants on an event construction task. Participants were given a neutral cue word and asked to (re)construct events across four time conditions: real past, imagined past, imaged present, future. These event narratives were analyzed for the number of internal and external details to quantify the extent of episodic re-experiencing. Given the literature on the involvement of the mPFC in self-referential processing we also analyzed the event narratives for self-reference. The patients with mPFC were unimpaired in their ability to construct highly detailed episodic events across time periods ($p = 0.54$), but were impaired in their incorporation of the self ($p < 0.001$), while patients with hippocampal damage were impaired in their ability to construct highly detailed episodic events across time periods ($p < 0.001$), but not in their incorporation of the self ($p = 0.82$). The results suggest a striking dissociation of the neural and cognitive contribution to self-projection and self-referential processing.

C100

THE EFFECTS OF FACE AGE ON MEMORY ENCODING: NEURAL SIMILARITIES AND DIFFERENCES IN ACTIVITY AND FUNCTIONAL CONNECTIVITY

Caitlin R. Bowman[1], Indira C. Turney[1], Nancy A. Dennis[1], Reginald B. Adams, Jr.[1]; [1]The Pennsylvania State University — Face processing has been shown to recruit a robust neural network including the ventral temporal lobe, medial prefrontal cortex (PFC) and fusiform gyrus. While factors such as race have been shown to moderate processing within this network, little is known about the effect of the age of a face stimulus on such processing. The current study utilized fMRI to examine neural responses in young adults to infant, younger, and older adult faces during memory encoding. Results revealed a common face encoding network across all aged faces including medial PFC and bilateral hippocampus. With regard

to differences, compared to all other faces, older adult faces elicited greater activity in early visual cortex, whereas younger adult faces elicited greater activity in bilateral hippocampus and PFC. Infant faces showed overall reduced activity compared to all other faces. Further, connectivity analyses revealed relatively similar processing with the left MTL for all aged faces. The right MTL, however, showed greater connectivity within the typical encoding network for young adult faces compared to older and infant faces and greater connectivity across a diffuse neural network for infant faces, but did not show a consistent pattern of unique connectivity for older faces. Together, results suggest that young adults process young adult faces as typical to-be-remembered items. Results also suggest that older faces may be encoded based on their visual distinctiveness and infant faces may recruit diffuse cognitive processes due to their lack of familiarity compared to young adult faces.

C101

THE EFFECT OF FUTURE RELEVANCE ON EMOTIONAL MEMORY TRADEOFFS AFTER SLEEP AND WAKE Alexis Chambers[1], Tony Cunningham[1], Jessica Payne[1]; [1]University of Notre Dame — Sleep selectively benefits memory for salient information, including emotional information and information expected to be relevant later. However, it is unknown how these two salience cues interact during consolidation intervals that span wakefulness and sleep. Participants encoded scenes composed of negative or neutral foreground objects placed on neutral backgrounds. Half the participants were then informed of the subsequent recognition test, while the other half were not. When there was no knowledge of future testing, negative objects were well-remembered at the cost of the neutral backgrounds on which they were placed [t(40)=2.6,p=.01], an effect observed only in participants who slept [t(17)=2.8,p=.01]. When informed of imminent testing, however, both the sleep [t(20)=6.0,p<.001] and wake groups [t(19)=4.7,p<.001] displayed this tradeoff. Moreover, there was an instruction (told/not told) x valence (negative/neutral) x scene component (object/background) [F(76)=4.3,p=.04] interaction. This was driven by superior memory for negative objects relative to their paired backgrounds when participants were informed of future testing, compared to when they were unaware [t(76)=2.6,p=.01]. While the wake group showed a threefold increase in this emotional memory tradeoff when the information had future relevance [t(39)=2.02,p=.05], no additional increase was afforded by sleep. This suggests that (1) future relevance and emotional salience interact to increase memory for emotional components of scenes during a consolidation period filled with wakefulness, while (2) the sleeping brain already actively tags emotionally salient information as important for later memory, such that explicit instruction of an upcoming memory test does not further improve emotional memory.

C102

THE HIPPOCAMPUS BINDS NOVEL INFORMATION TO DOMINANT MEMORY TRACES TO SUPPORT BOTH MEMORY STABILITY AND CHANGE Donna J. Bridge[1], Joel L. Voss[1]; [1]Northwestern University Feinberg School of Medicine — Memory is paradoxical in that some features remain relatively static over time, whereas other features are constantly modified to incorporate new information. We tested the notion that a single hippocampal associative novelty binding (ANB) mechanism supports both stability and change by binding dominant information in memory to associatively novel contexts. Healthy subjects (n=17) underwent concurrent fMRI and eye tracking while completing a spatial association task. After studying objects in unique locations (Location1) on a scene background image (Context1), subjects completed a reactivation phase with a new background scene (Context2) by moving each object to a new location (Location2). During Passive reactivation, subjects moved objects to predetermined locations on the screen. During Active reactivation, subjects recalled each object's associated location and moved it accordingly. Object-location recognition memory was then tested in Context1 or Context2. For Passive reactivation, the original location maintained dominance in memory, in that subjects remembered Location1 even when later testing occurred in the associatively novel context, Context2. In contrast, for Active reactivation, the new location became dominant in memory, in that subjects remembered Location2, even when testing occurred in the associatively novel context, Context1. Hippocampal activity selectively corresponded to ANB in both conditions, when the dominant location-memory was bound to associatively novel context information. Hippocampal ANB therefore allows dominant memories to be projected into future contexts and also to infiltrate previous memories, such that memory is adaptively tuned to information that is most salient. Findings of impaired ANB in individuals with unilateral hippocampal resection will be discussed.

C103

THE EFFECTS OF ANTICIPATORY STRESS ON THE NEURAL CORRELATES OF ASSOCIATIVE MEMORY RETRIEVAL Stephanie Gagnon[1], Alex Gonzalez[1], Anthony Wagner[1]; [1]Stanford University — Our ability to store and retrieve memories allows us to access knowledge about the past to inform decisions and actions in the present. The process of recollecting specific, associative details about past events involves, in part, engagement of frontoparietal control mechanisms. When confronted with a stressful situation, controlled processing is often impaired, and activity in frontoparietal networks may be disrupted. Here, we investigated whether acute anticipatory stress, operationalized by threat of shock, influences memory retrieval processes. To the extent that associative retrieval requires controlled processes, we hypothesized that performance will be vulnerable to interference under conditions of stress relative to safety. During encoding, images of faces were paired with either object or place associates. At retrieval, subjects (N=24) viewed old and new face cues while we recorded physiological measures (skin conductance; heart rate) and neural activity with electroencephalography (EEG). If subjects recognized the face as old, they were asked to recollect the paired associate. Stress during retrieval did not influence face recognition, whereas associative memory was selectively affected; more specifically, face-object associations were impaired by anticipatory stress, while face-place associations were unaffected. EEG time-frequency analyses revealed reduced recollection-related responses over parietal cortex approximately 500 - 800 ms post-stimulus onset for threat relative to safe blocks. Together, these findings suggest that stress disrupts the retrieval of associative information, and alters the parietal correlates of remembering.

C104

THE EFFECTS OF NEGATIVE EMOTION ON RELATIONAL BINDING INFORMATION WITH EYE MOVEMENT MEASURES Judy Yi-Chieh Chiu[1], Inge Karosevica[1], Jim Monti[1], Neal Cohen[1]; [1]University of Illinois at Urbana-Champaign — Much research reports an impairing effect of emotion on memory for peripheral information that accompanies central items of events. However, few studies have specifically queried the effects of negative emotional stimuli on memory accuracy for binding relations between item and peripheral information (such as what peripheral information accompanied a specific item), independent of how well these various components are remembered in isolation. The current study examines the effects of negative emotional stimuli on memory for bindings between background scenes, negative or neutral in valence, and arbitrarily paired faces. In addition to behavioral accuracy on a recognition task, we collected eye movements during both viewing and test of the face-scene pairs. This allowed us to obtain a more sensitive measure of memory behavior and to record differences in the viewing of paired stimuli containing negative versus neutral valence. At test time, for negative compared to neutral trials, participants were slower to choose the correct paired face to a background scene, from among 2 other previously studied familiar faces, and exhibited more transitions in viewing between the 3 face choices. Study time data additionally showed less proportion of viewing time to faces in the presence of paired negative scenes, compared to neutral scenes. Collectively, data suggest negative emotion leads to poorer memory representation of binding information, and identifies study time viewing patterns as a contributing factor to the differential memory behavior at recognition time for paired stimuli containing negative emotional information.

LONG-TERM MEMORY: Priming

C105

IMPLICIT AND EXPLICIT CONTRIBUTIONS TO STATISTICAL LEARNING Laura Batterink[1], Ken Paller[1], Paul Reber[1], Helen Neville[2]; [1]Northwestern University, [2]University of Oregon — Statistical learning refers to acquiring the ability to detect regularities in the environment. A fundamental assumption typically made about statistical learning is that it is implicit

in nature - it commonly occurs in the absence of conscious effort and seems to produce negligible explicit knowledge. However, this assumption has not been rigorously tested. Explicit learning may also play a role. We measured behavior and brain potentials to examine whether the knowledge gained via statistical learning results entirely from implicit learning. Learners were exposed to a continuous stream of repeating nonsense words and we then tested (a) explicit memory via a familiarity-judgment task with a remember/know procedure and (b) implicit memory via a speeded target-detection task. Both tasks showed statistical learning effects. On the familiarity task, accurate responses were associated with subjective feelings of stronger recollection, and learned words elicited an enhanced late positive component relative to nonword foils, which suggests that familiarity judgments were supported at least partially by explicit memory. On the target-detection task, both reaction times and P300 amplitude differed as a function of syllable position, reflecting facilitation attributable to statistical learning. Familiarity did not positively correlate with RT or P300 effects on the target detection task, suggesting that these two tasks rely upon dissociable mechanisms. Taken together, these results provide evidence that both implicit and explicit knowledge are accrued during statistical learning. The common assumption that statistical learning operates entirely implicitly is thus disputable.

C106

IMPLICIT RELATIONAL MEMORY IS FLEXIBLE: AN EYE MOVEMENT STUDY OF CONTEXTUAL CUING Youcai Yang[1], Anthony Greene[2]; [1]University of Wisconsin-Milwaukee, [2]University of Wisconsin-Milwaukee — Implicit memory has often been construed as inflexible. The present experiment is designed to use eye movement to explore the extent that implicit memory is capable of rapid relational flexibility. We examined this by manipulating learned relations and examining how new information was incorporated. Participants were recruited for a 27 blocks contextual cueing test with both eye-movement and reaction time as dependent variables. All participants were asked to identify the orientation of one rotated target "T" among 11 distractors "L" in each 12 repeated arrays and 12 novel arrays for each block. After nine blocks (Set A), the target switched with a distractor in diagonal quadrant for another nine blocks (Set B), then the target switched back to its initial location (Set A). We found faster reaction time in the repeated configuration at the end of Set A. After the target switched with a distractor (Set A to Set B), we noticed a temporary increase in reaction time before locating target in the first few blocks of Set B. In contrast, when the target switched back to its original location (Set B to Set A), no such behavior cost was observed; that is, on the first reversal trial we found immediate and full facilitation. The eye tracking data showed that participants changed their search strategy to include both learned locations. This experiment suggests that implicit performance is rapidly modified as relations change.

C107

ANTIPRIMING ACCOMPANIES REPETITION PRIMING IN AUDITORY WORD IDENTIFICATION Katie L. Galazen[1], Gabrielle F. Gloston[1], Katrina B. Archambault[1], Benjamin Munson[1], Chad J. Marsolek[1]; [1]University of Minnesota — In visual object and visual word identification, antipriming is a phenomenon that accompanies repetition priming. In particular, identifying one set of objects or words has the effect of both (a) enhancing subsequent identification of the same set of objects or words (repetition priming) and (b) impairing subsequent identification of a different set of objects or words (antipriming). How generalizable is this finding? Our aim was to determine whether antipriming accompanies repetition priming in auditory word identification. The experiment consisted of four phases. In the first phase, participants rated auditory tones and did not process any verbal information. In the second phase, participants identified spoken words that were presented at a very low volume, and this enabled a baseline measure of word identification when none of the words have recently been primed or antiprimed. In the third phase, participants heard and rated a new set of words presented at normal volume, enabling easy identification. Finally, in the fourth phase participants again identified words that were presented at a very low volume, some of which were repeated from the third phase (primed words) and some of which were new (potentially antiprimed words). Primed words were identified significantly faster than baseline (a repetition priming effect), and antiprimed words were identified significantly slower than baseline (an antipriming effect). These results indicate that antipriming generalizes to auditory word identification.

C108

THE EFFECTS OF ATTENTION AND TASK RELEVANCE ON REPETITION SUPPRESSION: AN FMRI STUDY Chun-Yu Lin[1], Han-Yuan Lai[1], Chih-Hao Lien[1]; [1]National Cheng Kung University, Taiwan — Priming refers to the change in speed, accuracy or bias in processing a stimulus without conscious awareness of prior exposures to the same stimulus. Neuroimaging studies have found that priming is often accompanied with repetition suppression (RS), the reduction of neural responses when a stimulus is presented repeatedly. Some theories proposed that RS is an automatic, low-level process, which would occur whenever a stimulus is repeated, and that RS is the neural basis of behavioral priming. This hypothesis has become popular; however, more and more recent findings have challenged this view. The aim of this study was to further investigate the patterns of RS under different conditions in order to elucidate the nature of RS and its relationship to behavioral priming and recognition. In Experiment 1, face and scene pictures were presented in a priming task and a continuous recognition task. RS was found in fusiform face area (FFA) and parahippocampal place area (PPA) for face and scene stimuli, respectively. But the patterns in the priming and the recognition tasks were not identical. In Experiment 2, face and scene pictures were used for different types of recognition tasks, including a traditional YES/NO, a YES-only and a NO-only recognition task. This was to examine the effects of attention and task relevance (whether it is the target) on RS in the recognition tasks. The results indicated the role of attention in RS, and suggest the need for a more comprehensive model for repetition suppression.

LONG-TERM MEMORY: Skill learning

C109

INHIBITION OF PRIMARY MOTOR AREA (M1) CAUSES RECRUITMENT OF THE VISUAL-SPATIAL NETWORK DURING LEARNING. Leonora Wilkinson[1], Adam Steel[1], Sunbin Song[1], Devin Bageac[1], Kris Knutson[1], Eric Wassermann[1]; [1]National Institute of Neurological Disorders and Stroke — In previous studies, continuous theta burst TMS (cTBS) over M1 impaired subsequent motor sequence learning and early recall/consolidation. However, it is unknown if this stems from inhibition of M1 alone or a network including M1. We examined the effects of M1 cTBS with fMRI to see how cTBS impairs sequence learning/early recall. Immediately after real or sham cTBS, participants underwent fMRI, while performing a probabilistic serial reaction time task. Both groups, demonstrated comparable online learning, associated with activation in the midbrain, superior frontal gyrus, BA 8, bilateral lingual gyrus, bilateral premotor cortex and thalamus. However, when learning followed sham, we saw more connectivity between regions in the motor learning network (left superior temporal gyrus, left cuneus, left inferior parietal lobule, supplemental motor area, left cerebellum and left M1) than after real cTBS. When learning took place after real cTBS, there was a shift from connectivity in the motor learning network to the visuo spatial network (anterior cingulate, right middle temporal gyrus, lingual gyrus, right middle temporal gryus, declive, midbrain, right middle occipital, and right M1. This suggests that M1 is a critical node in the motor learning network and inhibiting it causes a compensatory shift to the visual-spatial network. The learning and early implicit recall impairments caused by M1 cTBS may be due to these distributed effects.

C110

THE RELIABILITY OF IMPLICIT LEARNING MEASURES VARIES Priya Kalra[1], Amy Finn[2], John Gabrieli[2]; [1]Harvard Graduate School of Education, [2]Massachussetts Institute of Technology — Many studies have used tasks such as Artificial Grammar Learning (AGL), Serial Reaction Time (SRT), and Probabilistic Classification (PCT) to investigate the construct of implicit learning. However, few studies have considered the reliability of these measures. Reber (1993) suggested that measured differences are likely to reflect simple measurement error because implicit learning ability is highly uniform across (healthy adult) individuals. In the current study, we investigate the reliability of implicit learning measures, the construct validity of

implicit learning (as measured by AGL, SRT, and PCT), and individual differences in implicit learning. Sixty-four healthy young adults participated in a test-retest study (N=64). At Time 1, each participant performed multiple implicit learning tasks (AGL, SRT, PCT, and prototype-distortion category learning) and a measure of explicit learning (California Verbal Learning Task, CVLT). Each participant returned 7-14 days later (Time 2) and performed alternate versions of the same task. Individual IQ and personality scores were also measured at Time 2. Test-retest reliability (correlation between T1 and T2 scores) was found to be low-to-moderate for all implicit learning tasks (AGL: 0.01; category learning: 0.07; SRT: 0.36; PCT: 0.46). In contrast, T1-T2 explicit learning (CVLT) correlation was high (0.80). Correlations between tasks also ranged from low to moderate (lowest: AGL& SRT: 0.01; highest: AGL & PCT: 0.51). These results suggest that for some tasks used to measure implicit learning, Reber's prediction was correct, but for other tasks meaningful individual differences may exist. As a corollary, reliability varies across tasks commonly used as measures of implicit learning.

C111

PERSONALITY CORRELATES OF IMPLICIT PERCEPTUAL-MOTOR SEQUENCE LEARNING: REWARD RESPONSIVENESS AND COMPULSIVITY

Eric W. Gobel[1], Faith K. Ostrowski[1], Kelsey M. Garr[1], Monika E. Magierska[1]; [1]University of Illinois at Chicago — The Serial Interception Sequence Learning (SISL) task, where participants must correctly sequence precisely timed movements cued by moving stimuli, attempts to mimic requirements of real-world perceptual-motor skills in the laboratory. Practice with a repeating pattern leads to a performance benefit specifically for the practiced sequence, which does not depend on explicit knowledge (i.e., implicit learning). Previous neuroscientific research has suggested that sequence learning in the SISL task depends on intact dopaminergic signaling in corticostriatal circuits and is accompanied by activation of the ventral striatum. Therefore, there may be a relationship between skill learning ability and personality traits influenced by dopaminergic corticostriatal functioning. Since the dopaminergic system is sensitive to reward and central to reinforcement learning, participants with greater reward responsiveness may demonstrate higher skill learning ability. Additionally, obsessive-compulsive personality disorder is thought to arise in part from dysregulated corticostriatal processing, so participants with a compulsive personality may also show altered skill learning ability. To test these hypotheses, participants performed the SISL task and then completed questionnaires measuring reward responsiveness and various dimensions of obsessive-compulsive personality traits. As in previous studies, participants demonstrated implicit learning of the practiced sequence. Surprisingly, the magnitude of the sequence-specific performance benefit was moderately greater for those who were less responsive to reward and those who were less cognitively inflexible (i.e., less compulsive). These results raise questions about how reward responsiveness contributes to dopamine-dependent learning and suggests that cognitive flexibility - also thought to be modulated by dopamine - might be associated with skill learning.

C112

FORGETTING HOW TO RIDE A BIKE: MEASURING THE DECAY RATE OF IMPLICIT KNOWLEDGE

Daniel J. Sanchez[1], Hristo Bojinov[2], Patrick Lincoln[1], Dan Boneh[2], Paul J. Reber[3]; [1]SRI International, [2]Stanford University, [3]Northwestern University — The belief that implicit procedural knowledge is retained long after initial learning is so widely assumed that it has become a common aphorism. Yet, there have been few attempts to quantify the forgetting of implicit learning and empirical approaches have produced inconsistent results about the robustness of long-lasting implicit knowledge. Here, to assess the forgetting rate of implicit knowledge, we used the Serial Interception Sequence Learning (SISL) task to measure knowledge expression at variable time points after training. The Serial Interception Sequence Learning (SISL) task has been shown to produce robust perceptual-motor implicit sequence knowledge with minimal influence from concomitant explicit knowledge. In this task, participants make precisely-timed motor responses that intercept cues moving down a computer screen. Three groups of participants were trained on a 30-item repeating sequence (75-105 sequence repetitions) and knowledge expression was assessed either immediately, 1-2 days, or 1-2 weeks after training. Sequence knowledge, measured as the difference in performance accuracy between trained and novel sequences, was well fit by a model containing log(trained sequence repetitions), b = 1.65%, [1.40, 1.89; 95% CI], and log(delay in hours), b = -.328%, [-.659, -.003; 95% CI], with the intercept (initial knowledge) set to zero, r2 = .43. Based on this model, roughly 30 minutes of training (100 sequence repetitions) would produce knowledge that would likely be detectable for at least a month following the initial training session. This suggests that implicit sequence learning mechanisms do in fact produce long-lasting knowledge representations following relatively short periods of initial practice.

C113

NEURAL PATTERN STABILITY IN THE MEDIAL TEMPORAL LOBE AND NEOCORTEX PROMOTES MATURATION OF MEMORY-BASED PROBLEM SOLVING SKILLS WITH DEVELOPMENT

Shaozheng Qin[1], Jared Filseth[1], David Geary[4], Vinod Menon[1,2,3]; [1]Department of Psychiatry and Behavioral Sciences, Stanford Unversity, [2]Department of Neurology and Neurological Sciences, Stanford University, [3]Program of Neuroscience, Stanford University, [4]Department of Psychological Sciences, Interdisciplinary Neuroscience, University of Missouri — The ability to efficiently retrieve basic facts from memory and bring them to bear in ever-changing situations is a cardinal feature of mature memory-based problem solving. For instance, children's math problem solving becomes more dependent on direct retrieval but less on counting strategies and a pattern continues to stabilize through adolescence into adulthood. Little, however, is known about the neurodevelopmental basis of these maturational transitions. We integrated event-related fMRI and cognitive assessment of fact retrieval while solving single-digit addition problems in 20 children (aged 7-9), 20 adolescents (aged 14-17) and 20 young adults (aged 18-22). Strategies for solving addition problems were assessed using a well-validated trial-by-trial manner. Participants underwent fMRI while solving addition problems. Innovative trial-by-trial representational similarity analysis (RSA) with a searchlight method was used to compute a measure of trial-by-trial neural pattern stability. With development, participants became increasingly dependent on direct retrieval but less dependent on counting. Trial-by-trial RSA revealed a significant main effect of pattern stability in the medial temporal lobe (MTL), parietal, temporal and frontal cortices. Critically, pattern stability in the MTL (the left anterior hippocampus and perirhinal cortex), the left inferior frontal cortex and the inferior temporal cortex showed a linear-trend increase with development, while the right inferior parietal sulcus showed an initial increase from childhood to adolescence and then declined during adulthood. Our findings provide novel evidence that maturation of memory-based problem solving is characterized by both protracted and transient changes in the functional organization of the MTL and neocortical systems.

C114

A SMALL-WORLD FUNCTIONAL BRAIN NETWORK IS ASSOCIATED WITH LEARNING UNDER CONTEXTUAL INTERFERENCE

Chien-Ho Janice Lin[1,2], Allan Wu[3], Barbara Knowlton[3], Marco Iacoboni[3], Ming-Chang Chiang[1]; [1]National Yang-Ming University, Taiwan, [2]Yeong-An Orthopaedic and Rehabilitation Clinic, Taiwan, [3]UCLA — INTRODUCTION: Brain networks underlying various cognitive tasks have small-world topology, a feature associated with efficient communication across different regions. In motor learning, interleaved practice of different tasks generally induces superior retention than repetitive practice, a phenomenon called the contextual-interference (CI) effect. We investigated whether motor learning with greater CI strengthens brain network efficiency. METHODS: Over 2 successive days, 16 young adults practiced serial reaction time tasks (three distinct 4-element sequences) arranged in either repetitive or interleaved order 2-4 weeks apart. Retention was evaluated on Day 5 in an MR scanner. Using psychophysiological interaction analysis (PPI) across 90 brain regions, we identified a directed functional network underlying CI effects on learning, where between-region connectivity was greater in the interleaved than repetitive conditions. The network was considered small-world if the small-world index S > 1, where S is the ratio of clustering coefficient over characteristic path length of the network, normalized by that of random networks. RESULTS: Both motor learning and network efficiency improved after interleaved compared to repetitive practice; after interleaved practice, the functional network during retention on Day 5 had small-world topology (S = 2.99). Moreover, the left inferior frontal gyrus and temporal pole were most connected with other regions, and therefore considered as hubs

of the network. CONCLUSION: Improved motor learning following interleaved practice is associated with an efficient brain network showing small-world topology. Moreover, training with CI strengthens functional linkage between areas mediating visual memory (temporal pole), and motor planning/ execution (prefrontal cortex).

C115

CEREBELLAR ACTIVATION DURING PRACTICE IS CORRELATED WITH MOTOR SEQUENCE TRANSFER

Renee E. Shimizu[1], Allan D. Wu[1], Jennifer J. Choi[1], Barbara J. Knowlton[1]; [1]UCLA — Effective learning results not only in improved performance on a practiced task, but also in the ability to transfer the acquired knowledge to novel, similar tasks. The present study utilized functional magnetic resonance imaging to identify the neural substrates of motor sequence learning that lead to more effective transfer. Participants practiced three 8-element keypress sequences in an interleaved order during a training phase, and then were given three novel sequences during a transfer phase. Participants showed significant overall learning during the practice phase as indicated by a significant decrease in response time (RT), as well as significant sequence-specific knowledge of the practiced sequences. Furthermore, participants on average demonstrated positive transfer as indicated by a significant decrease in RT during the transfer phase in comparison to the first training session. Whole-brain analyses revealed that cerebellar BOLD activity bilaterally in lobules I-IV as well as in left lobules V and VI during the practice phase was positively correlated with subsequent transfer performance. This effect was independent of RT during training. It is possible that greater recruitment of the cerebellum during training results in the gain of more generalized task knowledge, such as improved response conflict resolution or maintenance of stimulus-response associations, which enhances later transfer performance.

METHODS: Neuroimaging

C116

WHAT DO DIFFERENCES BETWEEN UNIVARIATE AND MULTI-VOXEL ANALYSES MEAN? INFLUENCES OF SPATIAL- AND SUBJECT-LEVEL VARIANCE ON FMRI ANALYSIS

Tyler Davis[1], Karen LaRocque[2], Jeanette Mumford[3], Ken Norman[4], Anthony Wagner[2], Russell Poldrack[3]; [1]Texas Tech University, [2]Stanford University, [3]University of Texas, [4]Princeton University — Multi-voxel pattern analysis (MVPA) has led to vast changes in how fMRI data are analyzed and interpreted. Many studies now report both MVPA results and results from standard univariate general linear models (GLM), often with the goal of drawing different conclusions from each. Because MVPA results can be sensitive to latent multidimensional representations and processes whereas univariate analyses cannot, one conclusion that is often drawn when results differ is that the activation patterns underlying MVPA contain a multidimensional code. In the current study, we conducted simulations to formally test this assumption. Our results reveal that MVPA is sensitive to the magnitude of spatial variability- that is, variability in the effects of experimental variables across voxels - even when a single underlying dimension can characterize this variability. Moreover, we also find that MVPA is insensitive to between-subject differences in mean activation across space, which is the primary variance component that affects univariate group-level significance tests. Together, these results suggest that MVPA effects may be significant in the absence of univariate effects due to differences in sensitivity to spatial and subject-level variance between the two analysis types. On their own, differences between MVPA and univariate analysis do not afford conclusions about the nature of the neural code. Instead, principled tests of the informational content and/or dimensionality of activation patterns are critical for drawing strong conclusions about what significant MVPA results indicate.

C117

ENHANCEMENTS TO THE NEUROSYNTH FRAMEWORK FOR AUTOMATED SYNTHESIS OF FMRI DATA

Tal Yarkoni[1], Luke Chang[2], Alejandro De La Vega[2]; [1]University of Texas at Austin, [2]University of Colorado Boulder — 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 automatically conduct large-scale, high-quality neuroimaging meta-analyses, address long-standing inferential problems in the neuroimaging literature, and facilitate decoding of broad cognitive states from brain activity in both entire studies and individual human subjects (Yarkoni et al, 2011). Here we describe new extensions and improvements to this framework, including: (1) considerable expansion of the database (to nearly 9,000 studies); (2) improved metadata annotation, enabling meta-analyses based on methodological features of studies (e.g., software package employed, scanner field strength, etc.); (3) a revamped website designed around a comprehensive REST API, enabling other web services to easily consume Neurosynth data; (4) improved 2D and 3D visualization via an improved and modularized JavaScript viewer; (5) integration with the recently developed NeuroVault repository of user-uploaded whole-brain images; and (6) new clustering and network modeling features that support fully automated parcellation and decoding of complex activation patterns. These additional features improve usability, broaden the range of potential applications, and promote interoperability with other neuroinformatics platforms. The Neurosynth data and code are freely available on the web (neurosynth.org; github.com/neurosynth).

C118

THE COGNITIVE CONNECTOME PROJECT: MAPPING THE NEURAL REPRESENTATION OF NORMATIVE VARIANCE IN COGNITION

G. Andrew James[1], Tonisha E. Kearney-Ramos[1], Jennifer L. Gess[1], Jennifer S. Fausett[1], Clinton D. Kilts[1]; [1]University of Arkansas for Medical Sciences — The translation of functional magnetic resonance imaging (fMRI) into clinical decision making requires that we first understand the neural representation of normative cognitive variance in well-characterized samples of healthy adults. We have addressed this need by initiating the Cognitive Connectome Project, which pairs clinical neuropsychological assessments of cognition with canonical neuroimaging tasks. To date, we have acquired a demographically diverse sample of 52 participants [29 females; mean (sd) age = 32 (10) years, age range= 19-50 years]. Participants completed a battery of neuroimaging tasks and neuropsychological tests spanning the following cognitive domains: motor ability, visuospatial perception, attention, language, memory, affective processing, decision making, and executive function. As a proof of concept, we present results from the Judgment of Line Orientation (JLO) task, a neuropsychological test of visuospatial perception that we directly replicated as an fMRI task. Participants' JLO accuracy was significantly correlated inside and outside the MRI scanner (Spearman rho= 0.75, $p<0.0001$), indicating the neuroimaging task to be a valid replication of the neuropsychological instrument. We report the JLO task to significantly recruited the dorsal visual network ($t>6.4$). However, network activity negatively regressed to JLO accuracy ($t<-2.7$, $p<0.01$), suggesting that participants who performed best recruited less of this network. Furthermore, median-split analysis showed brain activity to be more variable for poorly performing participants, which may reflect suboptimal or maladaptive task strategies. In conclusion, we present a conceptual and theoretical framework for studying normative brain-behavior relationships and extending these findings into making patient-specific clinical inferences.

C119

DIFFUSION TENSOR IMAGING OF ADULTS WITH ADHD: PRELIMINARY FINDINGS FROM A SUBSTANTIALLY LARGE COHORT

Yuliya Yoncheva[1], Krishna Somandepalli[1], Clare Kelly[1], Adriana DiMartino[1], Mariana Lazar[1], Michael Milham[2], F. Xavier Castellanos[1,3]; [1]NYU Child Study Center, New York, NY, [2]Child Mind Institute, New York, NY, [3]Nathan S. Kline Institute for Psychiatric Research, Orangeburg, NY — Recent diffusion tensor imaging (DTI) studies have reported white matter (WM) abnormalities in adults with Attention-Deficit/Hyperactivity Disorder (ADHD). We examined potential whole-brain WM alterations using DTI (3T, 3x3x3mm voxels, 64 diffusion directions) in 42 adults with ADHD and 67 healthy controls. The groups (age: M=31.4, SD=9.4 years; 43 F) were matched for age, gender, IQ and notably in-scanner head motion (all $p>0.5$). Following standard tensor fitting, fractional anisotropy (FA), mean diffusivity (MD), and axial diffusivity (AD) were derived and analyzed via tract-based spatial statistics. Threshold-free cluster enhancement (TFCE) was used to correct for

multiple voxel-wise comparisons. T-tests contrasting ADHD with controls revealed no significant differences for FA (p>0.60), MD (p>0.48), or AD (p>0.43). This lack of significant between-group differences also held when the two ADHD subtypes, combined (n=23) or predominantly inattentive (n=18), were analyzed separately. Our non-significant between-group differences are generally consistent with the implied results of previous investigations. Most diffusion-weighted studies of ADHD in adults that have reported positive results have employed region-of-interest analyses. Furthermore, prior findings from whole-brain contrasts have been uncorrected for multiple comparisons, increasing type 1 errors. Finally, differential head motion has been shown to elicit spurious group differences in WM (Yendiki et al, 2014). Since how to best select an optimal correction method remains an open question, we present and discuss alternative approaches. The current results highlight that group comparisons must attend to potential confounders, particularly motion, and that reports of WM alterations in ADHD must be interpreted with caution when uncorrected for multiple comparisons.

C120

CHARACTERISTICS OF NETWORK ACTIVATION AND CONNECTIVITY RELATED TO REWARD CONTINGENCIES IN A MONOZYGOTIC TWIN SAMPLE

Craig Moodie[1], Ruskin Hunt[2], Steve Malone[2], Kathleen Thomas[2], Angus MacDonald III[1,3]; [1]Department of Neuroscience, University of Minnesota Medical School, [2]Institute for Child Development, University of Minnesota, [3]Department of Psychology, University of Minnesota — In recent work, we have shown that intrinsic connectivity networks (ICNs) derived from fMRI data capture signal from all brain regions independently and simultaneously. These ICNs are stable across time at rest and during task, and are also sensitive to task demands. Moreover, using a previous monozygotic twin sample, ICN morphology and connectivity were determined to be consistent across tasks, while the ICNs also exhibited task-responsiveness and familiality, which suggests that ICNs are trait-like. Given the context that all ICNs are always present irrespective of state, the next logical step was for this study to address how compatible ICNs were with regions of interest (ROIs) in a typical general linear model (GLM) of activation. Hence, GLMs and independent component analyses (ICAs) of data from a delayed response two-choice reward task were completed using a larger twin sample (n = 50 pairs). The GLMs revealed that the visual cortex and basal ganglia were activated in response to rewards, which recapitulated previous findings. On the other hand, the ICAs showed that all ICNs were indeed present during the task but specific ICNs, e.g.: visual ICNs, were related to task elements such as anticipation. Preliminary analyses show a correspondence between the activation beta weights and the correlation coefficients relating the ICN time courses to the task. Since this is a twin sample, familiality will be assessed in both the GLM and ICA analyses in order to determine the familiality of activation and connectivity in this reward paradigm.

C121

SOS LASSO: A NEW METHOD FOR FINDING DISTRIBUTED REPRESENTATIONS IN FMRI DATA.

Christopher Cox[1], Nikhil Rao[1], Robert Nowak[1], Timothy Rogers[1]; [1]University of Wisconsin-Madison — Univariate analyses of fMRI data derive power by making the strong assumption that meaningful signal is anatomically localized in the same way across subjects. This approach improves signal when the assumptions are met but can destroy signal where the location or nature of the neural code varies across subjects. Multivariate pattern analyses (MVPAs) often relax localizationist assumptions by analyzing each subject independently, but because fMRI yields a large number of noisy measurements it can be difficult to recover signal without bringing in other strong assumptions. We introduce a novel technique, the "sparse overlapping sets Lasso" (SOSlasso), that represents a middle ground between these poles. Like other MVPA approaches, SOSlasso assumes that the exact location and nature of the neural code can vary across individuals; but like univariate approaches, it also assumes that such variability is not completely arbitrary: signal-carrying voxels are assumed to be located in roughly similar locations across individuals. In application to simulated data we show how SOSlasso can discriminate signal-carrying from non-signal-carrying voxels better than other common MVPA approaches under a range of different model signals, and also succeeds in cases where univariate methods will necessarily fail. In application to a well-known published dataset, we demonstrate marked improvements in classifier performance and interpretability of classifier weights. The consideration of the simulated and real data together illustrate what such results might imply about the structure of neural representations.

C122

ALTERED RESTING STATE FUNCTIONAL NETWORK ORGANIZATION IN AUTISM, PHENYLKETONURIA, AND TRAUMATIC BRAIN INJURY

Rachel M. Zamzow[1], Jeffrey D. Johnson[1], Gary Yao[1], David Q. Beversdorf[1], Shawn E. Christ[1]; [1]University of Missouri — It has previously been suggested that functional connectivity, as measured by functional magnetic resonance imaging (fMRI), is altered in individuals with neurodevelopmental disorders or conditions with neurological symptoms. In the present study, we used graph theoretical analysis to examine how the organization of functional networks differs based on diagnosis. Resting state fMRI data was collected from 67 individuals with autism spectrum disorder (ASD) (mean age = 14.7), 8 individuals with phenylketonuria (PKU) (mean age = 24.8), 17 individuals with traumatic brain injury (TBI) (mean age = 38.1), and a comparison group of 81 typically developing individuals (TD) (mean age = 16.3). Partial correlation matrices for 90 cortical and subcortical regions were generated and then topological properties were compared between groups. The groups differed significantly across several topological properties. The ASD group demonstrated greater mean degree, global efficiency, cost, and mean strength, as compared to the TD, PKU, and TBI groups ($p < .05$, in all instances). The PKU group showed greater mean clustering coefficient and mean local efficiency ($p < .05$, in all instances) than the other three groups. Lastly, the TBI group displayed greater characteristic path length than the other groups ($p < .05$, in all instances). Accordingly, ASD, PKU, and TBI may be associated with a bias toward local connectivity, although in different respects. The results of the present study indicate alterations in functional network organization in multiple neurological disorders and conditions. Further analysis is needed to characterize these alterations within the contexts of development and symptom severity.

C123

SEX DIFFERENCES IN THE CLINICAL EXPRESSION AND RESTING STATE BRAIN CO-ACTIVITY IN BIPOLAR DISORDER

Sara Kimmich[1,3,5], Lisa Eyler[2,3,4,5], Sanja Kovacevic[3]; [1]UCSD Department of Cognitive Science, [2]UCSD Department of Psychiatry, [3]Veterans Medical Research Center, [4]Veterans Affairs Hospita, [5]UC San Diego — The course and expression of bipolar disorder(BD) clearly differs between women and men. Women more often have a seasonal pattern of mood disturbance,and are more likely to experience rapid cycling than men. Men are more likely to have a comorbid substance use disorder,while women more frequently have comorbid anxiety disorders. Previous studies have observed sex effects in connectivity of the default mode network (DMN) of healthy individuals, but more research is needed to see whether a similar effects holds among BD patients. This study investigates how sex differences in DMN activity among BD I patients compared to individuals without BD, and how sex differences may relate to clinical or cognitive differences in BD. We compared 27 euthymic patients with bipolar I disorder to 28 age and gender comparable healthy participants using functional magnetic resonance image during a period of eyes open rest. Averaged functional activity between the nodes of the DMN(medial prefrontal cortex,posterior cingulate, and bilateral angular gyrus) revealed that BD females tend to have greater co-activity within the default mode network than male BDs,which contrasted with the pattern of greater connectivity among male healthy participants compared to females($p=.01$). Negative psychotic symptoms were more pronounced in male than female bipolar participants($p=.07$). There was a significant negative correlation of average DMN connectivity with negative symptoms($r(28)= -.44$, $p=.05$). These results suggest subtle sex differences in the inter-relationship of resting brain activity within the DMN that may relate to clinical differences between men and women with bipolar disorder,including severity of negative psychotic symptoms.

PERCEPTION & ACTION: Motor control

C124

DIFFERENTIAL MU SUPPRESSION TO IMITATION AND OBSERVATION OF FACE AND HAND ACTIONS Mike Datko[1], Jaime Pineda[1]; [1]University of California, San Diego — Amplitude in the EEG frequency band known as mu (8-13 Hz) is typically attenuated during the execution, observation, and imagination of biological motion. Numerous studies have concluded that this mu suppression or event related desynchronization reflects motor resonance or activation of brain areas involved in visuomotor integration including the human mirror neuron system. Most studies that have shown this type of result have only examined observation and execution of hand actions or hand-object interactions, while very few have used tasks that include facial actions. The present study compared mu suppression, measured with a 32-channel active-electrode EEG system, during the observation and imitation of non-object oriented hand actions as well as non-affective face actions in healthy adult subjects. Each viewed either still images or short video clips of finger actions or non-affective face actions such as moving the lips to the left or right. Before each trial, subjects were instructed to either imitate or simply observe the face or hand action. The mu suppression index (MSI) was calculated using the ratio of mu power during the video clip to mu power during the still image condition for each type of stimuli. Significant and widespread mu suppression was found to both imitation and observation of finger actions, whereas significant and widespread mu enhancement was found to imitation and observation of non-affective face actions. These patterns were not the same for other EEG frequency bands. These results suggest different and generalized mechanisms for visuomotor integration of perceived hand actions compared to face actions.

C125

PROPRIOCEPTION ALONE DRIVES BODY SCHEMA PLASTICITY Marie Martel[1,2], Lucilla Cardinali[2,3], Christophe Jouffrais[4], Livio Finos[5], Alessandro Farnè[2,3], Alice Catherine Roy[1,2]; [1]CNRS, Laboratory of Language, Brain and Cognition (L2C2), UMR5304, Institute of Cognitive Sciences, 69675 Bron Cedex, France, [2]University Claude Bernard Lyon I,Lyon, France, [3]INSERM U1028, CNRS UMR5292, Lyon Neuroscience Research Center, ImpAct Team, Lyon, France, [4]IRIT UMR 5505,Toulouse, France, [5]University of Padova, Padova, Italy — Proprioception is considered as the major sensory input to Body Schema (BS), yet no empirical data show that proprioception is sufficient to BS update. We investigated BS plasticity in complete absence of vision. In a previous experiment (Cardinali et al, 2009), we have established that tool-induced BS plasticity is observable on the kinematics of subsequent free-hand movements. Here, we examined the kinematics of blindfolded right-handed subjects required to reach for an object before and after having performed the same action with a mechanical grabber. In experiment one, free-hand and tool reaching took place in the same sagittal plane. To test for genuine tool integration in the BS, in a second experiment tool-use was maintained in the sagittal plane but free-handreaching was performed in the frontal plane. Furthermore, to assess Body Image (BI) sensitivity to tool-integration, subjects had to estimate their forearm's length in both experiments. In the BS task, we found that after tool-use, subject free-hand movement kinematics showed longer latencies and smaller amplitude peaks. These consequences of tool-use are consistent with an increased length in the BS representation of the arm. Interestingly, the same modifications were found when comparing free hand movements of subjects with longer vs. shorter arms. In the BI task, forearm length did not vary, confirming that body image was immune to tool integration. Our results demonstrate for the first time that proprioception is sufficient for tool integration in the body schema, whereas vision is unnecessary.

C126

ATTENTION SHAPES MOTOR RESONANT RESPONSES DURING ACTION OBSERVATION Guglielmo Puglisi[1], Antonella Leonetti[1], Gabriella Cerri[1], Paola Borroni[1]; [1]University of Milano, Medical School, Milano, Italy — Observation of others' actions evokes in motor cortex a subliminal "motor resonance" (MR) response which reflects the motor program encoding the observed actions. While often described as an automatic and cognitively unmediated response, there is some experimental evidence suggesting that MR can in fact be modulated by cognitive processes. To verify the role of attention in MR we used a peripheral vision paradigm to dissociate attentional and visual focuses in observers. Two groups observed a 4s video of a hand grasping a ball, shown at 10° from foveal fixation. TMS-evoked motor potentials (MEPs) were recorded in muscles of their resting right hand (OP and ADM), at different delays during the observation of the video. In Experiment 1 subjects were asked to maintain their gaze on a fixation point, while viewing the video in periphery; in Experiment 2 different subjects were asked to do the same but also to pay (covert) attention to the video showed in periphery. Eye movements were monitored. Results of Exp.1 show that while MEPs in both muscles were significantly modulated by observation of actions in peripheral vision, the resulting MR responses were grossly imprecise in timing and muscle specificity, thus not reflecting the motor program encoding the observed action. However when subjects paid covert attention, the specificity of the MR response improved, showing a MEP modulation similar (though not identical) to the modulation recorded during observation of the same action in foveal vision. These results support the hypothesis that MR responses are shaped by attentional processes.

C127

VISUOMOTOR ADAPTATION AND COGNITIVE DECLINE IN THE ELDERLY Jeff Schaffert[1], Rebecca Neill[1], Chi-Mei Lee[1], Jin Bo[1]; [1]Eastern — Visuomotor adaptation requires adjusting movements in response to sensory input. Errors between planned and actual movements generally result in adaptive changes, which reduce the occurrence of similar errors in the future. Studies have shown that increasing error feedback can enhance adaptation in both healthy young participants (Wei et al., 2005) and hemiparetic stroke survivors (Patton et al., 2006). Limited literature on dementia and motor learning has indicated that mildly demented participants may rely more on sensory feedback when making movements. Thus, the purpose of this study is to evaluate the role of visual error feedback on visuomotor adaptation on neurotypical and mildly cognitive-declined elderly participants. A center-out visuomotor adaptation task is employed where the error feedbacks are either enlarged (gain of 2:1) or regular (gain of 1:1). Various neuropsychological tests, including the Montreal Cognitive Assessment (MoCA) and the Dementia Rating Scale-2 (DRS-2), are used to assess cognitive functions. It is hypothesized that individuals with cognitive decline will show worse visuomotor adaptation than controls in the regular feedback condition. However, little group differences in the enlarged feedback condition will be found. Five older adults have been tested so far. One of them showed mild cognitive decline. Visual inspection on individual data revealed overall learning in the normal feedback condition. However, the patterns in the enlarged conditions were not clear. Further participants will be recruited for objective statistical analyses.

C128

MOTOR IMAGERY IN DIFFERENT AFFORDANCE CONTEXTS Ya-Ting Chen[1], Wei-Chun Hsu[2], Hao-Ling Chen[1], Wen-Feng Huang[1], Chun-Fu Yeh[1], Chien-Te Wu[1]; [1]School of Occupational Therapy, College of Medicine, National Taiwan University, [2]Graduate Institute of Biomedical Engineering, National Taiwan University of Science and Technology — Motor imagery has been commonly studied with the well-established hand rotation paradigm in which participants are required to discriminate the laterality of a hand rotating in different angles on one or more axes for each trial. Most of previous literature has shown that biomechanical constraints and numbers of rotation axes are two main factors modulating participants' reaction times (RT) in the task. The modulation of different contexts of affordance (i.e., the characteristics of an object that potentiates actions) upon motor imagery remains unclear. The present study therefore modifies the original hand rotation paradigm to address this question. For each trial, participants (n=15) were required to discriminate the laterality of a 3-D hand stimulus displayed on a screen. Specifically, each stimulus depicts either a bare-hand or a hand-with-tool (a spoon or scissors) rotated on the frontal plane (0°, 60°, 120°, 180°, 240° and 300°), sagittal plane (0°, 60° and 300°) and/or transverse plane (prone or supine). The data were analyzed separately for the internal rotation (IR, 0°, 60°, 120° on the frontal plane) and external rotation (ER, 0°, 240° and 300° on the frontal plane) conditions. Two-way ANOVAs (TOOL x ANGLE) reveal significant TOOL main effects for both ER ($F_{2,13}=7.762$, $p=0.003$) and IR ($F_{2,13}=4.768$, $p=0.017$). In particular, the mean RT is higher for the hand-with-tool than the bare-hand condition, indicating that affor-

dance indeed enhances the engagement of motor imagery. However, only IR shows significant angle main effects (F2,13=10.704, p=0.001), suggesting that IR induces a higher degree of motor imagery than ER.

C129

THE "IMAGERY" FITT'S LAW OF MOTOR CONTROL IN HUMAN BRAIN WITH SINGLE-TRIAL EEG ANALYSIS Chun-Fu Yeh[1], Wei-Chun Hsu[2], Yi-Hung Liu[3], Po-Ming Chen[3], Yu-Tsung Hsiao[3], Ya-Ting Chen[1], Chien-Te Wu[1], Hao-Ling Chen[1]; [1]School of Occupational Therapy, National Taiwan University, [2]Graduate Institute of Biomedical Engineering National Taiwan University of Science and Technology, [3]Mechanical Engineering, Chun Yuan Christian University — Fitt's Law, a delineation of the relationship between movement time and task difficulties, is widely applied to model motor control strategy of goal-directed arm movements. Compared to easy task (e.g., reaching with short distance), performing a difficult task (e.g., reaching with long distance) requires longer movement time. Since motor imagery (MI) shares similar neural substrates with real motion, Fitt's Law extracted from real movement may also be applied to the same movement in MI. The current study therefore aimed to provide neurophysiological evidence for this hypothesis. Participants (N=15) were instructed to perform motor imagery tasks involved with posting pegs into slots with three distances (Ipsilateral side: 35% (short) and 70% (long) of functional arm length (FAL); contralateral side: 70% FAL, 15 trials each). A combination of Principal component analysis (PCA) and the k-nearest neighbor (k-NN) algorithm were adopted to classify the normalized band power (BP) of single-trial EEG signals between short and long distances of ipsilateral side (C1), and those between ipsilateral and contralateral FAL distances (C2). The mean classification accuracy is 59.73% (maximum: 63.66%, minimum: 57.81%) for C1 (N=13), and 66.01% (maximum: 74.50%, minimum: 57.54%) for C2 (N=15). Our results demonstrate that it is possible to classify motor imagery patterns defined by different "imagery" movement path in human brain using single-trial EEG analysis with very few trials (i.e., 15 in the current case). Furthermore, our findings support the hypothesis that Fitt's Law can also be applied in motor imagery.

PERCEPTION & ACTION: Other

C130

THE INFLUENCE OF SPATIAL ARRANGEMENT ON GOAL SELECTION AND TASK COMPLETION Grayden Solman[1], Alan Kingstone[1]; [1]University of British Columbia — A range of evidence indicates that the arrangement of objects in space has important influences on our decisions about which goals to pursue, and about how to go about achieving those goals. As a result of these influences, human behaviour can be understood as emerging from the interplay between an individual's deliberate intentions, and the opportunities present in the environment. We present results from a novel continuous performance sequential object access task combining large-scale search and open-ended decision-making, to investigate how goal pursuit is influenced by the arrangement of objects in space. Our results indicate a balance between optimal choices and familiar choices, indicating that incidental features of environmental layouts and early experiences may have lasting influences on task efficiency.

C131

AUTOMATICITY IN SOCIAL SIMON EFFECT: WORKING MEMORY LOAD IMPAIRS ACTION CO-REPRESENTATION Hyojeong Kim[1], Jae-Yoon Lee[1], Do-Joon Yi[1]; [1]Yonsei University — As a social being, we need to undertand others' actions as quickly and accurately as possible. Action undertanding can occur at many levels. We sometimes grasp others' intention unintentionally. Other times, however, we have to effortfully draw inferences about their goals. In the context of joint action, the social Simon effect (SSE) demonstrates that we are influenced by unintended representation of co-actor's actions (Sebanz, Knoblich, & Prinz, 2003). This effect has been described to be quasi-automatic, but it is not known in what aspect it is automatic and in what other aspect it is not. Thus, we asked participants to do a social Simon task with or without a concurrent working memory (WM) task. One group of participants maintained a single digit in their mind during WM load blocks (low load group) while the other group maintained five digits (high load group). As results, the low load group showed SSE both during no load and low load blocks. In contrast, the high load group did not show any SSE during either no load or high load blocks. However, the high load group showed intact SSE in the first no load block if the block was administered before the first high load block. These results suggest that SSE is not an automatic phonomenon given that it requires cognitive resource. SSE may be automatic only in the sense that it happens without intention.

C132

SELECTIVE INCREASE IN SALIENCE NETWORK CONNECTIVITY FOLLOWING ANTERIOR TEMPORAL LOBE RESECTION Matthew J Sutterer[1], Michelle W Voss[1], Joel Bruss[1], Daniel Tranel[1], Matthew A Howard[1]; [1]University of Iowa — Little work has been done investigating the role of focal lesions on intrinsic functional connectivity networks, and even less research has addressed how these networks change following a lesion-inducing injury over the course of recovery and reorganization. Using a within-subjects approach, we characterized functional network characteristics before and shortly after the onset of a focal lesion to the medial temporal lobe. Resting-state fMRI data were collected in patients undergoing surgery for medically intractable epilepsy at two time points: one month prior and two weeks following resection of the anterior temporal lobe. Seed-based functional connectivity analyses were employed to assess preoperative to postoperative changes in the salience, fronto-executive, and default mode networks. We hypothesized that focal resection of the anterior temporal lobe would selectively affect the salience and default mode networks, as these networks include resected areas in the amygdala, temporal pole, and hippocampus. The fronto-executive network does not involve medial temporal lobe areas, and was predicted to be unaffected by focal damage. We observed significant increases in the average connectivity of nodes in the salience network from preoperative baseline to acute postoperative assessments, while the default mode and fronto-executive networks showed no significant changes. Our results suggest early increased recruitment of non-resected salience network regions following focal damage to the medial temporal lobe, possibly reflecting spontaneous recovery and reorganization processes. Future directions include additional measurements of functional networks 6 months following surgery.

C133

TEMPORAL INTEGRATION OF SELF AND OTHER DURING JOINT ACTION: A DUAL-EEG STUDY OF PIANO DUOS. Giacomo Novembre[1,2], Daniela Sammler[1], Peter Keller[2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]The MARCS Institute, University of Western Sydney, Australia — The capacity to coordinate our actions with those of another is a crucial component of social cognition, but only a few studies have explored the brain signatures associated with the integration of actions produced by interactive individuals. The present dual-EEG study used a joint musical task to examine the neural markers associated with the integration of self-generated and other-related actions (in one individual's brain) in real time. Pairs of pianists were required to play complementary musical phrases under conditions eliciting variable levels of inter-personal coordination accuracy. We compared keystroke timing accuracy and EEG signatures across conditions for which the pianists had or had not previously trained each others' musical parts, to assess the stronger or weaker integration of self and other-related musical actions, respectively. Consistently with previous research, preliminary results suggested that alpha power (8-12 Hz) over centro-parietal electrodes was particularly suppressed during trials associated with higher inter-personal coordination accuracy. This suppression was more enhanced when the players had practiced each other's parts. Thus, these results support the hypothesis that alpha oscillations constitute a marker for the integration of actions related to others with those that are internally generated.

C134

ABSTRACT CATEGORIES OF FUNCTIONS IN ANTERIOR PARIETAL LOBE Anna Leshinskaya[1], Alfonso Caramazza[1,2]; [1]Harvard University, [2]University of Trento, Italy — Humans flexibly use thousands of objects to achieve goals. The connections between goals and objects must be sufficiently abstract to allow the selection of relevant objects even when their affordances are not obvious from their physical shapes - for instance, to know that both a painting and a vase can decorate a room. To identify such

abstract function representations, an fMRI experiment was conducted. Participants viewed a variety of objects and evaluated their utility to each of four goals (dress up for a night out, decorate a house, protect your body from the cold, or keep objects dry in a flooded basement). The first two share a common, broader goal of decoration, while the latter two are both broadly protection goals. This grouping is specific to goal similarity, and orthogonal to the physical way in which the goals are accomplished. To identify representations of "decorate" and "protect" categories, an multivoxel pattern searchlight analysis was performed across the cortex, and identified regions in which neural patterns were more similar for the pairs of similar-goal than dissimilar-goal conditions. Function category representations were found anterior inferior parietal lobe, a region previously implicated in representing concrete action goals. This finding extends our understanding of the nature of the representations in this region, by illustrating its capacity to represent highly abstract categories of functions, such as would be particularly useful for flexibly selecting objects to accomplish them based on functional criteria such as their aesthetic value, rather than shape or manner of manipulation.

C135

INFLUENCE OF PERSPECTIVE AND HAND USED ON SENSORIMOTOR EEG RESPONSES DURING ACTION OBSERVATION Ashley R. Drew[1], Peter J. Marshall[1]; [1]Temple University — An increasing amount of research in social-cognitive neuroscience has examined sensorimotor EEG rhythms (e.g., mu/beta rhythms over central sites) during the observation of hand actions being performed by others. This study addresses an important gap in the literature by examining two determinants of these EEG responses: 1) the effect of the hand used to carry out the action (left/right) and 2) the participant's visual perspective on the action (egocentric/allocentric). EEG was recorded from undergraduate participants (N=28) during the observation of video clips showing an actor's hand reaching for, grasping, and lifting a cylindrical object. The hand used by the actor (left/right) and the perspective from which the action was filmed (egocentric/allocentric in relation to the participant) were varied. For the egocentric perspective, significant differences in event-related EEG desynchronization between left and right hand actions were found over right mid-frontal, right central, and bilateral mid-parietal sites. For the allocentric perspective, an effect of the hand used was apparent bilaterally at occipital sites but not at other regions. The results show that actions viewed from egocentric and allocentric perspectives are associated with different EEG response profiles. A particularly salient finding is that sensorimotor rhythms over central electrode sites were only sensitive to the hand used to carry out an observed action when that action was seen from a first-person perspective. This finding assists in clarifying the interpretation of prior and future studies involving changes in sensorimotor EEG rhythms during the observation of hand actions.

PERCEPTION & ACTION: Vision

C136

NEURAL MECHANISMS OF VISUAL PERCEPTUAL ORGANIZATION IN AUTISM SPECTRUM DISORDERS Bart Boets[1], Lien Van Eylen[1], Ilse Noens[1], Maarten Demeyer[1], Stefan Sunaert[1], Jean Steyaert[1], Johan Wagemans[1]; [1]KU Leuven, Belgium — Atypical visual processing has often been reported in autism spectrum disorders (ASD), in particular superior local and inferior global processing. Here we used Gabor patterns that dynamically evolve from random to organized to investigate texture segmentation and contour integration of nonexistent and everyday objects in 19 adolescents with ASD and 19 matched typically developing controls (all males, aged 11-18 years, full scale IQ > 75). We performed functional magnetic resonance imaging (fMRI) while participants executed an object detection task comprising texture based nonexistent figures, texture and contour based nonexistent figures, and texture and contour based everyday objects, relative to a baseline condition of randomly reorienting Gabor stimuli. The behavioral data revealed that both groups performed similarly in terms of accuracy and response time across all conditions, and that the detection of figures in the texture condition was less accurate and slower than in the other conditions. Classical subtraction-based fMRI analyses showed that the conditions with more organized Gabor patterns systematically activated hierarchically higher areas along the ventral visual stream. Adolescents with ASD showed the same pattern of brain activity as typically developing adolescents, suggesting that visual perceptual organization is intact in ASD at the behavioral as well as at the neural level. To investigate possible group differences in efficiency of communication between various brain regions implicated in visual processing, these analyses will be supplemented with a structural connectivity analysis comprising fiber tracking of the inferior longitudinal and inferior fronto-occipital fasciculi and with a functional connectivity analysis.

C137

PREDICTING VISUAL FEATURE CONJUNCTION LEARNING RATE FROM BASAL GANGLIA ACTIVITY Eric A. Reavis[1], Sebastian M. Frank[1], Peter U. Tse[1]; [1]Dartmouth College — The ability to learn to process visual feature conjunctions quickly and efficiently is important for many visual activities, such as reading and driving. Adults can learn to quickly and accurately detect arbitrary visual feature conjunctions, such as color and shape, in a visual search task with trialwise response accuracy feedback, but the rate of conjunction learning varies widely between individuals. We hypothesized that response accuracy feedback might elicit an endogenous reward response involving the dopaminergic system, and that individual differences in the magnitude of this endogenous reward response might predict visual feature conjunction learning rate. To test these hypotheses, we used functional MRI to measure activity evoked by accuracy feedback ("correct" vs. "incorrect") while participants solved difficult multiple-choice arithmetic problems. Activity in the basal ganglia, a known target of dopaminergic neurons, was higher for correct feedback than incorrect feedback. We trained the same participants on a visual search task for an arbitrary conjunction of visual features outside the scanner, with trialwise response accuracy feedback. As expected, rate of learning for feature conjunctions varied substantially between participants. Consistent with our hypothesis, conjunction learning rate was predicted by the difference in basal ganglia activity evoked by correct vs. incorrect feedback delivery on the unrelated math task: the greater the difference in basal ganglia activity evoked by correct vs. incorrect feedback, particularly in the caudate nucleus, the faster the participant learned efficient processing of visual feature conjunctions. This suggests that reward-related dopaminergic signals may play a role in facilitating visual feature conjunction learning.

C138

IMPAIRED OCULOMOTOR BEHAVIOR PREVENTS READING AND SCENE PERCEPTION IN NEGLECT PATIENTS Silvia Primativo[1,2], Lisa Saskia Arduino[3,4], Maria De Luca[2], Roberta Daini[5], Marialuisa Martelli[1,2]; [1]Sapienza University of Rome, Rome, Italy, [2]IRCCS Fondazione Santa Lucia, Rome, Italy, [3]LUMSA University, Rome, Italy, [4]ISTC-CNR, Rome, Italy, [5]University of Milano-Bicocca, Milan, Italy — Unilateral spatial neglect (USN) is a composite and multifaceted neuropsychological disorder. Around 40% of patients show also a reading impairment (i.e., Neglect Dyslexia, ND). Recent findings of this research group demonstrated that ND is the consequence of the concomitant presence of USN and a non-lateralized eye movement deficit. Here we aim at clarifying the features of the altered eye movements both describing in detail the impaired eye movements behaviour and investigating how it affects also non-reading tasks, such as scene exploration. Using the controls eye movements performance in the verbal scene description task as a reference, patients were divided on the basis of their fixation location correlations with that of controls. The oculo-motor behaviour has been also examined by means of several saccadic tasks. The reading behaviour has been evaluated using words presented with and without text context. Patients identified by an impaired eye movement behaviour in scene exploration and in the saccadic tasks, produced left lateralized errors in reading single words and words presented within a text passage. The abnormal oculomotor behaviour during reading confirms the groups distinction based on image exploration. We conclude that roughly 40% of USN patients show an eye movement deficit, which prevents both reading and scene perception. This large percentage of impaired patients indicates that the oculomotor behaviour requires particular attention during the diagnostic phase in order to program the best rehabilitation strategy.

C139

VISUAL DETECTION IMPROVEMENTS WITH FRONTAL BETA PATTERNS OF RHYTHMIC NON-INVASIVE NEUROSTIMULATION DEMONSTRATED BY SHIFTS OF THE PSYCHOMETRIC FUNCTION

Romain Quentin[1], Marine Vernet[1], Seth Elkin-Frankston[3], Lorena Chanes[1], Monica Toba[1], Antoni Valero-Cabre[1,2]; [1]CRICM INSERM U975/Université Paris 6, [2]CNRS 7225 Paris, [3]Boston University — Rhythmic Transcranial Magnetic Stimulation (TMS) has demonstrated an ability to enhance brain oscillatory activity at the input frequency. Using this approach, we recently reported that uniform 30 Hz TMS patterns delivered pre-target on the right Frontal Eye Field (FEF) were able to improve the visual detection of near-threshold targets. Here, by recording the effects of these same TMS patterns on a complete psychometric function, we tested if this facilitatory visual impact was restricted to such stimulus contrast or could also be extended to other contrast levels. 14 participants performed a two alternative forced-choice visual task in which they were requested to report the right of left location of a lateralized Gabor. During the trials, participants received on the right FEF and 16 ms prior to target onset, either real/sham 30 Hz bursts or duration-matched non-uniform TMS bursts encompassing the same number of pulses. Participant detection performance for each TMS condition was fitted to a Gumbel function to reconstruct the psychometric curve. In agreement with prior observations, only frequency specific 30 Hz frontal patterns but not non-uniform bursts increased detection rates. Such effect occurred for the upper (i.e.,above 75% performance) but not the lower half of the psychometric curve. Our results support a causal role for frontal high-beta oscillatory activity in the modulation of contrast sensitivity and prove that such facilitatory mechanism is not solely restricted to near threshold targets but can be extended to a wider range of suprathreshold stimulus contrasts.

C140

THE IMPACT OF HIGH-BETA FRONTAL PRE-TARGET OSCILLATIONS ON VISUAL DETECTION SENSITIVITY IS PHASE INDEPENDENT

Lorena Chanes[1], Marine Vernet[1], Romain Quentin[1], Antoni Valero-Cabre[1,2,3]; [1]Université Pierre et Marie Curie, CNRS UMR 7225-INSERM UMRS S975, Centre de Recherche de l'Institut du Cerveau et la Moelle (ICM), 75013 Paris, France, [2]Laboratory for Cerebral Dynamics Plasticity & Rehabilitation, Boston University School of Medicine, Boston, MA 02118, USA, [3]Cognitive Neuroscience and Information Technology Research Program, Open University of Catalonia (UOC), 08035 Barcelona, Spain — Right frontal high-beta episodic activity induced through 4-pulse Transcranial Magnetic Stimulation (TMS) bursts delivered 17 ms prior to target onset has been shown to increase conscious visual detection of near-threshold targets. Interestingly, the phase of pre-target occipital oscillations has been causally linked to shifts in local excitability and found able in EEG studies to predict visual detection accuracy. However, its influence over visual performance behavior in frontal cortical locations remains to be causally explored. We addressed this issue in a population of 14 healthy participants by varying in steps of a quarter of phase during one and a half cycles the time interval (i.e., 17, 25, 33, 42 or 50 ms) between the last pulse of high-beta 4-pulse rhythmic TMS bursts and the onset of lateralized low-contrast (50 % consciously seen) Gabor stimuli. Participants performed a forced-choice visual discrimination followed by conscious visual detection task under the influence of either sham or real TMS delivered pre target onset. We report for the first time phase-dependent improvements of visual discrimination performance associated to high-beta frontal activity. More importantly, our results suggest that previously reported enhancements of conscious visual detection sensitivity (d) by high-beta frontal activity are phase-independent. Interestingly however, oscillation phase modulated detection response criterion (beta). As prior reports demonstrated a role for frontal gamma activity in criterion shifts, we hypothesize that this outcome could reflect cross-frequency phase-to-power interactions between beta and gamma frontal oscillators.

C141

HEY, HEY, WE'RE THE MONKEYS? IS ABILITY AND N170 RESPONSE TO HUMAN- AND MONKEY-LIKE FACES GRADED?

Nicole A. Sugden[1], Lan (Mary) Wei[1], Raj Sandhu[1], Ben Dyson[1], Margaret C. Moulson[1]; [1]Ryerson University, Toronto, Ontario, Canada — Nearly all adults are own-race face experts, in that own-race faces are better remembered, discriminated, and identified, as compared to other-race faces (Meissner & Brigham, 2001). This other-race effect (ORE) is also evident in greater amplitude and longer latency of the N170 to other-race faces (e.g., Bentin et al., 1996) . Faces may be perceived as more or less "other" based on physiognomic differences (e.g., colour; Balas et al., 2011), familiarity (Hancock & Rhodes, 2008), or social expectations (Shriver et al., 2008). To determine whether there is a gradation in the behavioral and neurological response to "other" face types, we used transformed faces that graded from human to monkey. Eighty participants completed a task rating faces for attractiveness, performing a surprise memory task, and rating the monkey- or human-ness of the face. The more human-like the face was rated to be, the better the recognition of the face ($r(80)=.448$, $p<.001$). Currently, we are testing participants on the same paradigm while recording ERPs to look for potential gradation in the N170. We expect that more human-like faces, in addition to being better remembered, will elicit smaller, faster N170 responses. This would suggest that there are gradations in what is considered "own-face", which are apparent early in perceptual processing. These findings may help tease apart what influences basic perceptual processing of faces.

THINKING: Decision making

C143

COGNITIVE CONTRIBUTORS TO IMPAIRED DECISION-MAKING IN MILD COGNITIVE IMPAIRMENT

Alison Perez[1], Erin Venza[1], Audette Rackley[1], Justin Eroh[1], Raksha Mudar[2], Winston Chiong[3], Sandra Chapman[1]; [1]The Center for BrainHealth at the University of Texas at Dallas, [2]University of Illinois at Urbana-Champaign, [3]University of California San Francisco — Declines in decision-making ability in older adults may be the first sign of cognitive decline related to disease. Mild Cognitive Impairment (MCI) is an initial indicator of future dementia; therefore understanding decision-making ability in adults with MCI will help to elucidate initial cognitive processes that initially diminish with disease. The purpose of this study is to examine cognitive factors related to decision-making behavior in both healthy adults and adults with MCI. In a sample of 15 older adults with MCI and 15 age and gender matched controls (60-85 years old), we examined the consistency of their decision-making through a financial behavioral task in which participants chose between risky gambles and sure choices. This paradigm measures consistency of decision-making behavior as well as susceptibility to contextual bias. Adults with MCI were significantly less logically consistent in their decision-making behavior than healthy controls, ($p=0.002$). Adults with MCI were more risk-seeking overall when faced with a loss, than healthy controls, ($p <.001$). In adults with MCI, MMSE scores were significantly correlated with decision-making behavior ($p=.034$). In both normal controls and adults with MCI, an executive function of strategic control was also significantly correlated with decision-making behavior ($p=.044$) Novel findings indicate decline in decision-making is evident, even in early stages of disease. Individuals with MCI are more likely to be susceptible to contextual bias, possibly leading to detrimental outcomes. Also, cognitive control processes were significantly related to decision-making behavior suggesting that cognitive control should be further investigated for its contribution to decision-making.

C144

CHIPS OR CHOCOLATE? PERSONAL PREFERENCE REVEALED IN REACHING

Grace Truong[1], Craig S. Chapman[2], Tina S.-T. Huang[1], James T. Enns[1]; [1]University of British Columbia, [2]University of Alberta — Potential action targets in the environment generate competition between actions plans (Cisek, 2007). This competition results in reach movements that are "spatially averaged" between potential targets, leading to less direct/more curved reach trajectories (Chapman et al., 2010), indicating that trajectories can reflect target processing in real-time (Freeman, Dale, & Farmer, 2010). We questioned whether reaching kinematics would be sensitive to target competition determined by subjective preference. If so, it would imply that hedonic preferences are accessible as observable cognition, without requiring explicit participant reports. Participants (n=32) were presented with four snack options, presented in pairs as pictures on a touch-interactive table. On each trial, participants reached to select the item they preferred more. As incentives, two trials were randomly chosen at the end and participants received the snack they chose on those trials. Subsequently, partici-

pants rated all snack options on a 9-point liking scale. We predicted "easy" decisions (choices between options with a larger preference difference) would produce faster and more direct movements than "hard" decisions (choices between options with a small preference difference). We found that reaction time, the directness of the reach, and an interaction between these measures were significant predictors of preference. Interestingly, reach-directness was predictive of preference when reaction times were fast, but not when slow. This shows that reach trajectories do carry subjective target competition signals, but that they become increasingly less informative as reach initiation is slowed down. This places an important constraint on using action kinematics as an index of observable cognition.

C145

DECISIONS ABOUT DECISIONS - HOW SIGNAL RELIABILITY AFFECTS METACOGNITIVE JUDGEMENTS Annika Boldt[1], Vincent de Gardelle[2,3], Christopher Summerfield[1], Nick Yeung[1]; [1]University of Oxford, [2]Laboratoire de Psychologie de la Perception, CNRS, [3]Université Paris Descartes — Human observers effortlessly and accurately judge the subjective probability of being correct in their decisions, leading to the view that metacognition is an integral part of decision-making. It remains a challenge for most models of confidence, however, to explain in what way precisely confidence is calibrated with objective performance, under which circumstances this calibration is reduced, and the influence other cues have on these metacognitive judgements. The present study aims at manipulating such a cue, namely the reliability of evidence supporting the initial decision. Participants had to judge the average colour of an array of eight coloured shapes, of which we critically manipulated the variability of information (De Gardelle & Summerfield, 2011). Our behavioural and EEG results suggest that in addition to objective accuracy on a given trial, other variables such as response time and reliability of evidence play a role in the generation of metacognitive judgements. Specifically, the results suggest that this effect is due to more selective information sampling in the case of more variable stimulus arrays, resulting in under-confidence.

C146

EEG THETA-BAND PHASE-COUPLING FOR THE COUNTRY-OF-ORIGIN EFFECT Byoung-Kyong Min[1], Erin Cho[2], Kwangsu Cho[3], Jungyeon Sung[3], Junhyuk Choi[1]; [1]Korea University, [2]Parsons The New School for Design, [3]Sungkyunkwan University — This study investigates EEG theta-band phase-couplings associated with the country-of-origin (COO) effect in the context of a mobile phone design. COO refers to the country where a particular product is made, which often serves as a signal for product quality. EEG data were collected from 15 healthy individuals while they performed a choice-reaction task in the context of mobile phone design. We observed distributed anterior-posterior theta-band phase-coupling, indicating crosstalk between anterior and posterior regions when forming a design preference based on COO information. The long-range theta-band phase-coupling networks were detected across the anterior and posterior regions for the favorable COO, which showed concentrated phase-couplings, particularly within the anterior region. In contrast, for the unfavorable COO, although anterior-posterior phase-couplings were still detected, theta-band phase-couplings were particularly concentrated in the posterior region. We attributed our findings to item-context binding and a conflict in decision-making involving central executive working memory. Our study provides neurophysiological evidence for the most critical conceptual foundation of COO studies in the social sciences. That is, the processing of COO cues involves substantial cognitive activity, which has a significant effect on a consumer's preference decision for a product.

C147

A TEST OF THE WARRIOR/WORRIER HYPOTHESIS FOR THE COMT VAL158MET POLYMORPHISM Kaileigh Byrne[1], Darrell A. Worthy[1], Valerie S. Knopik[3,4], John E. McGeary[3,4], Christopher G. Beevers[2], W. Todd Maddox[2]; [1]Texas A&M University, [2]University of Texas at Austin, [3]Rhode Island Hospital, [4]Brown University — The catechol O-methyltransferase (COMT) gene catalyzes the methylation and inactivation of catecholamine neurotransmitters and consequently regulates dopamine signaling and degradation in the prefrontal cortex. Our study (N=328) investigates the role of the COMT Val158Met single nucleotide polymorphism on a two-choice reflective decision-making task with and without a social pressure manipulation. In this task, the reward associated with the sub-optimal option decreases over time but offers more immediate reward on each trial, while the reward associated with the optimal option increases over time but offers less immediate reward on each trial. Prior research has shown that methionine (Met) carriers excel on memory and attention tasks compared to valine (Val) homozygotes. However, COMTVal158 has been associated with an advantage in response to challenging or stressful situations where rapid disengagement of cortical circuits is optimal. The warrior/worrier hypothesis (Goldstein, et al., 2005) posits that COMT may moderate response to challenging situations in which Met carriers (worriers) demonstrate enhanced executive functioning ability in no-pressure situations, while Val homozygotes (warriors) may perform better under pressure due to increased extracellular dopamine released in stressful circumstances. Our results demonstrate that in the absence of pressure, Met carriers outperform Val homozygotes in selecting the optimal decision strategy. However, under pressure, Met carriers' performance declines by over 25%. In contrast, Val homozygotes show a less pronounced decline in performance of 10% and outperform Met carriers on the task. These results show support for the warrior/worrier hypothesis.

C148

DIFFERENTIAL NEURAL RESPONSES TO REWARD FEEDBACK FOR SELF VERSUS OTHERS PREDICTS LEARNING-GUIDED PRO-SOCIAL BEHAVIOR René San Martín[1,2,3], Youngbin Kwak[1], John Pearson[1], Marty G. Woldorff[1,2], Scott A. Huettel[1,2]; [1]Center for Cognitive Neuroscience, Duke University, [2]Department of Psychology and Neuroscience, Duke University, [3]Centro de Neuroeconomía, Universidad Diego Portales, Santiago, Chile — Many real-world decisions are made in social contexts in which choices depend not only on personal goals, but also on potential benefits for others. Economists have formalized these pro-social behaviors in models in which outcomes for others are integrated into the decision-making process after being transformed into subjective payoffs for oneself. We used event-related potentials (ERPs) in a social gambling task to investigate the neural mechanisms underlying the differential processing of outcomes for others versus for oneself. Participants had to choose between four visual cues which they learned by trial-and-error were associated with different expected values for self and for a charity institution. We found that the frontocentral feedback-related negativity component (FRN, latency 225 ms) was larger for losses than for gains, as expected, and that this difference was significantly greater in response to self-relevant outcomes than for charity-relevant outcomes. Individual differences in this differential FRN effect, however, did not predict differences in self-versus-charity earnings. In contrast, outcomes for oneself elicited larger P3 responses (latency 300-600 ms) than did outcomes for charity, regardless of the valence (win vs. loss). Moreover, individual differences in pro-social behavior were predicted by this differential P3 activity: the greater the self-versus-charity P3 difference, the greater the difference in cumulative earnings for self versus charity These findings confirm and extend previous research showing that the P3 reflects goal-oriented behavioral adjustment. Moreover, they indicate that individual differences in pro-social behavior are linked to individual differences in the processes underlying P3 neural responses to self-relevant vs. others-relevant outcomes.

THINKING: Development & aging

C149

THE DEVELOPMENT OF HEMISPHERIC LATERALIZATION FOR NUMERICAL PROCESSING Yuan Deng[1], Jessica Cantlon[2]; [1]Institute of Psychology, Chinese Academy of Sciences, [2]University of Rochester — Evidence from brain imaging studies on both children and adults have shown that prefrontal cortex and parietal cortex are recruited in cognitive tasks involving symbolic and non-symbolic numerical forms. Numerical processing networks are often bilaterally activated although a right lateralization bias has been reported in parietal cortex for young children, and left parietal cortex activation is found to be more pronounced in adults. Little is known about how this lateralization pattern changes over the course of development. The present study focuses on understanding the developmental changes of cortical lateralization in the numerical processing network in children. We tested 26 children from 4 to 11 years old on a match-

ing task during fMRI to localize number-specific activated areas in bilateral prefrontal cortex and parietal cortex. Then, activations within these regions from a free-viewing video task were used to measure the lateralization indexes. Our results showed that both parietal and frontal region showed a shift from a bilateral activation pattern in younger children to a left-lateralized pattern in older children. Greater left-lateralized activation in posterior parietal cortex was associated with higher scores on math achievement tests. Moreover, we found that the relation between leftward lateralization of parietal cortex and math achievement was driven by the functional connectivity between frontal and parietal region in the left hemisphere. These finding suggest that the development of the fronto-parietal network plays a critical role in leftward lateralization of parietal cortex - which predicts early math achievement in children.

C150

CHANGES IN FEEDBACK PROCESSING FROM ADOLESCENCE TO YOUNG ADULTHOOD: AN FRN FOLLOW-UP STUDY Tina Zottoli[1], Elvira Kirilko[2], Jill Grose-Fifer[2,3]; [1]St. Joseph's College, New York, [2]John Jay College of Criminal Justice, [3]City University of New York, Graduate Center — Adolescent risk-taking may be partly attributable to immature incentive processing. In cohort studies, we and others have shown that the amplitude of the feedback-related negativity (FRN), an ERP component elicited by feedback, decreases with age. For this study, we recorded the FRN in a sample of adult males (18-20 years) who had participated in an earlier study when they were adolescents (14-16 years). The same simple gambling task was used to elicit the FRN in both studies. Between Time 1 (T1) and Time 2 (T2), FRN amplitudes decreased, as did the latency of the FRN after high-loss feedback. In general, these reductions were more pronounced for participants who were younger than 16 at T1 and for participants for whom T1 and T2 were more than four years apart. Larger FRN amplitudes at T1 and T2 were associated with higher trait anxiety scores measured at T2, and the relative difference in FRN amplitude for wins and losses at T1 and T2 was positively associated with sensation seeking at T2. Our data suggest that the FRN may have utility as a putative marker for personality traits associated with risk taking; and the relatively late maturation of incentive processing for high-loss feedback might partly explain reports of diminished risk aversion in adolescent boys.

C151

MULTIPLE LEARNING SYSTEMS IN ADOLESCENCE Juliet Y. Davidow[1], Karin Foerde[2], Adriana Galván[3], Daphna Shohamy[1]; [1]Columbia University, [2]New York University, [3]University of California - Los Angeles — In the adult brain, learning is accomplished by multiple systems, particularly the hippocampus and the striatum. These systems are engaged in different contexts, build different kinds of representations, and interact to support learning-guided behavior. However, far less is known about the cognitive and brain mechanisms underlying learning during the critical developmental stage of adolescence. Here we used behavioral studies combined with functional magnetic resonance imaging (fMRI) in healthy adolescents to begin to address this gap. We leveraged recent research showing that delaying feedback during reinforcement learning shifts learning from the striatum to the hippocampus and thus investigated how feedback timing modulates learning in adolescents. Participants (adolescents aged 13-17 and adults aged 25-30) were scanned with fMRI while engaged in a probabilistic feedback-learning paradigm with outcomes presented immediately, or after 7 seconds. We found that adolescents outperformed adults in the delayed feedback condition and had better episodic memory for feedback events. We also found distinct relationships between memory-sensitivity (d-prime) and age. We fit a reinforcement-learning model to examine trial-by-trial learning related responses. Though there were not differences in optimal choice performance between age groups, adolescents had a lower learning rate than adults for immediate feedback, suggesting more incremental learning in this condition. Further, we found that adolescents displayed enhanced prediction error signals in the ventral striatum and in the hippocampus during learning. Together, our results suggest alterations in the balance between the striatum and the hippocampus during adolescence, providing insight into the development of the balance between different forms of learning.

Poster Session D

ATTENTION: Auditory

D1

PERCEPTUAL LOAD MODULATES NEURAL CORRELATES OF AUDITORY ATTENTION IN AUTISM SPECTRUM DISORDERS. Debra Karhson[1], Edward Golob[1,2]; [1]Tulane Univeristy, Neuroscience Program, [2]Center for Aging — Atypical sensory reactivity to visual and/or auditory stimuli is prevalent among individuals with autism spectrum disorders (ASD). Data from cognitive neuroscience research suggests that changes in attention can alter sensory processing at several levels of analysis, and thus could be contributing to changes in sensory reactivity. Furthermore, attentional pathways are modulated by the individual difference variable of working memory capacity (WMC). This study examined the relationship between sensory reactivity, individual difference, and auditory attention in ASD by using electroencephalography (EEG) technique. Participants (n=32, 16 with ASD and 16 age- and IQ-matched controls) completed a sensory profile, complex operation span task, and performed a modified 3-stimulus (target, non-target, and distractor) oddball task under varying perceptual load (high or low). Event-related potential (ERP) analysis assessed measures of cognitive control (N200, ~200ms latency), attentional processing (P3a and P3b, ~300ms latency) and sustained attention (slow wave, ~400-600ms latency). Behavioral data demonstrates a significant positive correlation between sensory sensitivities and WMC in participants with ASD. Under high perceptual loads, target stimuli elicited large N200 amplitude followed by smaller P3b amplitudes in ASD compared to typically developing controls ($p<0.05$), suggesting an uneven distribution of attentional resources early in processing. Late negative slow wave potentials of white noise distractors were significantly modulated by varying auditory perceptual load ($p<0.005$) and may indicate difficulty in individuals with ASD to integrate bottom-up stimuli processing with top-down goals. Data suggests atypical distribution of limited attentional resources in auditory processing in individuals with ASD, particularly in high perceptual load environments.

D2

THE SIGNIFICANCE OF THE BASAL GANGLIA FOR SUBJECTIVE RHYTHMIZATION - EVIDENCE FROM ALPHA OSCILLATIONS Christian Obermeier[1], Sonja A Kotz[1,2]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]University of Manchester, School of Psychological Sciences, UK — When we listen to identical tones in isochrony (i.e. an equitone sequence), we perceive some tones as more salient than others. This phenomenon is termed subjective rhythmization (e.g. Brochard et al., 2003). It is assumed that this effect is due to internal dynamic fluctuations of attention, which are related to changes in oscillatory brain activity, i.e. a relative increase in the alpha band (8-12 Hz) for strong versus weak beats. It has been proposed, that such adaptive temporal processing recruits a wide-spread cortico-subcortical network including premotor areas, the thalamus, the basal ganglia and the cerebellum (Schwartze & Kotz, 2013). The basal ganglia, for instance, play an important role in sequencing, beat and rhythm perception, but also in attention regulation - all potentially relevant processes in subjective rhythmization. Using EEG, we explored whether the basal ganglia crucially modulate this effect. For this purpose, we presented healthy participants and patients with lesions in the basal ganglia with equitone sequences containing one or two intensity-attenuated deviants at strong and weak positions. Whereas healthy adults showed subjective rhythmization as indicated by a relative alpha enhancement for perceptually strong as compared to weak tones, no such effect was found in the basal ganglia patients. Preliminary topographic and source analyses suggest the involvement of classical sensorimotor regions as well as areas involved in temporal-processing (bilateral SMA, left IPL). The present findings provide new evidence for the crucial modulatory role of the basal ganglia for subjective rhythmization and in favor of a wide-spread cortico-subcortical network involved in temporal processing.

D3

CREATIVITY AND P50 ERP SENSORY GATING: SELECTIVE VERSUS LEAKY ATTENTION IN DIVERGENT THINKERS AND CREATIVE ACHIEVERS. Darya Zabelina[1], Mark Beeman[1]; [1]Northwestern University — The present study investigates neural markers of sensory gating in creative people. We examine a very early neurophysiological response - an event-related potential (ERP) that occurs 50 ms after stimulus onset. The P50 ERP in response to the second of two auditory clicks is a well-established marker of sensory gating. Reduced sensory gating, or leaky sensory filter, indicated by the failure to suppress response to the second auditory click, is viewed as a marker of vulnerability to some psychopathology, particularly to schizophrenia spectrum disorders (SSD; Oilincy et al., 2010). We hypothesized that individual differences in sensory gating should be associated with individual differences in creativity. Creativity was assessed in two different ways: 1. Divergent thinking (ATTA; Goff & Torrance, 2002) - a standard laboratory test of creative cognition; 2. and an assessment of people's real-world creative achievements (CAQ; Carson et al., 2002). We found that the two measures were differentially associated with sensory gating. Divergent thinkers had more selective sensory filters, suggesting that performance on this measure, although thought to assess creative cognition, may in fact draw on cognitive processes such as selective focus and inhibition, rather than on broad or leaky attention. Real-world creative achievers, on the other hand, showed reduced sensory gating, suggesting that people with real-world creative achievements may indeed have "leaky" sensory filters. We conclude that different types of creativity may each emphasize different types or degrees of attention. Specifically, divergent thinkers appear to have selective, while creative achievers may have leaky sensory filters.

D4

LOW-FREQUENCY PHASE TRACKING AT A CROWDED COCKTAIL PARTY Dillon A. Hambrook[1], Matthew S. Tata[1]; [1]University of Lethbridge — In noisy environments your brain can select one auditory stream from a mixture of competing sounds - the cocktail party effect. Selective attention to a single stream gives that stream access to cognitive mechanisms of different brain areas. One theory suggests that endogenous neural oscillations facilitate communication between these different subsystems, but neural oscillations are also influenced by exogenous stimuli. Low frequency (3-8 Hz) electroencephalogram (EEG) activity tracks changes in the acoustic energy present in rhythmic stimuli such as speech. Tracking is enhanced for attended speech. It has been hypothesized that by selectively entraining neuroelectric dynamics to the acoustic dynamics of a single stream, the selected speech gains privileged access to a synchronized network that performs tasks that includes memory encoding and response planning. Competing inputs are excluded from this network. While evidence from experiments with two speakers suggests that selective entrainment may be a mechanism which solves the cocktail party problem, it remains unclear how such a mechanism would function in a more crowded scene. Using a multi-speaker virtual reality audio system we created a simulated "cocktail party" with up to seven simultaneous speakers while listeners performed a selective listening task. We recorded neuroelectric dynamics with dense-array EEG. By cross-correlating EEG activity with signals derived from the acoustic dynamics of individual target and distractor streams we identify phase-locked activity unique to each stream. We show reduced phase-locked activity evoked by the target stream as distractors are added to the scene. Furthermore, phase-locked power differentiates correctly and incorrectly identified targets.

D5

DIFFERENCES IN NEURAL MECHANISMS FOR SELECTIVE ATTENTION ARE IMPACTED BY BILINGUAL EXPERIENCE AND SOCIOECONOMIC STATUS Jimena Santillan[1], Byron DeVos[1], Pawel Buczkowski[1], Helen Neville[1]; [1]University of Oregon — It has been proposed that when bilinguals want to produce one of the two languages they speak, the non-target language has to be inhibited in order to produce the target language. This

is the basis for the bilingual advantage hypothesis, the idea that bilinguals enjoy an advantage in inhibitory control. To date, multiple studies testing this hypothesis have yielded inconsistent evidence. Socioeconomic status (SES) has been proposed as a potential confound that may account for some of these inconsistencies. The present study took advantage of the high temporal resolution of the event-related potential (ERP) technique to examine whether there are differences between English monolinguals and Spanish-English bilinguals in very early stages of inhibitory control processing when controlling for SES. Participants completed an auditory selective attention ERP paradigm in which they were simultaneously presented with two different narrative stories and were asked to attend to only one story while ignoring the other. Brain responses elicited by identical sound probes embedded in both narratives were compared when they appeared in the attended story to when they appeared in the unattended story. Preliminary results show that, when matched for SES, bilinguals exhibit a larger P1 attentional modulation than monolinguals, suggesting that they are more efficient at enhancing the signal of the attended story and inhibiting the signal of the distracting story. This early attention effect was also larger in higher SES bilinguals compared to lower SES bilinguals, consistent with previous evidence indicating that SES has an effect on selective attention.

D6

PSYCHOPATHY IS ASSOCIATED WITH ABNORMAL HEMODYNAMIC AND ELECTROCORTICAL CONTEXTUAL BASELINE FEATURES IN AUDITORY TARGET DETECTION TASKS.

Nathaniel E. Anderson[1], Vaughn R. Steele[1], J. Michael Maurer[1], Kent A. Kiehl[1,2]; [1]The Mind Research Network, Albuquerque, NM, [2]University of New Mexico, Albuquerque, NM — A great deal of research has demonstrated that various forms of psychopathology are associated with abnormal brain responses during simple target detection tasks. Extant research has largely demonstrated attenuated brain responses during target detection among individuals characterized by externalizing vulnerability, including substance dependent individuals and those exhibiting antisocial traits. There has been more variability, however, among reports examining psychopathy, a disorder characterized by externalizing symptoms as well as emotional processing deficits and abnormalities in certain fundamental attentional processes. This study examined hemodynamic activity (fMRI) and event-related potentials during an auditory oddball target-detection task with incarcerated individuals and healthy controls in an attempt to parse the contributing effects of psychopathy, antisocial behavior, and substance dependence. Contrary to expectations, the most substantial differences were not observed during the target condition; but rather, psychopaths showed robust differences in brain activity during processing of the frequent, standard stimuli. Widespread negative associations between psychopathy and brain responses to standard stimuli were found in both fMRI and ERP data, during independent recording sessions. A differential in standard stimulus processing has broad implications for our understanding of the fundamental cognitive features of psychopathy. In the target detection task, brain activity during standard stimuli represent a kind of baseline contextual condition for the neural representation of more salient features of the environment - i.e. response targets. These differences in baseline neural responses may help to account for psychopaths' apparent abnormalities in basic attentional processes.

ATTENTION: Development & aging

D7

AGE-RELATED DIFFERENCES IN EARLY NOVELTY PROCESSING: USING PCA TO PARSE THE OVERLAPPING NOVELTY P2 AND N2

Kirk Daffner[1], Brittany Alperin[1], Katherine Mott[1], Eliza Ryan[1], Phillip Holcomb[2]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — Many investigators have reported an age-related increase in the anterior P2, which indexes the motivational salience of visual events as determined by novelty or task relevance. We tested the hypothesis that this finding is due to an age-associated reduction in the temporally and spatially overlapping anterior N2 component, which indexes the mismatch between novel visual stimuli and stored representations. The amplitude of the anterior N2 has been shown to decrease with age. Temporospatial principal component analysis (PCA) was used to investigate whether age-associated changes in the P2 and N2 would still be present after decomposing overlapping waveforms into their underlying components. One hundred five subjects, ages 18-85, participated in a visual novelty oddball task. A temporospatial factor representing the P2 exhibited an age-associated increase in amplitude in response to novel stimuli. A temporospatial factor representing the N2 demonstrated an age-related decrease in amplitude in response to novel stimuli. The size of the P2 factor inversely correlated with the size of the N2 factor, even after controlling for age. The results from the PCA suggest that age-related changes in the anterior P2 and N2 in response to novel stimuli are not simply the result of temporal-spatial overlap between these components, but likely represent the activity of independent cognitive operations. One hypothesis is that the age-related increase in anterior P2 activity (marking an augmentation in motivational salience) serves as a compensatory mechanism for diminished anterior N2 activity (indexing the reduced ability of older adults to process ambiguous or conflicting representations).

D8

INTRINSIC FUNCTIONAL CONNECTIVITY MEDIATES AGE-RELATED DIFFERENCES IN COGNITION

David Madden[1], Emily Parks[1], Ying-hui Chou[1], Sally Cocjin[1], David Hoagey[1], Michele Diaz[1], Guy Potter[1], Nan-kuei Chen[1], Roberto Cabeza[2]; [1]Duke University Medical Center, [2]Duke University — Aging is associated with decrements in some forms of cognitive functioning including elementary perceptual speed, memory, and executive function. These behavioral changes are often accompanied by decreases in intrinsic (resting-state) functional connectivity within relevant brain networks. The relationship between age-related differences in brain function and in behavior, however, remains unclear. In this study, the goal was to determine whether age-related differences in intrinsic functional connectivity contribute directly to cognitive deficits associated with aging. Participants were 72 healthy individuals distributed continuously between 19 and 79 years of age. Analyses of a battery of psychometric tests revealed two underlying clusters of tests representing: 1) perceptual speed; and 2) memory and executive functioning. Both clusters exhibited significant age-related decline. We obtained measures of intrinsic functional brain connectivity from an independent component analysis of functional magnetic resonance imaging data. Functional connectivity declined with age in several components, including a left frontoparietal network previously associated with attentional control. Using a bootstrapping approach, we found that age-related decline in memory/executive functioning was mediated by functional connectivity strength in this frontoparietal network. In contrast, age mediated the relationship between frontoparietal intrinsic connectivity and perceptual speed. These results support the theory that cortical disconnection underlies healthy aging. However, different models of the relations among aging, the brain, and cognition may be needed to account for different forms of cognitive performance.

D9

NEURAL MECHANISMS FOR SELECTIVE ATTENTION IN BILINGUAL PRESCHOOLERS FROM LOWER SOCIOECONOMIC STATUS BACKGROUNDS

Eric Pakulak[1], Amanda Hampton Wray[1], Jimena Santillan[1], Theodore Bell[1], Zayra N. Longoria[1], Helen Neville[1]; [1]University of Oregon — The impact of lower socioeconomic status (SES) on the cognitive skills and brain function of children and adults has been well documented (for review, see Hackman et al., 2010). Event-related potential (ERP) studies of selective attention have shown that it is a highly malleable system that is enhanced in remaining modalities following sensory deprivation, shows deficits in developmental disorders, and can be improved in both typically and non-typically developing children following training (for review, see Stevens & Neville, 2010). We have also previously shown that selective attention is vulnerable in monolingual children from lower SES backgrounds (Stevens, Lauinger, & Neville, 2009). Here we extend this work to Spanish-English bilingual children from lower SES backgrounds, employing a Spanish version of the child-friendly selective attention paradigm used in previous studies. ERPs were recorded to linguistic and nonlinguistic probe stimuli embedded in two different narrative contexts as they were either attended or unattended in a dichotic listening paradigm. In contrast to monolingual children from lower SES backgrounds, bilingual children displayed a robust early (100 ms) neural modulation to attended stimuli. Results are consistent with previous evidence suggesting that bilingualism may confer advantages in aspects of attention early in development (e.g., Carson & Meltzoff, 2008) and extend these results to neural measures of

selective attention. These findings also raise the hypothesis that aspects of Latino parenting culture, in addition to or in combination with bilingualism, may confer resilience to the deleterious effects of SES on the development of vulnerable systems early in development.

D10

SENSITIVITY OF RESTING-STATE NETWORK CONNECTIVITY TO EFFECTS OF AGING AND DOPAMINE GENOTYPE Franziska M Korb[1], Dorothea Hämmerer[1,2], Franka Thurm[1], Shu-Chen Li[1,2]; [1]Chair of Lifespan Developmental Neuroscience, Department of Psychology, TU Dresden, Germany, [2]Center for Lifespan Psychology, Max Planck Institute for Human Development, Berlin, Germany — Aging is associated with declines in different aspects of executive, memory and motivational functions. These cognitive impairments have been linked to declines in dopaminergic modulation (e.g. Bäckman et al. 2006, Li et al., 2001, TICS) as well as reduced functional connectivity in the resting-state network (RSN; e.g. Andrews-Hanna et al 2007, Neuron). In recent studies, the neurotransmitter dopamine has been identified to modulate RSN connectivity. Greater striatal dopamine signaling due either to genetic predisposition (Gordon et al., 2013, Cerebral Cortex) or pharmacological intervention (Konova et al., 2013, JAMA Psychiatry) results in a stronger coupling between RSN components which then is associated with better cognitive performance. So far, however, studies have pursued the effects of aging or neuromodulation on RSN functional connectivity separately. Here, we sought to investigate the conjoint effects of aging and dopamine predisposition on RSN connectivity. To this end, we compared RSN brain imaging data of younger adults (age 20-30; n = 42) and older adults (age 60-70, n = 41), using striatal and hippocampal seed regions. For all the participants, SNPs (single nucleotide polymorphisms) that are known to be associated with the efficacy of striatal and hippocampal dopamine transmission were also available. Preliminary results show reduced RSN connectivity in older compared to younger adults. Furthermore, RSN connectivity is sensitive to dopamine genotypes to varying degrees in younger and in older adults.

D11

DEVELOPMENT OF NEURAL MECHANISMS FOR SELECTIVE ATTENTION IN YOUNG CHILDREN FROM LOWER SOCIOECONOMIC STATUS BACKGROUNDS Amanda Hampton Wray[1], Pakulak Eric[1], Bell Theodore[1], Isbell Elif[1], Stevens Courtney[2], Neville Helen[1]; [1]University of Oregon, [2]Willamette University — Selective auditory attention is a foundational developmental skill important for academic outcomes (Stevens & Bavelier, 2012). Event-related brain potential (ERP) studies of selective attention have shown that it is a highly malleable system that is enhanced in remaining modalities following sensory deprivation, vulnerable in developmental disorders, and trainable in both typically and non-typically developing children (for review, see Stevens & Neville 2010). We have also previously shown that selective attention is vulnerable in monolingual children from lower SES backgrounds (Stevens, Lauinger, & Neville, 2009). However, to date, the development of selective auditory attention across time in lower SES children has not been investigated. Thus, it is unclear whether the vulnerability of selective attention in lower SES children represents primarily delay or deviance from typical developmental trajectories. In the current study, ERPs were recorded in children from lower SES backgrounds participating in Head Start preschools at two time points: at age four and one year later at age five. At age four, lower SES children did not display the early (100 ms) neural modulation to attended stimuli previously observed in higher SES children (Stevens et al., 2009). However, at age five, the same children displayed this early attention effect. These findings indicate that, while initially demonstrating deficits in neural modulation to attended stimuli, children participating in Head Start preschools begin to exhibit a neural response with selective attention more comparable to higher SES preschool-aged children, supporting a model of developmental delay in attention development among young children from lower SES backgrounds.

D12

THE DEVELOPMENT OF LOCAL AND GLOBAL VISUO-SPATIAL PERCEPTION IN AUTISM SPECTRUM DISORDER Jacalyn Guy[1,2], Laurent Mottron[3], Armando Bertone[1,2]; [1]Perceptual Neuroscience Laboratory for Autism and Development, [2]McGill University, [3]Université de Montreal — Individuals with Autism Spectrum Disorder (ASD) present an atypical visuo-perceptual profile (Mottron et al., 2006; Bertone et al., 2010) and often excel at tasks requiring the local analysis of detailed information. Developmental studies examining local and global visuo-spatial processing have produced mixed findings, often due to the inclusion of a broad age range and the heterogeneity of participants. It therefore remains unknown when a bias for detailed information in ASD emerges in development. We investigated the development of local and global visual processing strategies in a respective 40 and 55 individuals with and without ASD between the ages of 6-15 years using a hierarchical, compound letter task (Navon, 1977). Participants completed a selective attention version of the task, where they responded to either local or global features of the stimuli in two separate conditions. Analyses of reaction time and accuracy reveal that individuals with ASD are both significantly slower and less accurate than the typically developing participants in the global condition of the task, specifically when the large and small letters are incongruent. Moreover, a trend for a local advantage is seen with age in the ASD group, suggesting that a local processing bias may become more evident in adolescence than in mid or late childhood. These results indicate that the development of a locally-oriented visual processing style in ASD may be experience-dependent.

EMOTION & SOCIAL: Development & aging

D13

GAMBLING FOR SELF, FRIENDS, AND ANTAGONISTS: DIFFERENTIAL CONTRIBUTIONS OF AFFECTIVE AND SOCIAL BRAIN REGIONS ON ADOLESCENT REWARD PROCESSING Barbara R. Braams[1], Sabine Peters[1], Jiska S. Peper[1], Berna Gürolu[1], Anna C.K. van Duijvenvoorde[1], Eveline A. Crone; [1]Leiden University, The Netherlands — Typically, adolescence is associated with an increase in risk-taking behavior. This has been linked to a heightened adolescent reward-response. Adolescence is also associated with an increased sensitivity to social contexts. For instance, in adolescence peer relations become more important and peers may influence risk-taking behavior. Recent neuroscientific studies show that "social brain" regions, such as the medial prefrontal cortex (mPFC), and the temporal parietal junction, are particularly responsive to social information. However, it is not clear whether neural networks related to reward processing during adolescence are also sensitive to the social context. The aim of this fMRI study was to shed light on the interaction between reward sensitivity and social context across adolescence. In this study, 249 participants aged 8-26, performed a gambling task in the scanner, in which they could win or lose money. Participants played for themselves, their best friend, and a disliked peer. Winning for self resulted in a mid- to late adolescent specific peak in neural activation in the ventral striatum, whereas winning for a disliked peer resulted in a mid- to late adolescent specific peak in the mPFC. Current findings reveal that ventral striatum hypersensitivity in adolescence is dependent on social context and that the mPFC displays a similar sensitivity to age and social context as the limbic regions. These results are important for a better understanding of the neural mechanisms underlying risk-taking behavior in adolescence.

D14

OXYTOCIN AND AGING: EFFECTS ON SOCIAL DECISION-MAKING AND EMOTION PROCESSING Natalie Ebner[1], Hakan Fischer[2], Ronald Cohen[1]; [1]University of Florida, [2]Stockholm University — The oxytocin (OT) system is involved in various aspects of social cognition and prosocial behavior. Specifically, OT has been examined in the context of social memory, emotion recognition, cooperation, and bonding, and - though evidence is somewhat mixed - OT appears to benefit aspects of socioemotional functioning. However, most of the extant data on aging and OT is from animal research and human OT research has focused largely on young adults. As such, though we know that various socioemotional capacities change with age, we know little about whether age-related changes in the OT system may underlie age-related differences in socioemotional functioning. Based on our newly proposed Age-Related Genetic, Neurobiological, Sociobehavioral Model of Oxytocin (AGeNeS-OT model), two independent projects examined age-related changes in the OT system and effects of these alterations on social decision-making and emotion process-

ing, considering genetic, neural, and behavioral data in young and older adults. Study 1 provides evidence of age-differential associations of oxytocin receptor gene (OXTR) polymorphisms with brain response during reading of facial emotions in young and older adults. Study 2 explores age differences in the effect of intranasal OT on trust-related decision-making and face processing. The broader translational potential of this line of research in depression, social stress, and anxiety - all of which have high relevance in aging - will be discussed.

D15

GENDER DIFFERENCES IN EMOTION-COGNITION INTERACTIONS IN EARLY AND MIDDLE CHILDHOOD Sarah Elke[1], Aamena Kapasi[2], Diya Shi[1], Sandra A. Wiebe[1]; [1]University of Alberta, [2]Western University — In early childhood, emotion regulation and inhibitory control are more closely related in girls than in boys. This finding has been attributed to sex differences in anterior cingulate and prefrontal cortex development, important areas for cognitive and emotional regulation. The present study investigated the moderating effect of gender on the relationship between emotion regulation and inhibitory control in early and middle childhood using event related potentials (ERPs). The frontocentral N2, reflecting response conflict, and the posteriocentral P3, reflecting attentional control and working memory demands, were examined in a frustration-inducing child-adapted Flanker task. A sample of 19 4-5 year olds (10 girls) and 24 7-8 year olds (11 girls) indicated the direction a central fish was swimming on a response pad. This target fish was flanked by fish swimming in the opposite direction (incongruent), the same direction (congruent) or by starfish (neutral). Emotion regulation was manipulated across three blocks: a Baseline block where the task was presented normally; a Frustration block where some trials included a 2- to 10-second temporal lag; and a Recovery block where the task returned to normal. In the Frustration block only, girls performed the task more slowly than boys, but with equivalent accuracy. There were also sex differences in both ERP measures in the Frustration block: girls had smaller N2 peaks and larger P3 peaks. This suggests that boys and girls differ in their response to frustration, such that girls slow to deal with their frustration, decreasing their conflict sensitivity and increasing their working memory load.

D16

AN ERP STUDY OF APPETITIVE STIMULUS PROCESSING IN ADOLESCENTS Danielle diFilipo[1,2], Alison Higgins[2], Kevin Constante[2], Elvira Kirilko[2], Amy Medina[1,2], Jill Grose-Fifer[1,2]; [1]The Graduate Center - CUNY, [2]John Jay College of Criminal Justice — Neurobiological changes in reward and motivation-related circuitry increase the saliency of social and other appetitve stimuli during adolescence. In this study, we used ERP recording to determine whether there are differences in the ways adolescents and adults process appetitive images, especially those containing social information. We recorded the EEG using 64 scalp electrodes in 12-17 year-olds and 25-35 year-olds while they viewed pleasant pictures from the International Affective Picture Series. Half of the pictures featured people (social stimuli), while the other half did not (non-social stimuli). In both adolescents and adults, early components such as the N1 and P1 showed no differences in amplitude to social versus non-social stimuli. This implies that early, automatic processing does not change substantially from adolescence into adulthood, and early processing is similar for both social and non-social information. However, the late positive potential (LPP) was more positive-going for adolescents for non-social versus social stimuli. In adults, LPP amplitudes were greater for social than for non-social images. Interestingly, in a later memory test, both adults and adolescents recalled social pictures more reliably than non-social pictures. Although the LPP data imply that adolescents processed the non-social stimuli more extensively than adults, this did not result in better encoding of the non- social material. Our results imply that there may be age-related differences in social stimulus processing, and they support the idea that social information processing is still developing during adolescence.

D17

AFFECTIVE STIMULI MODULATE THE ERROR RELATED NEGATIVITY IN ADOLESCENTS Rebecca K. Reed[1], Kevin Constante[2], Elvira Kirilko[2], Jill Grose-Fifer[1,2]; [1]The Graduate Center, CUNY, [2]John Jay College of Criminal Justice, CUNY — Adolescents frequently make poor choices when making emotional decisions. There is growing neurobiological evidence that suggests that this may be because subcortical areas that mediate emotional responses develop more rapidly than prefrontal cortical control areas. In this study, we used event related potentials (ERPs) to examine response monitoring and error detection in adolescents. We hypothesized that immaturities in the anterior cingulate cortex (ACC) would result in adolescents being less able than adults to ignore distracters in an affective flanker task. We compared amplitude differences in the error-related negativity (ERN), which is thought to be generated in the ACC, in adults (25-35 years) and adolescents (13-17 years) in an emotional face flanker and a traditional letter flanker task. The results showed age-related differences in the ERN; errors elicited larger ERNs in adults than in adolescents. Also, as hypothesized, there was an age-group by stimulus interaction, such that in adolescents, errors elicited disproportionately smaller ERNs in the affective conditions compared to the non-affective condition. Similarly, adolescents made more errors than adults for affective targets, but not for letter targets. These data demonstrate that adolescents are less able to self-regulate in cognitively "hot" situations and offer further support for current neurobiological models of adolescent brain development.

D18

THE EFFECTS OF DIVIDED ATTENTION AND AGE ON EMOTION REGULATION John Morris[1], Christina Leclerc[2], Elizabeth Kensinger[1]; [1]Boston College, [2]State University of New York at Oswego — Cognitive reappraisal is an emotion regulation strategy demonstrated to rely on cognitive control processes implemented with prefrontal cortex (PFC). However, older adults, a group with impaired cognitive control, have also been shown to have success with reappraisal. It is unclear, however, how further taxing cognitive control with a secondary task affects the neural correlates of successful reappraisal in old age. The current study investigates this by asking participants to regulate their reactions to positive or negative images while undergoing fMRI. Participants viewed images from the IAPS database and were instructed to use cognitive reappraisal to increase or decrease their emotional response to the images or to view the images without regulation. For some participants, full attention was devoted to the regulation task. For other participants, an auditory discrimination task was performed concurrently with regulation. In young adult participants, greater activity was found during the regulation of negative images than during the regulation of positive images. However, in older adults, this disparity was not present. When attention was considered as a factor, older adults with full attention recruited posterior regions much more so than in divided attention, while prefrontal regions were preferentially recruited for those with divided attention. Younger adults showed PFC recruitment regardless of attention, but with more medial PFC and less lateral PFC during divided attention. These results suggest neural differences in the way young and old adults effectively regulate emotions, with valence and attention having different effects on the neural signatures of reappraisal in the two age groups.

D19

AMYGDALA-PREFRONTAL CIRCUITRY DIFFERENTIALLY PREDICTS RECOVERY AND CONVERSION TO PSYCHOSIS AMONG ADOLESCENTS AND YOUNG ADULTS AT CLINICAL HIGH RISK FOR PSYCHOSIS Dylan G Gee[1], Carrie Bearden[1], Sarah McEwen[1], Jean Addington[2], Kristin Cadenhead[3], Barbara Cornblatt[4], Thomas McGlashan[5], Diana Perkins[6], Larry Seidman[7], Elaine Walker[8], Scott Woods[5], Tyrone Cannon[5]; [1]UCLA, [2]University of Calgary, [3]UCSD, [4]Zucker Hillside Hospital, [5]Yale University, [6]UNC, [7]Harvard University, [8]Emory University — With research on psychosis increasingly focusing on early detection and intervention, integrating biological markers derived through neuroimaging into predictive algorithms represents a promising avenue to improve risk detection (Fusar-Poli et al., 2013). Based on amygdala-prefrontal abnormalities in schizophrenia (Fakra et al., 2008), the present study investigated whether alterations in amygdala-prefrontal circuitry predate the onset of psychosis and predict clinical outcomes. Participants were adolescents and young adults at clinical high risk (CHR) for psychosis (n=216) and healthy controls (n=129) who completed an emotional faces fMRI task at baseline and received follow-up clinical assessments through the North American Longitudinal Prodrome Study. Findings revealed differential activation and functional connectivity at baseline among CHR participants who recovered symptomatically (n=38) within six months or who converted to psychosis (n=15). Compared

with the recovery, non-conversion, and healthy control groups, converters exhibited reduced activation in the amygdala and prefrontal cortex (PFC) during emotion processing (p<.0001, corrected). Converters showed positive amygdala-PFC connectivity, compared with the expected pattern of negative connectivity in this regulatory circuit. In contrast, the recovery group resembled controls and showed increased amygdala and PFC activation, as well as stronger negative amygdala-prefrontal functional connectivity, compared with the non-recovery and conversion groups (p<.0001, corrected). Thus, the extent to which amygdala-PFC circuitry is abnormal or typical among individuals at risk for psychosis may predict the severity of clinical course. Taken together, these results provide novel insight into the nature of emotion processing deficits in the development of psychosis and may enhance early identification of risk for psychosis.

D20

THE RELATIONSHIP BETWEEN EMOTION REGULATION AND DISRUPTIVE BEHAVIOUR IN INDIVIDUALS WITH NEURODEVELOPMENTAL DISORDERS Kate Woodcock[1], Raj Bhatoa[1], Eleanor Callaghan[1]; [1]Cerebra Centre for Neurodevelopmental Disorders, School of Psychology, University of Birmingham, UK — Many neurodevelopmental disorders associated with intellectual disability - such as autism spectrum disorders and several genetically defined disorders - are linked to elevated expression of behaviours that include signs of heightened emotional arousal. Despite this, there has been very little systematic study of emotion regulation in these populations. We aimed to develop a measure of emotion regulation appropriate for use with these atypical populations; and assess the relationship between emotion regulation and clinically elevated temper outbursts. An assessment of emotion regulation was developed from an economic game in which unfair treatment is linked to experience of anger. Neurofunctional; cognitive and behavioural evidence shows that participants perform better when they reduce (down-regulate) their own anger. We adapted the game so that performance would index engagement in the down-regulation of anger. 40 typical adults and 40 typical children completed the game assessment and previously validated self-report questionnaires on anger regulation. A paired case series approach was taken to examining individuals with neurodevelopmental disorders. Individuals were selected showing high levels of temper outbursts; and matched to individuals with the same neurodevelopmental disorder, of comparable age, who did not show clinically elevated temper outbursts. These participants completed the emotion regulation game and their caregivers completed structured interviews on temper outbursts. In the typical samples, associations were demonstrated between performance on the emotion regulation game and self-reported anger regulation. In the atypical individuals, clinically elevated temper outbursts were linked to poorer performance on the emotion regulation game.

D21

COGNITIVE CONTROL IN EMOTION PERCEPTION Ilana Pomerantz[1], Spencer K. Lynn[1], Justin B. Kopec[1], Gabriella Joseph[1], Lisa Feldman Barrett[1,2]; [1]Northeastern University, [2]Harvard Medical School, Massachusetts General Hospital — Inferring the emotional state of another person is a frequent judgment made under uncertainty (a given facial expression can mean different things in different situations) and risk (there are costs to being wrong). Like other uncertain, risky decisions, age and gender may influence how effective perceivers are at judging the emotions of others. We tested 234 visitors at the Boston Museum of Science, age 5-80 years (median 20 years) to examine the effects of age and gender on perceivers' ability to optimize categorization of faces depicting fear (n=120) or happiness (n=114). Participants attempted to earn as many points as they could by categorizing faces of variable expressive intensity as emotional (i.e., fearful or happy, depending on group), or not. Points were earned or lost on each trial for correct or incorrect judgments, and a slight bias to categorize faces as "not emotional" would maximize points. Overall, men and women in their 40's exhibited the highest perceptual sensitivity on the task. However, for faces depicting fear, boys were significantly worse at adjusting their response bias to accommodate their low sensitivity. This effect was associated with behavioral over-compensation specifically following missed detections of fear, and was not apparent for boys judging smiling faces or among other participants. Our results suggest that emotion perception is subject to cognitive control issues - affectively salient content (here, fearful facial depictions) disproportionately interferes with boys' ability to use feedback and balance the risks inherent in emotion perception.

EMOTION & SOCIAL: Emotion-cognition interactions

D22

NEURAL MECHANISMS FOR STRESS-MEDIATED SHIFT IN REWARD-PUNISHMENT LEARNING Michael Treadway[1], Roee Admon[1], Samuel Douglas[1], Gordana Vitaliano[1], David Olson[1], Diego Pizzagalli[1]; [1]McLean Hospital and Harvard Medical School — A wealth of data suggests that stress exposure alters how individuals process and make decisions about rewards in their environment. In particular, recent evidence suggests that under stressful conditions, loss-minimization may take precedence over gain-maximization. To date, however, the neural mechanisms that mediate this switch are unknown. In the current study, a sample of healthy adults females completed an instrumental conditioning paradigm both before and during a social stress manipulation (negative social evaluative feedback). The social stressor used was a variant of the Montreal Imaging Stress Task, a well-validated paradigm for inducing psychological stress in an MRI scanner environment (Dedovic et al., 2005). In our initial sample, stress exposure significantly attenuated learning about reward-predicting stimuli while boosting learning about loss-predicting stimuli. Instrumental conditioning about wins and losses was associated with activity within mPFC and striatum. These findings provide preliminary evidence for cortico-striatal circuitry mediating stress-induced shifts in gain vs. loss maximization.

D23

INSULTS HURT AND THEY KEEP HURTING, ESPECIALLY WHEN THEY ARE ABOUT YOU! EVIDENCE FROM EEG AND SKIN CONDUCTANCE MEASURES Marijn Struiksma[1], Hannah De Mulder[1], Nicola Spotorno[2], Jana Basnakova[3], Jos van Berkum[1]; [1]Utrecht University, [2]University of Pennsylvania, [3]Slovak Academy of Sciences — Research on emotion in language has mainly focused on the processing of emotion words in isolation (Citron, 2012). Using EEG and skin conductance measures, we investigated how compliments and insults are processed in a sentence that either directly addressed the participant or targeted somebody else (e.g. "[participant's name]/Jane is ugly/beautiful"). Relative to compliments, insults elicited a stronger P2 response (150-250ms), regardless of who was addressed. This suggests that a generic negativity bias is already present during early perceptual processing, possibly reflecting rapid detection of, and focus on, the taboo nature of insulting words. In the 350-500ms latency range the negativity bias was modulated by who was addressed. Relative to compliments, insults elicited a strong Late Positive Potential (LPP) response, but the effect was strongest when the insults were directed at the participant. These personal insults also elicited the strongest skin conductance response, suggesting that sympathetic activation is not only driven by the occurrence of a negative word, but is also sensitive to the sentence context. Interestingly, multiple repetitions of our stimuli did not modulate the early and late effects, which suggests that both the initial generic response to insults and the following specific response to personal insults do not readily adapt. Together, our findings indicate that even in a contrived and highly "impersonal" lab setting, insults affect participants' physiological and neural responses and, at the neural level, they continue to do so over repetition.

D24

HOW ANXIETY AND SENTENCE CONTEXT AFFECT THE PROCESSING OF INSULTS AND COMPLIMENTS: INSIGHTS FROM THE EMOTIONAL STROOP PARADIGM Hannah De Mulder[1], Marijn Struiksma[1], Jos van Berkum[1]; [1]UiL OTS - Utrecht University — The emotional Stroop effect (slower colour-naming of negative than non-negative words in coloured font; McKenna & Sharma, 1995) is particularly pronounced in anxious individuals (Williams et al., 1996) and suggests that the emotional content of words interferes with the allocation of attentional resources. The current study considers whether complimenting and insulting words are processed differently when they are placed in a sentence context that either directly addressed the participant (self-directed context) or targeted somebody else (i.e. "[participant's name]/Linda is nasty/lovely". The results showed that colour-naming response times for insults were longer than for compliments, thereby demonstrating that a typical emotional Stroop effect

can be obtained in the context of a sentence (regardless of participants' anxiety level). Furthermore, there was an interaction between anxiety and perspective in that highly anxious individuals responded more slowly to the colour naming task in the self-directed context, whereas low anxious individuals' response times were not affected by who the sentence was directed at. These findings thus show that insults draw attentional resources away from goal-directed processing and that, at least for highly anxious individuals, the context in which a word is presented (self vs. other directed) influences the extent to which attentional resources are diverted away from the task. In risky situations (i.e., self-directed context), processing of word meaning is thus given priority over colour naming, suggesting that the emotional Stroop effect does not just represent an automatic response to the negative valence of a single word, but that context-sensitive computations also come to play.

D25

THE NEURAL CORRELATES OF ATTENTIONAL SWITCHING IN APPROACH AND AVOIDANCE STATES

Rebecca D. Calcott[1], Elliot T. Berkman[1]; [1]University of Oregon — Successful goal pursuit often requires attentional flexibility, which facilitates adaptive behavior change in response to changing environmental demands. Our previous work added to a mounting literature showing that approach and avoidance motivational states can influence attentional flexibility. Despite the emerging evidence of affective/motivational influences on attention shifting, the neural correlates of attentional shifts are generally studied without consideration of motivational state. Therefore, the goal of the present study was to examine whether the neural correlates of attentional shifts differ depending on motivational state. Participants completed a composite letter task while their neural activity was measured using fMRI. In this task, participants identified a target by attending either to global or local stimulus features. Trials were classified as either switch trials, in which participants shifted their attention between global and local features in sequential trials, or non-switch trials, in which participants maintained their attention at the same level as the previous trial. Motivation was manipulated using pretested images to induce approach and avoidance states. Behaviorally, there was no interaction between motivational state (approach vs. avoidance) and trial type (switch vs. non-switch); however the fMRI analysis showed a significant interaction between motivation and trial type in bilateral mid/posterior insula and inferior parietal cortex. These regions showed greater activity during approach switch trials and avoidance non-switch trials, but reduced activity during approach non-switch trials and avoidance switch trials. This interesting pattern of brain activity may suggest that attentional flexibility can be achieved via different mechanisms, which depend on one's current motivational state.

D26

THE INFLUENCE OF EXECUTIVE ATTENTION IN THE DOT-PROBE TASK

Jaiya R. Choles[1], Russell E. Costa[1], Chrono S. Nu[1], Benjamin P. Cohen[1], Lesa K. Ellis[1]; [1]Westminster College — There is strong evidence to suggest that attentional biases to negative or threatening information occur in both clinically anxious and high anxiety populations. The Dot-Probe task is often used to measure such biases behaviorally, typically resulting in faster reaction times (RTs) on trials in which the probe appears spatially congruent with negative stimulus presentation. Interestingly, studies indicate that increased negative affectivity results in part due to an inability to redirect attention away from thoughts, feelings, and stimuli (an executive attention ability). In addition, measures of Effortful Control (a self-reported measure of executive attention) have been found to correlate negatively with Negative Affect. To better understand the connection between affect and executive attention, we administered the Adult Temperament Questionnaire (ATQ), in addition to a modified version of the pictorial Dot-Probe task to 30 undergraduate students. In line with other studies, RT data suggest self-reported Negative Affect modulates the congruency effect typically found in the Dot-Probe task. However, when also including Effortful Control in the analysis, results suggest that individual differences in executive attention predict congruency-based interference effects found in the Dot-Probe task to a greater degree than does Negative Affect. Our findings further demonstrate the importance of attention and executive control in the bias of emotional processing in the Dot-Probe task.

D27

AUTOMATIC SIMULATION IN PSYCHOSIS-RISK POPULATION

Sarah Hope Lincoln[1], Caitlin Carey[2], Natalie Kleeman[3], Erin Guty[4], Christine I. Hooker[1]; [1]Harvard University, [2]Washington University, [3]Brown University, [4]Princeton University — Simulation, the internal representation of the emotions or actions of another person, is a social cognitive process that facilitates empathy, which in turn assists in effective social interactions. Previous research suggests that the process of simulation recruits somatosensory and social-emotional regions such as the superior temporal gyrus, temporal pole, medial prefrontal cortex (MPFC), amygdala, and insula. Impairment in the process of simulation could affect social cognition and social functioning, and may explain deficits in these processes in individuals at a clinical high risk (CHR) for psychosis. In this study we investigated simulation-related neural activity in CHR young adults relative to a control group (HC). Participants viewed social interaction words with either a positive (e.g. kiss) or negative (e.g. bite) valence; these conditions were compared to control conditions including nonsocial somatic words (e.g. hungry) and nonsocial, non-somatic words (e.g. wagon). We hypothesized that CHR individuals would show less activation in sensation regions such as the somatosensory cortex and insula and regions associated with social-emotional processing. Additionally, we hypothesized that less neural activity when viewing social interaction words would be related to self-report and interview measures of social functioning. Our results indicate that relative to HC, CHR individuals show less simulation-related neural activity in the insula and temporal pole when viewing social interaction words. Additionally, self-reported social dysfunction is negatively correlated with simulation-related activity in the insula. These findings suggest that CHR individuals have impairments in the process of simulation and that these impairments are related to social dysfunction.

D28

NEURAL ACTIVITY TO A ROMANTIC PARTNER'S BELIEFS PREDICTS THEIR PARTNER'S POSITIVE MOOD AND WELL BEING AFTER EMPATHIC INTERACTIONS

David Dodell-Feder[1], Matthew Yung[1], Steven Felix[1], Christine I. Hooker[1]; [1]Harvard University — Greater engagement in theory-of-mind (ToM) - the ability to think about other minds - during a social interaction may lead to greater empathic accuracy, and better understanding of the other person's needs. Furthermore, for the recipient, the feeling of being understood may have positive effects on mood and well-being. Engagement in ToM recruits a network of brain regions including temporo-parietal junction. To the extent that ToM is an effective strategy for understanding others during empathic interactions, activity in the ToM network should predict greater feelings of being understood by the recipient, as well as increases in the recipient's positive mood and well-being. Here, we investigated these proposed relationships with adults in romantic relationships. Participants were scanned using fMRI while making judgments about their partner's beliefs and physical attributes. Neural activity in regions associated with the ToM network when judging the partner's beliefs versus physical attributes was used as a metric of ToM engagement. After scanning, participants completed a 21-day online daily-questionnaire that asked participants to report on how empathic their partner was during an interaction. Participants also reported on their own mood and well-being. As expected, participants had more activity in ToM regions when making judgments on their partner's beliefs versus physical attributes. The extent of ToM-related activity predicted the relationship between their partner's reports of feeling understood after a "meaningful discussion" and their level of positive mood and well-being the next day. Together, the findings highlight the functional significance of using ToM during empathic interactions with one's romantic partner.

D29

REWARD ON BOTH SIDES OF THE MIRROR: TESTING THE REWARDING EFFECTS OF MIMICKING AND BEING MIMICKED USING EYE-GAZE TRACKING

Janina Neufeld[1], Virginia Levrini[2], Annabel Barry[1], Bhismadev Chakrabarti[1]; [1]Centre for Integrative Neuroscience and Neurodynamics, School of Psychology and Clinical Language Sciences, University of Reading, Reading, United Kingdom, [2]Faculty of Biology, University of Cambridge, Cambridge, United Kingdom — Social psychological studies have shown that people like those who mimic them, suggesting that mimicry

may alter the reward value of social targets. To directly test the reward value of mimicry, we investigated the impact of mimicking and being mimicked on preferential looking, using 2 conditioned-learning experiments. In study 1 conditioning phase, 30 adults made happy, sad, or neutral expressions: crucially, <1s after they started making the expression, they saw a video of a person making the same expression (Mimicking face) or another person making a different expression (AntiMimicking face). In the test phase, "Mimicking face" and "AntiMimicking face" were presented side-by-side on a gaze-tracking monitor, and participants showed longer gaze duration for Mimicking faces than AntiMimicking faces (controlling for baseline difference in gaze duration between faces) (t=2.99, p=.005). In study 2 conditioning phase, a separate sample of 37 adults mimicked expressions of certain faces (Mimicked faces) and performed the opposite expression when seeing other faces (NoMimicked faces). In the test phase, Mimicked face and NoMimicked face were presented side-by-side, and people looked longer at Mimicked faces than NoMimicked faces (t=2.18, p=.018). This effect is unlikely to be driven by greater response conflict associated with certain faces, as no effect of spatial congruency on gaze duration was detected in a separate experiment. These findings provide direct evidence that both mimicking and being mimicked alter the reward value of social targets and provides avenues for research into conditions such as autism, marked by deficits in social reward perception and spontaneous mimicry.

D30

THE INFLUENCE OF MOTIVATION ON EPISODIC MEMORY ENCODING Maiya R. Geddes[1], Colleen Meehl[1], Margaret R. Walker[1], John D.E. Gabrieli[1]; [1]McGovern Institute for Brain Research, Massachusetts Institute of Technology — We used functional magnetic resonance imaging (fMRI) to investigate the effect of motivation from monetary rewards and punishments on episodic memory encoding. Converging evidence suggests that motivation to avoid punishments and obtain rewards enhances learning and that reward processing relies on a network of dopaminergic regions including ventral tegmental area (VTA), and ventral striatum (VS). Previous studies show an interaction between these and memory-related regions including hippocampus and parahippocampal gyrus in response to monetary incentive rewards, however, the influence of monetary punishment on episodic memory is relatively poorly understood. In the present study, 22 healthy adults studied words under three conditions (reward +$2 , punishment -$2 , and neutral $0) in an event-related fMRI design and were financially compensated depending on memory performance the following day. Recognition accuracy was significantly greater for words studied under reward and punishment compared to neutral conditions. A monetary incentive delay task independently localized regions activated during reward and loss anticipation, including VTA and VS. Reward and memory-related brain regions showed greater activation during encoding of high confidence remembered versus forgotten stimuli in the punishment and reward versus neutral conditions. In addition, there was a high degree of overlap in the network of brain regions activated when participants were motivated to obtain rewards and avoid punishments. This study shows that monetary punishments and rewards enhance memory, and this may be due to an interaction of overlapping reward/punishment-related and memory-related brain regions. This work characterizes interacting networks in motivated learning.

D31

HIGHER STATE ANXIETY AND NEGATIVE AFFECT ARE ASSOCIATED WITH LESS COGNITIVE CONTROL DURING DISENGAGEMENT FROM NOVEL NEUTRAL FACES Seungyeon Annie Yoon[1,2], Amberle Cusmano[2], Mariann R. Weierich[1,2]; [1]The Graduate Center of the City University of New York, [2]Hunter College of the City University of New York — Anxiety and negative affect are associated with less recruitment of cognitive control during disengagement from negatively valenced stimuli (e.g., Bishop et al., 2004; Ellenbogen et al., 2002). Novelty also independently activates affective brain regions (e.g., Weierich et al., 2010), and the amygdala response to novelty is heightened in anxiety (e.g., Schwartz et al., 2003). We investigated the relation between state anxiety and more general negative affect and cognitive control during disengagement from novel information. We hypothesized that higher state anxiety and negative affect would be associated with less activation in cognitive control regions (rostral anterior cingulate cortex, rACC; rostral middle frontal gyrus, rMFG) during disengagement from novel faces. During an fMRI scan, 19 participants identified a simple target that appeared to the left or right of a novel or familiar emotional (angry, happy, or neutral) face. For novel versus familiar neutral faces only, higher state anxiety and negative affect were associated with decreased activation in the rostral anterior cingulate (state anxiety: left rACC, r=-.49, p=.045; right rACC, r=-.54, p=.025; general negative affect: left rACC, r=-.47, p=.045; right rACC, r=-.58, p=.009). In addition, negative affect was associated with decreased activation in the left rostral middle frontal gyrus (r=-.61, p=0.01). Results suggest that higher state anxiety and negative affect are associated with reduced top-down control during disengagement from uncertain (i.e., non-obviously affective, or neutral) novel information. In addition, although state anxiety and negative affect overlap considerably, the data suggest an additional effect of negative affect, beyond state anxiety, on cognitive control.

EMOTION & SOCIAL: Person perception

D32

VERBAL VERSUS VISUAL PRESENTATION OF INTENT INFORMATION DIFFERENTIALLY RECRUITS THE RIGHT TEMPORO-PARIETAL JUNCTION Lily Tsoi[1], Liane Young[1]; [1]Boston College — Prior research shows that the right temporo-parietal junction (rTPJ) plays a key role in mental state reasoning. However, this work has mostly relied on (1) verbal narratives to present intent information and (2) stimuli featuring social (and moral) interactions. Using functional magnetic resonance imaging (fMRI), we investigated the neural correlates for processing verbal versus visual intent information in non-social contexts. Fifteen participants were scanned while (1) reading descriptions of intentional and accidental non-social actions (e.g., opening an umbrella intentionally/accidentally) and (2) viewing video clips of actors performing the same intentional and accidental actions. Our results indicate a significant interaction pattern in rTPJ: the magnitude of response was similar for intentional and accidental acts presented in video format, but the magnitude of neural response was greater for intentional than accidental acts presented verbally. Using multivoxel pattern analysis (MVPA), we also investigated whether intent information in non-social scenarios, across presentation formats, is encoded in the rTPJ. We found that rTPJ does not discriminate between intentional and accidental acts in its spatial pattern of activity. In sum, analyses of response magnitude suggest that rTPJ is recruited differentially for intentional versus accidental acts in non-social contexts depending on presentation format (i.e., visual versus verbal). MVPA results suggest that the difference between intentional and accidental acts, at least in non-social contexts, is not encoded in the spatial pattern of activity in rTPJ.

D33

REAL-TIME SOCIAL INTERACTION MODULATES ACTIVITY IN THE MENTALIZING NETWORK DURING A NOVEL SOCIAL PREDICTION TASK Katherine Rice[1], Kayla Velnoskey[1], Elizabeth Redcay[1]; [1]University of Maryland — Studying the social brain in detached and offline contexts (e.g., listening to prerecorded stories about characters) may not capture real-world social processes; recent evidence suggests that contingent, social interaction differentially engages social brain regions (e.g., Redcay et al., 2010). Studies on the neural correlates of mentalizing - or thinking about others' mental states - have predominately been conducted in offline contexts, despite behavioral differences between online and offline mentalizing. In the current study, 19 adults completed a novel fMRI mentalizing task in which, for the "Live" condition, participants believed they were making predictions about a social partner communicating via a live audio feed, and, for the "Not-live" condition, participants made predictions about characters in a recorded story. Two separate events were analyzed: 1) Story, which was an audio segment matched across conditions for speech characteristics and linguistic content (e.g., "there are apples and candy"), and 2) Social Prediction, where participants heard a preference (e.g., "I/Mary want(s) to be healthy") and made a choice. Regions of the mentalizing network (bilateral TPJ, dMPFC, precuneus) were significantly more active during Social Prediction for a live partner versus a third-party character, despite equivalent accuracy across conditions. For the Story (i.e., matched linguistic content), dMPFC activity was higher when participants were listening to the live partner. These findings provide preliminary evidence that

real-time social interactions alter neural processing, and that the extent of this effect depends upon the interactive context. Further, this novel paradigm has implications for autism, where deficits are most pronounced in real-world social interaction.

D34

INCREASED FEELINGS OF DOCTOR-PATIENT SIMILARITY PREDICT REDUCED PAIN RATING DURING SIMULATED CLINICAL INTERACTIONS Elizabeth Reynolds Losin[1], Luke J. Chang[1], Tor D. Wager[1]; [1]University of Colorado, Boulder — Individuals from ethnic minorities are most often treated by doctors of an ethnicity different from their own. This ethnic discordance has been linked to lower patient satisfaction and is thought to be mediated in part by reduced feelings of personal belief similarity between ethnically discordant patients and doctors. Here we tested whether feelings of similarity between doctors and patients (independent of ethnicity) influenced pain perception during medical care. A mixed-ethnicity group of 80 participants (4 per session) was divided into two groups based on the similarity of their self-reported political, religious, and gender beliefs, and randomly assigned to the role of doctor or patient. Each participant took part in two simulated clinical interactions--one with an ingroup member and one with an outgroup member--in which patients rated pain from noxious thermal stimulation delivered by the doctor. We found that patients reported feeling more similar to ingroup doctors than outgroup doctors, and that the more similar to their doctors the patients felt, the less pain they reported. These findings suggest that interventions aimed at increasing patients' feelings of similarity to their doctors may decrease patient pain during medical care regardless of ethnic concordance. Such interventions may help mitigate the negative impact of the high prevalence of ethnically discordant doctors on minority populations.

D35

EXPECTATIONS AND PREDICTIONS FOR UNDERSTANDING OBJECT-RELATED ACTION Sasha Ondobaka[1], Floris P. de Lange[1], Marco Wittmann[1], Chris D. Frith[2,3], Harold Bekkering[1]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud Univesity Nijmegen, [2]Welcome Trust Centre for Neuroimaging, University College London, [3]Interacting Minds Centre, Aarhus University, Denmark — Recent accounts of understanding goal-directed action underline the importance of a hierarchical predictive architecture. However, the neural implementation of such an architecture remains elusive. In the present study, we used functional neuroimaging to quantify brain activity associated with predicting physical movements, as they were modulated by conceptual expectations regarding the purpose of the object involved in the action. Participants observed object-related actions preceded by a cue that generated both conceptual goal expectations and movement goal predictions. In two tasks, observers judged whether conceptual or movement goals matched or mismatched the cue. At the conceptual level, expected goals specifically recruited the posterior cingulate cortex, irrespective of the task and the perceived movement goal. At the movement level, neural activation of the parieto-frontal circuit, including inferior frontal gyrus and the inferior parietal lobe, reflected unpredicted movement goals. Crucially, this neural reflection of a movement prediction error was dependent upon the confirmation of the conceptual expectation about the purpose of the object. These findings provide neural evidence that prior conceptual expectations influence processing of physical movement goals and thereby support the hierarchical predictive account of action observation.

D36

TRACKING NEURAL REPRESENTATIONS OF FAIRNESS BASED ON IMPARTIALITY, RECIPROCITY AND NEED Laura Niemi[1], Liane Young[1]; [1]Boston College — Fairness represents a fundamental moral virtue, and yet fairness might take distinct forms even within the same context. For example, fair behavior might involve distributing resources to recipients based on reciprocity (i.e., returning favors to specific individuals), need (i.e., giving to individuals who would benefit the most), or impartiality (i.e., using a rule-based procedure independent of the relationship between giver and recipient). We examined moral judgments and neural representations of fairness in its different forms, compared to a control condition in which the specific motivation for resource distribution was left unspecified. We focused on brain regions for social cognition and theory of mind (ToM). We found that dorsal and ventral medial prefrontal cortex (DMPFC, VMPFC) and precuneus (PC) were recruited robustly for reciprocity and need, compared to impartiality and control. The more personal nature of the interaction or relationship between giver and recipient in these two cases of fairness may rely more on ToM. Interestingly, however, participants judged reciprocity-based fairness as significantly less morally praiseworthy than need-based fairness; impartiality was seen as intermediate. Consistent with this behavioral discrimination, multi-voxel pattern analysis (MVPA) revealed spatially distinct patterns of activity within the DMPFC for reciprocity versus need. These findings suggest that "fairness" is not associated with a unified behavioral or neural pattern and may best be understood as taking fundamentally different forms.

D37

THE NEURAL RESOLUTION OF STEREOTYPES TO PERCEIVE OTHERS ACCURATELY. Eric Hehman[1], Jonathan Freeman[1]; [1]Dartmouth College — Perceivers extract multiple social dimensions from another's face (e.g., race, emotion), and these dimensions can become linked due to stereotype knowledge (e.g., Black individuals → angry). Sometimes, however, these multiple dimensions can conflict (e.g., happy Blacks) and stereotypic associations must be resolved to perceive such targets accurately. Using functional magnetic resonance imaging (fMRI), the current research examined how the brain resolves these conflicts between facial cues and stereotype knowledge in person perception. Participants (n=23) passively viewed faces varying in race (e.g., Black, White) and emotion (e.g., angry, happy) while neural activity was measured using fMRI. Following scanning, participants categorized these same targets by race and emotional expression while hand movements en route to responses were recorded using real-time hand-tracking. Across all participants, results revealed that the medial prefrontal cortex and anterior cingulate cortex exhibited linearly increasing responses as race and emotion became stereotypically more incongruent. Most importantly, participants who had a stronger behavioral tendency to link race and emotion stereotypically during categorization, as indexed by subtle hand-movements, demonstrated greater dorsolateral prefrontal cortex (dlPFC) activation to targets incongruent with stereotypes (all p's <.05 corrected). Because the dlPFC has been linked with the suppression of prepotent responses, these results suggest that individuals with stronger stereotypical links between race and emotion might need to inhibit these associations to perceive others accurately. This research is the first to link fMRI with real-time measurement of behavioral tendencies to stereotype, and helps reveal how conflicting stereotypes at the nexus of multiple social dimensions are resolved neurally.

D38

HOW AGENTS AND OBJECTS VIOLATE OUR EXPECTATIONS James Dungan[1], Michael Stepanovic[1], Liane Young[1]; [1]Boston College — When forming expectations about objects and agents, we may appeal to our knowledge of their past behavior, or additionally for agents, their mental states (e.g., intentions). We used fMRI to examine the cognitive processes that support how people form expectations and respond to violations of expectations across these contexts. Twenty participants read stories containing background information about 1) an object's behavior, 2) an agent's behavior, and 3) an agent's beliefs. After participants made a prediction about a story's outcome, an actual outcome was revealed; critically, this outcome was either expected or unexpected based on the story's initial background information. When forming predictions about agents versus objects, region of interest (ROI) analyses revealed greater activation in mentalizing regions: bilateral temporo-parietal junction (TPJ), precuneus (PC), and dorsomedial prefrontal cortex (DMPFC). These ROIs also showed increased activity for unexpected versus expected outcomes, driven by the social conditions. Furthermore, outcomes that were unexpected versus expected based on an agent's past behavior elicited especially robust activity in the right TPJ, indicating spontaneous mentalizing. Finally, the magnitude of response in the right TPJ to unexpected versus expected outcomes based on an agent's past behavior is correlated with autism-related traits: the greater the number of autism-related traits individuals report having, the less activity their right TPJ exhibits in response to unexpected versus expected outcomes. These findings reveal key differences in how we process violations of expectation across contexts, providing insight into our ability to navigate and learn about our social world.

D39

NEURAL ORGANIZATION OF MENTAL STATE KNOWLEDGE Mark A. Thornton[1], Diana I. Tamir[1], Juan Manuel Contreras[2], Jason P. Mitchell[1]; [1]Harvard University, [2]The Walt Disney Company — The ability to understand the mental states of other individuals is a key feature of human social cognition. Psychological researchers have posited many dimensions along which mental states might vary including arousal, valence, agency and experience, emotion and reason, mental versus bodily, shared (with animals) versus unique (to humans), social versus nonsocial, and warmth and competence. Although these models each offer considerable explanatory power in certain domains, they often make different predictions about which mental states ought to be similar to one another. It is also not clear whether people use lay versions of all these theories to guide their thinking, even implicitly. The present study used multivoxel pattern analysis of functional magnetic resonance imaging (fMRI) data to assess both whether and where these different ways of organizing mental states are encoded in the brain. During fMRI scanning, participants viewed pairs of scenarios and judged which would better evoke a specific mental state in another person. A searchlight analysis was used to generate neural similarity matrices between mental states for each voxel in the brain. These similarity matrices were then compared to matrices based on theoretical models with the dimensions described above. Although several distinct regions carried information related to individual models, the model based on agency and experience provided the best explanation for neural similarity across much of the social brain network. This suggests that understanding the degree of agency and depth of experience implicit in the mental states of others may serve particularly useful purposes in social cognition.

EXECUTIVE PROCESSES: Development & aging

D40

DYNAMIC ADJUSTMENTS OF COGNITIVE CONTROL IN WORKING MEMORY DURING HEALTHY AGING Alexandra Morrison[1], Suzanne Parker, Amishi Jha; [1]University of Miami — Prior research shows that during completion of a working memory task, younger adults perform better following high-demand trials than low-demand trials. This suggests that younger adults can dynamically adjust cognitive control according to the cognitive demand of a trial. Here, we ask whether the pattern of enhanced performance following high-demand trials is observed in not only younger adults (mean age = 18.5 years old), but also middle (mean age = 50.17 = years old) and older adults (mean age = 60.8 years old). Healthy aging is generally accompanied by diminished performance at high working memory loads and high levels of interference, and accordingly, we hypothesized that younger and older individuals would differ in performance immediately following high-load or high-interference trials. Participants completed a delayed-recognition task in which mnemonic load (one or two items) and interference level (confusable or not confusable with memoranda) were manipulated. Younger adults outperformed middle and older adults while the older two age groups performed equivalently. In all three age groups, current trial performance decreased as the demand characteristics of a trial increased. When current trial performance was assessed as a function of previous trial load and interference level, all participants were more accurate following high- vs. low-load trials. Yet, only younger adults were more accurate following high- vs. low-interference trials. These results suggest that dynamic adjustments according to load persist into middle and older adulthood, but adjustments according to interference demands may be more fragile and compromised during healthy aging.

D41

MODULATION OF LARGE-SCALE BRAIN NETWORKS IN OLDER ADULTS AFTER EXECUTIVE CONTROL TRAINING Areeba Adnan[1], Gary R Turner[1,2], Anthony J.W. Chen[3,4,5,6], Tatjana Novakovic-Agopian[3,4,6,7], Mark D'Esposito[4,6]; [1]York University, [2]Sunnybrook Health Sciences Centre, [3]Veteran's Administration Medical Centre, [4]Veteran's Administration Northern California Health Care System, [5]University of California, San Francisco, [6]University of California, Berkeley, [7]California Pacific Medical Centre — Introduction: Emerging research suggests that cognitive training in older adulthood may alter the trajectory of neurocognitive decline. fMRI has been used to elucidate the neural basis of age-related neurocognitive change. These neural markers can, in turn, serve to guide intervention design and evaluate training outcomes. Here we investigate changes in large-scale brain networks known to subserve executive control following a targeted executive control training intervention in healthy older adults. Methods: Healthy older adults were randomized to an executive control training program (N=16) or a control condition (N=18). The Goal-based Self-Management (GOALS) training protocol (Novakovic-Agopian et al., 2011) involves training in attention regulation and distraction suppression strategies. Participants completed a visual selective working memory task while undergoing fMRI scanning pre- and post-training. Multivariate neuroimaging analyses were conducted using Partial Least Squares. Results: Activation in brain regions closely overlapping with the frontal-parietal control network was significantly enhanced in the GOALS versus the control group ($p<0.001$). These network changes also included enhanced activity in the parahippocampal place area during selective working memory for scenes. These brain changes co-occurred with behavioural improvements on the visual attention task in the GOALS group. Conclusions: These results suggest that executive control training is associated with enhanced goal-directed modulation of visual association cortices in healthy aging. The brain and behavioural changes observed here suggest that executive control is malleable into older adulthood and improvements are associated with changes in functional connectivity within large-scale brain networks.

D42

THE PERSISTENT INFLUENCE OF PEDIATRIC CONCUSSION ON ATTENTION AND COGNITIVE CONTROL DURING FLANKER PERFORMANCE Robert D Moore[1], Lauren B Rain[1], Eric S Drollette[1], Mark R Scudder[1], Dominika M Pindus[2], Charles H Hillman[1]; [1]University of Illinois at Urbana-Champaign, [2]Loughborough University — While increased efforts have been dedicated towards understanding neurocognitive outcomes of concussive injuries in adults, fewer efforts have been dedicated towards understanding outcomes in developing populations. The aim of this study was to investigate the influence of concussion history on children's neurocognitive performance. Twenty-eight children age eight to ten (14 controls, 14 with a history of concussion) were matched based on the demographic factors of age, sex, SES, IQ, pubertal timing, ADHD symptoms and cardiorespiratory fitness. Children completed compatible and incompatible conditions of a flanker task, while neuroelectric and behavioral data were collected. Relative to controls, formerly concussed children exhibited several behavioral and neuroelectric differences. Specifically, formerly concussed children responded less accurately, committed more commission errors and longer error runs, with the greatest group differences occurring for the incompatible condition. Formerly concussed children also evidenced increased response variability, with the greatest group difference occurring for congruent trials irrespective of task condition. Across conditions, formerly concussed children also exhibited longer N2 latency, and trended towards greater N2 amplitudes. Further, a selective group difference for N2 amplitude was observed for congruent trials, irrespective of task condition. Formerly concussed children also exhibited decreased P3 amplitude and trended towards decreased ERN amplitude across conditions, but a selective group difference for ERN amplitude was observed for the incompatible condition. These results suggest that pediatric concussion may negatively influence the development of attention and cognitive control. These results will serve to inform a growing public health concern in a poorly understood population.

D43

ABNORMALITIES IN THE WHITE MATTER INTEGRITY OF AN EYE-MOVEMENT NETWORK HEALTHY, OLDER ADULTS Dana Wagshal[1], Judy Pa[1], Hilary Heuer[1], Iryna Lobach[1], Adam Boxer[1]; [1]University of California, San Francisco — Brain aging is accompanied by changes in cognitive functioning and may be a risk factor for neurodegenerative disease. A better understanding of the mechanisms of age-related cognitive impairment would help to determine which individuals would most benefit from early therapeutic interventions to prevent dementia and how normal aging contributes to cognitive decline. The most common age-related changes in cognition occur in executive function, which has been associated with elevated risk for decline in cognitive and functional performance associated

with the onset of dementia (Blacker et al., 2007; Fine et al., 2008; Royall et al., 2004; Kramer et al., 2007). A useful tool in measuring executive function is the antisaccade (AS) task. The AS task is strongly correlated with impairments in executive function (Nieman et al., 2000; Hutton et al., 2004; Boxer et al., 2006) that occur with normal brain aging (Mirsky et al., 2011; Hellmuth et al., 2012). We investigated the white matter integrity of the cortical oculomotor network involved in AS task performance by using diffusion tensor imaging (DTI), which is a method that allows for the measurement of white matter fiber tracts in vivo based on the diffusivity of water in the white matter of the brain. Tractography in key regions in the AS eye-movement network were revealed to be important in predicting AS performance in older adults. These findings suggest that differences in executive control in healthy elders emerge from altered white matter integrity within a fronto-parietal brain network and could be regions vulnerable for future decline.

D44

GAIN AND LOSS FEEDBACK PROCESSING IN YOUNGER AND OLDER ADULTS: A PARTIAL LEAST SQUARES ANALYSIS Holly Bowen[1], Julia Spaniol[1], Cheryl Grady[2,3]; [1]Ryerson University, [2]Rotman Research Institute at Baycrest, [3]University of Toronto — Aging is associated with declines in dopaminergic processing and reward-based learning (Li et al., 2010). However, few studies have examined age differences in reactivity to gain and loss feedback in the absence of S-R learning demands. The current study investigated gain and loss feedback processing in younger and older adults in the context of the Monetary Incentive Delay task (MID; Knutson et al., 2001; Samanez-Larkin et al., 2007). Sixteen younger adults (mean age = 25.4 yrs.; 9 female) and 15 older adults (mean age = 69.0 yrs.; 9 female) underwent fMRI while completing a variant of the MID task that yielded four types of feedback: gain, missed gain, loss, and missed loss. We assessed feedback related activations using mean-centered Partial Least Squares (PLS; McIntosh et al., 2004), a multivariate technique optimal for identifying spatio-temporal whole-brain patterns. The analyses yielded a significant latent variable (LV) showing a pattern that was more pronounced in older adults than in younger adults, and that included the striatum, insula, amygdala, anterior cingulate, and visual cortex. These regions were deactivated following missed-gain feedback, and activated following all other types of feedback. In older adults, the activation was particularly pronounced following loss feedback. Overall, these findings converge with previous reports of intact gain and loss feedback processing in learning-free tasks in older adults (Cox et al., 2008; Samanez-Larkin et al., 2007). Contrary to the predictions of socioemotional selectivity theory, there is no evidence of an age-related decrease in loss sensitivity.

D45

SULCAL PATTERN OF THE ANTERIOR CINGULATE CORTEX PREDICTS COGNITIVE CONTROL DURING CHILDHOOD: A LONGITUDINAL STUDY. Gregoire Borst[1,2,3], Arnaud Cachia[1,2,3], Julie Vidal[1,2,3], Gregory Simon[1,2,3], Clara Fisher[4], Arlette Pineau[1,2,3], Nicolas Poirel[1,2,3,5], Jean-François Mangin[4], Olivier Houdé[1,2,3,5]; [1]CNRS U3521, Laboratory for the Psychology of Child Development and Education, Sorbonne, Paris, France, [2]University Paris Descartes, Sorbonne Paris Cité, Paris, France, [3]University Caen Basse Normandie, Caen, France, [4]Computer-Assisted Neuroimaging Laboratory, Neurospin, I2BM, CEA, France, [5]Institut Universitaire de France, France — Difficulties in the ability to control impulses and to inhibit a prepotent response (cognitive control) are related to the pathophysiology of several psychiatric conditions. In healthy subjects, the cognitive control (CC) efficiency in childhood is a strong predictor of academic and professional successes later in life. The dorsal anterior cingulate cortex (ACC) is one of the core structures of the brain functional network responsible for CC. Although quantitative structural brain characteristics of the dorsal ACC contribute to CC efficiency, the qualitative structural brain characteristics contributing to the CC development are less-understood. Using anatomical magnetic resonance imaging, we investigated whether the sulcal pattern of the ACC, a stable qualitative characteristic of the brain determined in utero, predicts the development of CC. In this study, the same children performed Stroop tasks at age 5 and 9. We found that the ACC sulcal pattern predicted CC efficiency both at age 5 and 9: ACC sulcal pattern at age 5 explained 27% of the Stroop interference score variability at age 5 and 25% at age 9. The ACC sulcal patterns appear to affect specifically the development of CC efficiency given that the ACC sulcal patterns had no effect on the development of the ability to maintain and manipulate information in verbal working memory. Thus we evidence that the sulcal pattern of the ACC - a qualitative structural characteristic of the brain determined in utero that is not affected by maturation and learning after birth - predicts the development of the CC efficiency.

EXECUTIVE PROCESSES: Goal maintenance & switching

D46

ON YOUR MARK, GET SET& : NEURAL CORRELATES OF CUE-RELATED RESPONSE PREPARATION Savannah Cookson[1], Heather Roberts[1], Greg Szalkowski[1], Stephanie Spratt[1], Erin McPherson[1], Richard Hazeltine[2], Eric Schumacher[1]; [1]Georgia Institute of Technology, [2]University of Iowa — Humans use cues to partially program motor movements prior to the presentation of critical stimuli (e.g., Rosenbaum, 1980; Miller, 1982). These cues take advantage of Gestalt-like grouping principles that result in compatible stimulus-response overlap (Adam et al, 2003). The present research investigates how informative cues affect brain processing. Specifically, to what extent is activity modulated for stimulus and response cues versus neutral cues in control- and processing-related regions? Participants made manual responses to the identity of face or place stimuli in a variation of the response cuing paradigm while fMRI BOLD signal was recorded. Prior to the stimulus, a letter cue indicating the upcoming stimulus type (face or place) or response hand (left or right) or a neutral cue was presented. Stimulus-response mappings segregated stimulus types by response hand (i.e., faces were associated with responses from one hand, and places with responses from the other), which resulted in a complete overlap of stimulus type and response hand. We proposed three hypotheses: 1) control-related activity (e.g., prefrontal, parietal) would increase for cued vs. uncued trials; 2) activity in face and place processing regions and left and right premotor regions would activate for their respective cues, although all cues were letters; and 3) stimulus processing regions would also be activated by response cues, and vice versa. The results largely confirm these hypotheses. These findings suggest that, when presented with a cue, participants activate a task set consisting of groupings of stimuli and their associated responses, which then guides control of downstream processing.

D47

TRANSCRANIAL DIRECT CURRENT STIMULATION AND ACQUISITION OF A COMPLEX TASK; EFFECT OF STIMULATION TIMING DURING TRAINING. Melissa Scheldrup[1], Jessica Vance[1], Sarah Glazier[1], Yasmin Darmani[1], Brian Falcone[1], Ryan McKendrick[1], R. Andy McKinley[2], Raja Parasuraman[1], Pamela Greenwood[1]; [1]George Mason University, [2]Air Force Research Laboratory — Transcranial direct current stimulation (tDCS) facilitates learning and retention of cognitive and motor tasks (Jacobson, Koslowsky, Lavidor, 2012). We previously found that components of a complex training task, the Space Fortress task (SF, Mane & Donchin, 1989), shows significant learning in only 1 hour if tDCS is applied during training. However, benefits vary with site of stimulation, with the strongest benefits resulting from stimulation to regions of the right hemisphere that are part of ventral and dorsal attention networks (Scheldrup et al., 2013 submitted). As a follow-up study to examine effects of tDCS during later stages of acquisition, we are currently examining the effects of tDCS to right inferior frontal (F3 in 10-20 system) during a 3-day training period with a follow-up retention assessed 1 week after training. During the three consecutive days of SF training, participants received stimulation either "Early" (active on Day 1, sham on Days 2, 3), "Late" (sham on Days 1, 2, active on Day 3), "Both" (active on Days 1,3, sham on Day 2) or "Sham" (sham on Days 1,2, 3). Participants returned one week after training to test for performance retention. Data will be presented regarding group differences in performance measures (ANOVAs) as well as rate of learning (Growth Curve Analysis). This is the first long-term study of the facilitatory effects of tDCS on a complex task.

D48

EEG EVIDENCE OF SEQUENTIAL DYNAMICS DURING HIERARCHICAL COGNITIVE CONTROL Patricia Shih[1], Erika Nyhus[1,2], Sean Masters[1], Lucy Huijun Duan[1], David Badre[1]; [1]Brown University, [2]Bowdoin College — Many rules that we use to guide our everyday actions have an underlying hierarchical structure. In these cases, multiple latent decisions will intervene between stimulus and response. While functional MRI has provided evidence of hierarchical organization for rule processing in the prefrontal cortex, much less is known about the temporal dynamics of these complex rules. Specifically, it remains uncertain whether the processing of hierarchical rules occurs in series, with decisions at each level of a given rule performed sequentially, or whether these rules are processed in parallel such that the decisions at each level are reached at roughly the same time. To investigate this question, we recorded neural activity using a 64-channel EEG system while participants performed a task containing nested rules with parametrically varied levels of control demand. Event-related potential and time-frequency analysis provided initial evidence of serial processing. However, the latent state transitions were difficult to assess using these standard approaches. Thus, we examined the spatiotemporal patterns of EEG activity during rule execution using hidden Markov modeling with Gaussian mixtures. The results indicate that the execution of hierarchical rules appears to unfold serially and involves abrupt sequential transitions to lower order decision states. Further, it was found that the number of brain states for a given hierarchical rule scales with the number of levels in the complex rule. Thus, we currently conclude that the processing of hierarchical rules may be associated with a cascade of latent transient states, which is inconsistent with a fully parallel processing model.

D49

THE ENGAGEMENT OF COGNITIVE CONTROL REFLECTS A PREDICTIVE MODEL OF TASK DEMANDS Michael Waskom[1], Michael Frank[1], Anthony Wagner[1]; [1]Stanford University — Cognitive control allows humans to align stimulus-response processing with internal goals and is thus central to intelligent, purposeful behavior. Although it is generally understood that brain regions comprising a distributed frontoparietal network are more active when humans must exert control over cognitive processing, the computational parameters driving these responses remain unspecified. The present experiment evaluated the sensitivity of control processes to parametric task demands as formalized in a probabilistic model. Subjects performed a context-dependent perceptual decision task in which they were cued to report either the direction of coherent motion or the dominant color of a random dot stimulus. Over the course of the experiment, we parametrically manipulated the relative frequency of motion and color trials without indicating to the subjects which context was more likely. We then implemented a Bayesian learning model to obtain an optimal estimate of these probabilities on each trial. This model allowed us to formally test whether control processes were sensitive to the local structure of task demands. Both reaction times and the amplitude of task-evoked frontoparietal activation were modulated by context surprisal, an information theoretic measure of prediction error in response to the rule cue on each trial. Our findings thus suggest that behavior is tuned by a predictive model that learns over high-level representations of task context to optimize behavior in shifting environments. This offers a computationally rigorous interpretation of widely observed responses to control manipulations in neural and behavioral investigations of human cognition.

D50

BEHAVIORAL AND NEURAL CORRELATES OF ATTENTIONAL CONTROL DURING LEARNING Yuan Chang Leong[1], Reka Daniel[1], Angela Radulescu[1], Yael Niv[1]; [1]Princeton University — Reinforcement learning models are often applied to study human learning and decision-making. However, simple RL algorithms do not fare well in real world situations where the environment is complex and multi-dimensional. Yet, people are able to learn efficiently in such settings. We propose that learning in multi-dimensional environments is facilitated by selective attention to some aspects of the environment while ignoring other aspects. To test our hypothesis, we had 18 participants perform a series of decision-making tasks with multi-dimensional stimuli and probabilistic rewards. In each task, only one dimension was relevant for predicting reward. Participants were not told which was the relevant dimension and had to figure it out by trial-and-error learning. We decoded participants' focus of attention on each trial using eye-tracking and multi-voxel pattern analysis of fMRI data. Trial-by-trial model-based analysis of participants' choices indicated that a reinforcement-learning model in which choice and learning were constrained by the decoded focus of attention described behavior best. We then used the model to generate regressors for attentional control that we correlated with fMRI data. Activity in dorsolateral prefrontal (dlPFC) correlated with switching attention across dimensions while activity in the anterior portion of the medial prefrontal cortex (mPFC) correlated with sustaining attention over time. Both the dlPFC and mPFC are often implicated in cognitive control processes. Taken together, our results suggest that human learning processes are constrained by an attention filter that is dynamically controlled by frontal areas involved in executive function.

D51

NEUROCOGNITIVE FINGERPRINTS OF COGNITIVE CONTROL IN DYSLEXIA Edita Poljac[1], Vera van 't Hoff[1], Inti A. Brazil[1]; [1]Radboud University Nijmegen, The Netherlands — Developmental dyslexia involves difficulties with acquisition of profound reading skills despite adequate intelligence and educational opportunity. Recent findings, however, clearly indicate that dyslexia is also associated with impairments in goal-directed cognitive regulation "top-down modulation" of behavior. Specifically, it has been shown that adolescents with dyslexia have problems with switching between rather simple cognitive tasks. The current study was designed to further investigate the possibility of deviations in top-down cognitive control of behavior in dyslexia. To this aim, students with and without dyslexia were asked to repeatedly choose between two cognitive tasks. In this voluntary task switching procedure, the choice was to respond either to the location or to the shape of a presented stimulus, which was preceded by either a long or a short preparatory interval. We measured their response times and accuracy, while recording the preparatory and stimulus-related brain activity with electroencephalography (EEG). Whereas no significant group differences were observed in the behavioral outcome measures, EEG markers related to cognitive control revealed marked group differences in top-down processing. Specifically, a weaker preparatory contingent negative variation (CNV) "slowly developing frontal negativity" implied a less efficient task preparation in students with dyslexia. Interestingly, the subsequent stimulus-related posterior P3 component reflected postponed task processes in these individuals. These findings suggest that behaviorally latent differences in cognitive control in young adults with dyslexia become apparent when looking at their neurocognitive fingerprints. Our findings furthermore corroborate recent literature advocating the advantages of such an approach to better understand clinical constructs and inform treatment.

EXECUTIVE PROCESSES: Working memory

D52

RESPONSE INTERFERENCE DURING WORKING MEMORY-BASED ACTION CONTROL: A NEW INTERFERENCE PARADIGM FOR NEUROIMAGING Andrew C. Garcia[1], Mark W. Geisler[1], Ezequiel Morsella[1,2]; [1]San Francisco State University, [2]University of California, San Francisco — Response interference can be caused by the presence of external visual distractors that are goal-incompatible (e.g., as in the flanker task; Eriksen & Eriksen, 1974) or by representations held in working memory (WM) that are incompatible with action goals (Hubbard et al., 2013). Building on this research, we developed a paradigm in which participants (n = 10), after learning to press certain buttons when presented with certain letters, are presented with two action-related letters (the memoranda) but must withhold responding (4 s) until cued to emit the response associated with one of the two letters. In the Congruent condition, the action corresponds to the cue (e.g., memoranda = AB, cue = B, response = B); in the Incongruent condition, the action corresponds to the other item of the memoranda (e.g., memoranda = AB, cue = B, response = A). Another condition (Spatial Cueing) presented a non-letter cue (a dot) associated with the spatial location of a target; in the Incongruent condition, participants responded to the item that was not cued spatially. Response times (RTs) were longer for Spatial Cueing than Letter Cueing, $F(1, 9) = 6.32$, $p = .03$; and RTs were longer in the Incongru-

ent than Congruent conditions, F (1, 9) = 22.41, p = .001. We also examined the subjective aspects (trial-by-trial "urges to err") and neural aspects (electroencephalography) of performance. Our results are discussed alongside findings showing increased fronto-parietal coherence within the theta band (4-7 Hz) during goal-directed WM (Sauseng et al., 2005).

D53

A COMPARISON OF TEMPORAL ORDER MEMORY AND STANDARDIZED NEUROPSYCHOLOGICAL TESTS OF EXECUTIVE FUNCTION AND MEMORY IN PREMANIFEST AND MANIFEST HUNTINGTON'S DISEASE

Lindsay J. Rotblatt[1], Savanna M. Tierney[1], Eva Pirogovsky[2], Diane R. Nicoll[1], Adrienne E. Collazo[1], Jody Corey-Bloom[2], Paul E. Gilbert[1,3]; [1]San Diego State University, [2]University of California San Diego, [3]San Diego State University - University of California San Diego Joint Doctoral Program in Clinical Psychology — Recent studies indicate that temporal order memory for sequences of stimuli may be impaired in Huntington's disease (HD), possibly due to frontostrial loop dysfunction. The present study examined performance on a temporal order memory test (TOMT) compared to standardized neuropsychological measures of executive function and memory. Individuals with manifest HD (n=20), premanifest gene carriers for HD (Pre-HD; n=18), and demographically similar controls (n=25) completed a visuospatial TOMT as well as tests of executive function (letter/category fluency, color word interference test) and the Hopkins Verbal Learning Test. HD patients were significantly impaired ($p<.05$) on all tests relative to the control and Pre-HD groups. The Pre-HD group was significantly impaired ($p<.05$) relative to the controls on the TOMT but did not differ on any of the standardized tests. To facilitate comparisons between the tests, raw scores were converted into scaled scores and effect sizes for group differences on each test were calculated using Cohen's d. The effect size for differences between the HD and control groups was largest for the TOMT (d=2.67) compared to the standardized tests (d=1.64-2.26). The effect size for differences between the Pre-HD and control groups was large for the TOMT (d=1.42), but small to medium (d=.07-.57) for the standardized tests. The data provide preliminary evidence that temporal order memory may be particularly impaired during the premanifest and manifest stages of HD relative to other cognitive domains. Therefore, larger scale studies are needed to examine the incremental value of the TOMT compared to other measures of cognitive function.

D54

STIMULUS DISCRIMINABILITY AND PREDICTIVENESS MODULATE ALPHA OSCILLATIONS IN A PERCEPTUALLY DEMANDING MEMORY TASK

Malte Wöstmann[1,2], Björn Herrmann[1], Anna Wilsch[1], Jonas Obleser[1]; [1]Max Planck Research Group "Auditory Cognition", Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]International Max Planck Research School on Neuroscience of Communication, Leipzig, Germany — Alpha (~10 Hz) oscillatory changes are a candidate neural signature to quantify task demands in younger and older listeners. Here, we tested the hypothesis that alpha power in an effortful listening task depends on both, acoustic stimulus detail as well as the stimulus' predictiveness of subsequent information. Electroencephalograms (EEGs) were recorded while human participants (younger: N=20, 20-30 years; older: N=20, 60-70 years) listened to two to-be-compared numerals (S1, S2) masked by a distracting talker. Task demand was manipulated along two dimensions: Primarily, the perceptual discriminability of numerals and masker was modulated by the degree of acoustic detail presented (temporal fine structure). Secondly, the degree to which the S1 numeral was predictive of the S2 numeral was varied. Task performance improved with more acoustic detail and (to a lesser degree) with increasing predictiveness. Most importantly, broadly distributed alpha power depended parametrically on acoustic detail in the stimulation and on predictiveness. That is, alpha power decreased with more acoustic detail (more strongly for older participants) and also decreased when stronger predictions could be formed (similarly in both age groups). The results speak for alpha oscillations as a versatile indicator of complex task demands. Parametrically decreasing task demands allows for facilitated processing of information, which, on a neural level, manifests in according alpha decreases. With respect to age, results suggest that older adults are particularly dependent on sensory detail, whereas the formation of predictions to compensate for sensory uncertainty is equally important for both age groups.

D55

MENTAL ROTATION: THE ROLE OF GENDER OR EXPERTISE?

Jenny Kathinka Krüger[1], Elisabeth Reschke[1], Boris Suchan[1]; [1]Institute of Cognitive Neuroscience, Dept. of Neuropsychology, Ruhr University Bochum — It has been shown in various studies that men outperform women in mental rotation. This study aimed to answer the question whether this sex specific advantage may be modulated by expertise based on experiences from daily work. Therefore, using a Mental Rotation Test (MRT) we investigated male and female aviation security assistants of different airports in Germany. Based on the M R T by Peters et al. (1995) a computer based version was developed. Stimuli and instruction were based on the original test. In the MRT participants have to decide which two of the four shown 3-D items are rotated forms of a target stimulus. Normative date have been generated based on this computerized on a sample of 1000 subjects. Results yielded evidence for no gender specific mental rotation advantage in the group of security assistants. In contrast, the control subject sample showed this clear and significant gender effect. Results suggest that everyday life experience can modulate the well-known gender effect in mental rotation. Specific factors that contribute to the shaping of mental rotation abilities like that shown in the present work have to be further elucidated in future work.

D56

THE EFFECT OF HIGH-FAT ANIMAL-BASED DIET VERSUS LOW-FAT, PLANT-BASED DIET ON COGNITIVE FUNCTION IN MICE

Robert Torrence[1,2], Sheryl Reminger[2], Joshua Carlson[1], David Towers[2], Michelle Vander Hyde[1]; [1]Northern Michigan University, [2]University of Illinois at Springfield — Obesity is related to health problems such as insulin resistance, glucose intolerance, hypertension and cognitive decline. Research has shown that a diet high in saturated fatty acids can induce cognitive dysfunction. Although cognitive function has been enhanced in animal models through environmental manipulation research has not examined if diet-induced cognitive dysfunction can be reversed through diet alone. The purpose of this study was to induce cognitive dysfunction in mice through diet, and then attempt to reverse the symptoms through diet alone. This study had two hypotheses: (1) after two months of a diet high in animal-derived saturated fatty acids, cognitive function would significantly decrease, and (2) the cognitive dysfunction induced by diet would be reversed through altering to a low-fat, plant-based diet. This study used 27 C57BL/6 mice divided up into three groups: control high-fat diet, control low-fat diet, and an experimental group. An eight-arm radial maze was used to assess working memory. The two control groups remained on their specified diet throughout the study. However, the experimental group ate a high-fat diet for two months and then their diet was switched to a low-fat diet for three months. Working memory was assessed on all groups at the two-month and five-month time points. The results indicated that the two control groups had relatively the same amount of working memory errors in both phases of testing, while the experimental group significantly improved.

D57

THE DIFFERENTIAL RELATION OF SEX ON FITNESS AND WORKING MEMORY IN PRE-PUBERTAL CHILDREN

Eric S. Drollette[1], Mark R. Scudder[1], R. Davis Moore[1], Lauren B. Raine[1], Matthew B. Pontifex[2], Charles H. Hillman[1]; [1]University of Illinois Urbana-Champaign, [2]Michigan State University — Previous investigations have indicated that fitness enhances working memory among preadolescent children. However, few studies have systematically explored fitness-related differences among key demographic characteristics, such as sex, which have been shown in previous research to influence working memory performance. The present investigation examined the differential relation of sex to cardiorespiratory fitness on working memory in preadolescent children (8-10 years old). Data were collected during three separate studies (n=114 [53 female], n=103 [51 female], n=101 [45 female]), using separate and unique tasks that tap different aspects of working memory (i.e., operation span task, n-back task, Sternberg task). Participants also completed a cardiorespiratory fitness test to assess maximal aerobic capacity (i.e., VO2max). Hierarchical regression analyses were conducted separately on males and females. Results from all three studies revealed a positive relation of fitness on working memory that was selective for males; a relationship not observed for females. Further, these results were only evident for task conditions necessitating greater working memory demands. The findings are consonant with previous literature

and reveal new evidence that fitness may selectively modulate working memory, specifically for developing male children. This investigation also provides unique insight into how interventions aimed at improving fitness may influence cognitive development differentially among males and females and further demonstrates the need for individualized physical activity programs.

LANGUAGE: Development & aging

D58

HOW CORTICAL RESPONSES TO VOWEL CATEGORIES REORGANIZE ACROSS THE EARLY READING YEARS: A LONGITUDINAL AUDITORY ERP INVESTIGATION OF MANDARIN LEXICAL TONE.

Chang Gu[1], Micheal Sandbank[1], Han Wu[2], Hua Shu[2], Bruce McCandliss[1]; [1]Vanderbilt University, [2]Beijing Normal University — Categorical perception (CP) effects for speech contrasts that only occur in one particular language suggest learning experiences "tune" the response properties of the auditory system. This two-year longitudinal ERP study investigates changes in pre-attentive auditory processing that underlies CP of Mandarin lexical tones during the years children learn to read fluently. Using a stimulus continuum spanning from one lexical tone category exemplar to another, we identified a "between-" and a "within-category" tone deviant that were both were acoustically equidistant from a standard stimulus. 8-year-old Mandarin speakers participated in both an initial ERP oddball paradigm and returned for a two-year follow up. Mismatch negativity (MMN) responses demonstrated CP effects for both conditions at age 8. At age 10, however, between-category MMN responses showed reduced latencies and durations, and a shift toward a more adult-like topography. In contrast, the P3a component showed no evidence of CP in 8-year-olds. By age 10, these same participants demonstrated robust CP effects in their P3a responses. Clearly, the pre-attentive auditory processes underlying CP of Mandarin lexical tones have only partially developed by age 8. The ensuing two years, coincidental with the rise of fluent reading, provides a window into profound reorganization of the neural correlates of vowel category perception that include changes to both preconscious responses as well as P3a responses related to orienting to sound change. Finally, the degree of MMN topography shifting toward adult-like predicts the amplitude of the P3a CP response of a child, providing a potential functional link between these components.

D59

CHARACTERIZING THE PROCESSING OF SPECTRAL, TEMPORAL, AND PHONOLOGICAL AUDITORY INFORMATION IN DEVELOPMENTAL DYSLEXIA

Bogdana Ulytska[1,2], Claudia Steinbrink[3], Thomas Lachmann[3], Christian J. Fiebach[1,2]; [1]Department of Psychology Goethe University Frankfurt, Germany, [2]IDeA Center Frankfurt am Main, [3]TU Kaiserslautern — While phonological processing deficits are established as a core symptom of developmental dyslexia, it is still unclear whether these deficits are a primary cause of dyslexia or arise from more general underlying auditory processing deficits. We studied vowel length perception using the mismatch negativity (MMN), to investigate whether dyslexics' auditory processing deficits are rooted in processing temporal, spectral, or spectro-temporal (i.e., phonological) aspects of speech. In German, vowel length is characterized by spectral as well as temporal information. In the phonological condition, two natural vowels of different length were combined. Standards and deviants thus differed in both temporal and spectral characteristics, whereas the temporal and spectral conditions were constructed so as to vary only on one of these two dimensions, by combining natural with artificially modified vowels. Importantly, this paradigm examines phonological vs. auditory processing with stimuli of identical complexity in all conditions. Fifteen dyslexic children (M = 9.28 years) and fifteen age- and grade-matched controls (M = 9.33 years) took part in the study. In both groups, reliable MMNs were found for the phonological and temporal condition, in the former even a two-peaked one, while spectral differences produced less consistent MMN effects, indicating that spectral information is perceptually more difficult. Additionally we observed that spectral is processed before temporal information. Differences between vowels weight the importance of spectral vs. temporal information during vowel perception, and our data provide initial evidence that this fine balance between the processing of spectral vs. temporal information may be altered in children with dyslexia.

D60

REDUCED LOW-FREQUENCY SAMPLING OF SPEECH IN DYSLEXIC READERS

Nicola Molinaro[1], Mikel Lizarazu[1], Mathieu Bourguignon[2], Marie Lallier[1], Manuel Carreiras[1,3]; [1]BCBL, Basque centre on Cognition, Brain and Language, San Sebastian/Donostia, Spain, [2]Aalto University School of Science, Aalto, Finland, [3]Ikerbasque, Basque Foundation for Science, Bilbao, Spain — Difficulties in literacy development (dyslexia) have been related to poor speech processing skills: reading abilities are, in fact, highly correlated with phonological awareness. However, it is not clear if such behaviourally observable deficits are due to basic difficulties in speech perception or to the metalinguistic nature of the employed paradigms involving conscious decisions. Available neurophysiological data do not provide clear evidence, since few studies focused on natural speech perception. In the present MEG study we evaluated the neural entrainment between natural speech and brain oscillations at multiple frequencies. Dyslexic participants (N=10; mean age: 31 ± 5.3) and controls (N=10; mean age: 32 ± 5.3) listened to sentences for comprehension. We computed the spectral coherence between the speech signal and the MEG recordings collected either when participants were listening to sentences or during resting state. We observed significantly higher coherence values during listening both in the 0.5-2 Hz and 5-7 Hz frequency bands. Group differences however only emerged at 0.5-1 Hz. Source reconstruction (Dynamic Imaging of Coherent Sources) revealed significantly reduced coherence values in the right auditory cortex and the left inferior frontal gyrus (pars opercularis) for dyslexic participants: Only activity in the latter region correlated with both reading measures and phonological awareness ratings. We thus support the claim that natural speech sampling (at low frequencies) is impaired in dyslexic readers; in addition, we propose that the relationship linking such impairment and phonological disorders in dyslexia is mainly subtended by activity in the left inferior frontal cortex.

D61

DYNAMICS OF THE ANATOMICAL CHANGES THAT OCCUR IN THE BRAINS OF SCHOOLCHILDREN AS THEY LEARN TO READ

Gregory Simon[1], Nicolas Poirel[1,2], Virginie Beaucousin[3], Arlette Pineau[1], Olivier Houdé[1,2]; [1]LaPsyDÉ, Unité CNRS 3521, Université Paris Descartes, Université de Caen, PRES Sorbonne Paris Cité, [2]Institut Universitaire de France (IUF), Paris, [3]EA 2027, Laboratoire de Psychopathologie et Neuropsychologie, Universié Paris 8 — Although the functional brain network involved in reading for adults and children is now well documented, a critical lack of knowledge still exists about the structural development of these brain areas. To provide a better overview of the structural dynamics of the brain that sustain reading acquisition, we acquired anatomical MRI brain images from 55 children that were divided into two groups: one prior to the formal learning of reading (n=33, 5-6 years old) and the second a few years after formal learning (n=22, 9-10 years old). For the second group, reading performances were collected based on the French reading test "Alouette-R". Voxel-based morphometry analysis of gray matter showed that only the right insula volume was different between the two groups (when corrected for sex, hand preference and brain volume). Moreover, in the reading group the volumes of the left fusiform gyrus (corresponding to the well-known visual word form area, VWFA), the anterior part of the left inferior occipital gyrus and the left thalamus were significantly modulated by reading performance. Taken together, the present results reveal crucial information regarding reading development, showing that gray matter of the VWFA is modulated by the reading performances of the children, independently of their age. Moreover, in the reading group, the volume of the VWFA is the one that correlated with the larger amount of other reading brain ROIs, suggesting that the VWFA is fully connected with the traditional left-hemispheric language brain network and that these connexions are essential to read efficiently.

D62

A CRUCIAL ROLE FOR PHONOLOGICAL INHIBITION IN AUDITORY REFERENTIAL WORD LEARNING: EVIDENCE FROM AN ARTIFICIAL LEXICON PARADIGM James Magnuson[1,2], Stephen Frost[2], Nicole Landi[1,2], Peter Molfese[2], Daniel Sharoh[2], Jay Rueckl[1,2], Jonathan Preston[2], W. Einar Mencl[2], Kenneth Pugh[1,2]; [1]University of Connecticut, [2]Haskins Laboratories — We report a study from a large-scale effort to identify component abilities supporting robust language and reading. Participants (n=21, college-aged) completed assessments of reading (range = 71,130, M=112), language, and cognition (performance IQ range = 85,139, M=110). They then learned novel spoken names for pictures (unusual fish or minerals) to a criterion of 90% correct (~3 hours). The following day, they retrained (6 trials per word), and then learned a second artificial lexicon from a different semantic class (e.g., minerals if Day 1 had been fish). Lexicons included 24 words; half had onset competitors, half had rhymes; half were in dense neighborhoods (5 onset or rhyme competitors), half in sparse (1 competitor). Accuracy, response latency, and eye movements were recorded. Performance IQ and measures of language/reading ability were significantly correlated with Trials-to-Criterion for both lexicons. In multiple regressions, language/reading measures accounted for significant variance in learning beyond that accounted for by performance IQ. Follow-up analyses indicated that reading measures were most strongly associated with learning the most difficult items: dense onset neighborhoods. Computational modeling (interactive activation) suggests these results, along with previous results from our lab, are best explained by phonological inhibition variation (not phonetic resolution or lexical inhibition or feedback). Learning to read a language like English may strengthen phonological inhibition, or focus it at a segmental (rather than syllabic) level - or better phonological inhibition in spoken language processing may promote better reading. In either case, phonological inhibition explains individual differences in a variety of tasks and measures.

D63

DIFFERENTIAL EFFECTS OF SLEEP IN ADULTS AND CHILDREN LEARNING A AN ARTIFICIAL LANGUAGE Tali Bitan[1], Michael Nevat[1], Qamar Daher[1], Karin Levenberg[1]; [1]University of Haifa — Learning a second language may rely more on procedural learning in children compared to adults. Adults' performance on procedural learning tasks improves after the end of training, depending on sleep, while children do not benefit from sleep. For declarative learning tasks sleep may prevent deterioration of performance. We examine differences between adults and children in the consolidation of a new linguistic rule after the end of training. 34 Adults and 36 children (9-10yrs) received one session of training on new words and their plural inflections, which varied in frequency. Their performance was tested immediately after training as well as after 12 and 24 hours. In each age group half of the participants were trained in the morning and the other half were trained in the evening. Our results show that children's performance improved during the 12 hours period immediately after the end of training, regardless of sleep, while adults did not show any improvement. However, for adults sleep provided protection against the decay inflicted by time awake for the high frequency inflection. Moreover, for the generalization of the acquired knowledge to new words only adults show a sleep dependent increase in the reliance on phonological cues after the end of training. Our results are consistent with the notion that children are less susceptible to interference during wakefulness. Our results also suggest that when learning new linguistic skills children rely more on procedural learning mechanism compared to adults.

LANGUAGE: Lexicon

D64

IS THE OPTIMAL VIEWING POSITION (OVP) ASYMMETRY FOR FOVEAL STIMULI SIMILAR TO RIGHT VISUAL FIELD ADVANTAGE FOR NON-FOVEAL STIMULI? AN ERP INVESTIGATION OF HEMISPHERIC ASYMMETRY Wen-Hsuan Chan[1], Thomas P. Urbach[1], Marta Kutas[1,2]; [1]University of California, Cognitive Science, San Diego, [2]University of California, Neurosciences, San Diego — Visual word recognition is slower and less accurate when fixating further from a position left-of-center within a word (the optimal viewing position, OVP), and more so when fixating a word's end than its beginning. OVP asymmetry (observed for foveal stimuli) has been attributed to the same factors that lead to the right visual field advantage for non-foveal words -- left hemisphere language dominance. We have found that the OVP asymmetry is not word-specific. Here we ask whether a similar mechanism leads to the observed asymmetries for foveal (OVP) and non-foveal (RVF word advantage) stimuli. We used event-related brain potentials (ERPs) to non-wordlike stimuli that spanned fixation or were non-foveally lateralized to one or the other visual field. The latency of the occipital P100 for all lateralized stimuli was delayed in the hemisphere ipsilateral to the side of stimulus presentation. The occipital N170 exhibited similar ipsi vs contralateral latency delay, and smaller amplitudes ipsilaterally. These amplitude reductions were larger with non-foveal than foveal presentation, with a more pronounced difference for left than right visual field presentation. The P100 and N170 latency delays imply a unilateral hemispheric projection for both foveal and non-foveal locations in the visual field at a relatively early visual processing stage. By contrast, the hemispheric asymmetry in N170 amplitude differs for foveal versus non-foveal vision; since N170 is linked to letter identity processing, the suggested hemispheric differences in processing of letters might contribute to OVP asymmetry.

D65

EYE-TRACKING AND EVENT-RELATED POTENTIAL EFFECTS OF TRANSPOSED LETTERS DURING COMPOUND WORD COMPREHENSION: DO MORPHEMES MATTER? Mallory C. Stites[1], Kara D. Federmeier[1], Kiel Christianson[1]; [1]University of Illinois — The current study investigates the online processing consequences of encountering compound words with transposed letters (TLs), to determine if TLs that cross morpheme boundaries are more disruptive to reading than those within a single morpheme. Previous eye-tracking work has demonstrated that reading text with TLs produces reading time costs relative to correctly spelled words (Rayner, White, Johnson, & Liversedge, 2006), but behavioral evidence is mixed as to whether across-morpheme TLs are more disruptive to processing than within-morpheme TLs (Christianson, Johnson, & Rayner, 2005) or not (Rueckel & Rimzhim, 2011). To address this disparity, two separate experiments were conducted, one employing eye-tracking during natural reading, and the other using event-related potentials (ERPs) during word-by-word sentence reading. In both experiments, subjects read sentences containing correctly spelled compound words (cupcake), or compounds with TLs either across morpheme boundaries (cucpake) or within one morpheme (cupacke). Results showed that between- and within-morpheme TLs produced equal processing costs in both measures. In eye-tracking, reading times were longer for all TL words relative to correctly-spelled words, with no difference between the two TL conditions. In the ERPs, TL words elicited a late posterior positivity (from 600-900 ms) that again did not differ between the two TL conditions. Findings across both methods converge to suggest that within- and between-morpheme TLs are equally disruptive to reading compound words in a sentence context. This study provides evidence against the idea that compound words are obligatorily recognized via decomposition into their constituents, which would predict greater processing costs from across-morpheme TLs.

D66

SAME NETWORK BUT DIFFERENT CONNECTIVITY IN L1 AND L2 READING: EVIDENCE FROM CHINESE LEARNERS OF ENGLISH Fan Cao[1], Say Young Kim[2]; [1]Department of Communicative Sciences and Disorders, Michigan State University, [2]Division of Psychology, Nanyang Technological University, Singapore — It has been well documented that L1 and L2 reading share very similar brain network. In the current study, we examined Chinese (L1) word rhyming judgment and English (L2) pseudo-words rhyming judgment in a group of late Chinese-English bilingual adults. We found that the two tasked activated very similar brain network. However, in psychophysiological interactions analysis, we found the activity of three visuo-orthogrpahic regions is more strongly related with left postcentral gyrus when reading English pseudowords while they are more strongly related with right precentral gyrus when reading Chinese characters. We also found that there was a significant correlation between English proficiency and connection between right middle occipital gyrus and left postcentral gyrus in reading English pseudowords, suggesting higher pro-

ficiency is related with greater connection between these two regions. It may be due to a sound-out strategy in the English pseudoword rhyming task, because the left postcentral gyrus is involved in sensory perception. We also found that higher accuracy in the English pseudoword task was correlated with greater connection between right middle occipital gyrus and left supramarginal gyrus, and that faster reaction time in the English pseudoword task was correlated with greater connection between the right middle occipital gyrus and left superior temporal gyrus. The correlations with accuracy and reaction time in the Chinese task were not significant. It suggests that the orthographic-phonological mapping region in left supramarginal gyrus and the phonological representation region in left superior temporal gyrus are more connected with the visuo-orthographic area in English pseudoword rhyming.

D67

N170 EFFECTS DURING MASKED VISUAL WORD PROCESSING - EVIDENCE FOR AUTOMATICITY He Pu[1], Katherine J. Midgley[1,2], Marianna Eddy[1,3], Phillip J. Holcomb[1,2]; [1]Tufts University, [2]San Diego State University, [3]U.S. Army NSRDEC — Although the N170 ERP component is most well-known for its sensitivity to face processing, research has also shown left-lateralized N170 effects to visual language stimuli. Such early effects have been argued to reflect the initial stages of word recognition, as larger N170s are found for words compared to symbols and consonants (Compton et al., 1991; Maurer et al., 2005). The current study extends the previous literature by demonstrating the automaticity of the visual word N170 through the use of masking. Seventy-two Native English speakers engaged in a no/no-go semantic categorization task containing forward and backward masked 50 millisecond presentations of high/low frequency words, pseudowords, strings of consonants, and strings of false fonts. Results showed significantly larger N170 amplitudes to words than to false fonts in occipito-temporal scalp regions and significantly larger N170 amplitudes to words than to consonant strings in occipital scalp regions, indicating that words are processed differently than false fonts and consonant strings. Unlike some previous studies, these effects were not left-lateralized. The presence of an N170 in a masked paradigm where participants were unaware of the critical stimuli suggests the N170 reflects not only early, but importantly, automatic processes during word reading.

D68

TRACKING THE TIME-COURSE OF COMPETITION IN LANGUAGE PRODUCTION: EVIDENCE FOR A POST-RETRIEVAL MECHANISM OF CONFLICT RESOLUTION AND A NEW COMPUTATIONAL MODEL Niels Janssen[1], Juan Andres Hernández[1], Maartje van der Meij[1], Horacio Barber[1]; [1]Universidad de La Laguna, Spain — Producing a word is often complicated by the fact that there are other words that share meaning with the intended word. The competition between words that arises in such a situation is a well-known phenomenon in the word production literature. To account for this phenomenon, models in the behavioral literature standardly assume that competition is resolved early, during the retrieval of words from memory (e.g., Roelofs, 1992). Here we present a new computational neural-network model of word production, in which competition resolution is associated with a mechanism of conflict detection that arises late, after the retrieval of words from memory (e.g., Badre & Wagner, 2007; Botvinick et al., 2001). We tested the predictions of this model using electroencephalography (EEG). In the experiment, participants named pictures using the semantic blocking task, a task often used to study competition (e.g., Kroll & Stewart, 1994). To avoid the high probability of type I errors typically associated with EEG analyses, we relied on novel mixed effect regression techniques. We found that competition was associated with a frontally distributed effect that arose in a late time window, between 500 and 750 ms post-picture onset. Given that the average naming latency in the experiment was around 650 ms, we interpret these data as consistent with the assumptions of our neural-network model of cognitive control, and inconsistent with models from the behavioral literature. These data suggest that competition resolution during word production relies on a late, post-retrieval detection mechanism.

D69

MODELLING LEXICAL DECISION IN NORMAL AND PATIENTS WITH ACQUIRED DYSLEXIA AND SEMANTIC DEMENTIA Ya-Ning Chang[1], Matthew Lambon Ralph[2], Steve Furber[3], Stephen Welbourne[2]; [1]Brain and Language Laboratory, Academia Sinica, Taiwan, [2]Neuroscience and Aphasia Research Unit (NARU), University of Manchester, UK, [3]School of Computer Science, University of Manchester, UK — Lexical decision (LD) has been widely used for studying cognitive processes involved in visual word recognition. Words and nonwords can differ in several aspects. It is likely that different strategies or information can be used for lexical decision (e.g., Grainger & Jacobs, 1996). Recent evidence from behavioural, neuroimaging and patient studies shows that visual, orthographic, phonological and semantic processing all involved in lexical decision albeit to different extents (Evans, Lambon Ralph, & Woollams, 2012; Meyer, Schvanev, & Ruddy, 1974; Woollams, Silani, Okada, Patterson, & Price, 2011). However, the issues as to how the information is generated and combined during the decision tasks remain unclear. To explore this computationally, we developed a fully implemented recurrent model of visual word recognition based on the parallel distributed processing framework. The model was able to perform the lexical decision task by integrating measures of polarity across various processing layers in the model. More importantly, when a specific type of information was inhibited in the model, the damaged model was able to capture the general behavioural patterns as seen in patients with pure alexia, phonological dyslexia and semantic dementia in lexical decision. The decision performance largely depended on the difficulty of the decision task corresponding to different nonword foils. These results suggest that the integrated information across layers within the visual word recognition system can be flexibly used to support lexical decision.

D70

HOW PHONOLOGICAL NEIGHBORHOOD DENSITY AFFECTS VISUAL WORD RECOGNITION Haydee Carrasco-Ortiz[1,2], Katherine J. Midgley[2,3], Jonathan Grainger[4,5], Phillip J. Holcomb[2,3]; [1]Universidad Autonoma de Queretaro, [2]Tufts University, [3]San Diego State University, [4]Aix-Marseille University, [5]Centre National de la Recherche Scientifique — The present study investigated the neural correlates of phonological neighborhood density (PND) in written word recognition. Previous behavioral research has showed that the influence of PND on visual word recognition is modulated by the number of orthographic neighbors of words. To further explore the neural and temporal dynamics of these phonological and orthographic neighborhood effects on visual word recognition, we orthogonally manipulated orthographic and phonological similarity of words using measures of orthographic and phonological Levenshtein Distance 20 (OLD20 and PLD20, respectively). Electrophysiological results showed opposite PND effects as a function of orthographic neighborhood density (OND). Larger N400 amplitudes were elicited by words with high PND compared with low PND when OND was high, and smaller N400 amplitudes were observed with high PND compared with low PND words when OND was low. These findings can be accounted for by the notion of cross-code consistency proposed by Grainger et al. 2005, according to which, the level of compatibility across orthographic and phonological representations generated by a word target, including those that are phonologically and orthographically similar to the target, will affect the process of visual word recognition.

LANGUAGE: Other

D71

EXPOSITORY TEXT COMPREHENSION & EXECUTIVE FUNCTION: AN FMRI STUDY OF ADOLESCENT READERS Stephen Bailey[1], Katherine Swett[1], Angela Sefcik[1], Scott Burns[1], Laurie Cutting[1]; [1]Vanderbilt University — Executive Function (EF) is a critical component of successful reading comprehension, and yet the specific neurobiological relationship between these higher order cognitive skills and reading comprehension is poorly understood. Behavioral studies indicate that, compared to other text types, expository text comprehension specifically places greater demand on EF, particularly working memory, planning/organization, and inference processes (Eason, 2012). Expository text is consequently a unique environment in which to study the interaction between EF and reading comprehension;

however, no imaging studies to date have examined the neural correlates of expository text comprehension. In our study, we observed 40 adolescents (ages 10-14) with normal word efficiency scores (standard score between 85-115), while they comprehended single words and expository text in the fMRI. First, we sought to identify the neural underpinnings of expository text comprehension using a General Linear Model (GLM) analysis. These results suggest that, in addition to traditional left-lateralized language regions, adolescent readers rely on bilateral angular gyrus, posterior cingulate cortex, and temporal poles, as well as left-lateralized medial prefrontal cortex - all higher order processing regions previously implicated in both narrative comprehension and EF studies - when reading expository texts. Additionally, by running a covariate analysis on two non-linguistic measures of general EF ability, we found that higher working memory ability results in less activity in medial prefrontal cortex, while higher planning/organizational scores correlate with less activity in the left dorsolateral prefrontal cortex. This suggests that higher EF scores results in greater efficiency (less activation) in frontal lobe EF regions during adolescent reading comprehension.

D72

SELECTIVE AND INVARIANT NEURAL RESPONSES TO SPOKEN AND WRITTEN NARRATIVES

Mor Regev[1], Christopher Honey[1], Erez Simony[1], Uri Hasson[1]; [1]Princeton University — Linguistic content can be conveyed both in speech and in writing. But how similar is the neural processing when the same real-life information is presented in spoken and written form? Using functional magnetic resonance imaging, we recorded neural responses from human subjects who either listened to a 7 min spoken narrative or read a time-locked presentation of its transcript. Next, within each brain area, we directly compared the response time courses elicited by the written and spoken narrative. Early visual areas responded selectively to the written version, and early auditory areas to the spoken version of the narrative. In addition, many higher-order parietal and frontal areas demonstrated strong selectivity, responding far more reliably to either the spoken or written form of the narrative. By contrast, the response time courses along the superior temporal gyrus and inferior frontal gyrus were remarkably similar for spoken and written narratives, indicating strong modality-invariance of linguistic processing in these circuits. These results suggest that our ability to extract the same information from spoken and written forms arises from a mixture of selective neural processes in early (perceptual) and high-order (control) areas, and modality-invariant responses in linguistic and extra-linguistic areas.

D73

NEURAL AND BEHAVIORAL CORRELATES OF SPEECH MOTOR SEQUENCE LEARNING

Jennifer A. Segawa[1], Jason A. Tourville[1], Deryk S. Beal[1,2], Frank H. Guenther[1,3]; [1]Boston University, [2]University of Alberta, [3]Massachusetts General Hospital — Speech requires a series of rapid and precisely coordinated tongue, jaw, lip, and laryngeal movements. Learning and optimizing motor programs for frequently produced utterances is a key component of this process, but the underlying neural mechanisms are largely unknown. Here, we studied the behavioral and neural correlates of learning new speech motor sequences. After two days of repeated practice, participants produced novel speech sequences containing phonotactically illegal consonant clusters (e.g. GVAZF) faster and more accurately, indicative of motor learning. Using functional magnetic resonance imaging, we compared brain activity during production of novel and learned illegal sequences. The production of novel sequences resulted in greater activity in brain regions linked to general motor sequence learning, including the basal ganglia and pre-supplementary motor area. Novel sequence production also resulted in greater activity in regions associated with learning and maintaining speech motor programs, including lateral premotor cortex, frontal operculum, and posterior superior temporal gyrus. Moreover, across participants, greater behavioral improvement correlated with more efficient processing in frontal operculum and greater structural integrity under posterior superior temporal gyrus. Together, these findings suggest that speech motor sequence learning relies on not only brain regions involved generally in motor sequence learning but also those associated with feedback-based speech motor learning. The results also suggest that individual learning success is modulated by the integrity of structural connectivity between these motor and sensory regions of the brain. These data provide new insight into how the uniquely human trait of speech motor sequence learning is represented in the brain.

D74

SPONTANEOUS INTERPERSONAL SYNCHRONIZATION IN DYSLEXIA

Alexander P. Demos[1,3], Stephanie N. Del Tufo[1,2], Kerry L. Marsh[1], Roger Chaffin[1], Rachel M. Theodore[1,2]; [1]University of Connecticut, [2]Haskins Laboratories, [3]McGill University — The primary etiology of dyslexia has long been considered to be a deficit of phonological awareness (Bradley & Bryant, 1983). Recent evidence, however, points to a more general auditory deficit as the locus of impairment (Banai & Ahissar, 2004). Specifically, impaired phonological processing in dyslexia may reflect a neural architecture that is overly plastic and that, as a consequence, fails to stabilize appropriately for both linguistic and nonlinguistic representations. There is evidence suggesting that children with dyslexia show impaired rhythmic discrimination (Holliman, Wood, & Sheehy, 2008; Overy, Nicolson, Fawcett, & Clarke, 2003), but these findings are at apparent odds with studies showing heightened musical abilities in adults with dyslexia. We examined auditory processing in adults of varied reading ability by asking them to generate rhythmic sounds with a maraca. We used standardized assessments to separate participants into three groups: dyslexic pairs, non-dyslexic pairs, and mixed pairs. Each pair participated in two conditions, holding a steady pace and synchronizing with each other. A wireless motion tracker measured hand movements, which correlated directly with maraca sounds. We measured synchronization between members of a pair using cross-correlation. There was a direct, inverse relationship between reading ability and synchronization. Those with the lowest phonological scores showed the most synchronization in the spontaneous condition, and no diminished capacity to intentionally synchronize with each other. These findings are consistent with the hypothesis that processing deficits in adults with dyslexia are a product of unstable auditory representations.

D75

SPATIAL DISTANCE INFLUENCES THE NEURAL RESPONSE TO DIFFERENT SEMANTIC RELATIONS

Melissa Troyer[1], Ernesto Guerra[2,3], Ben D. Amsel[1], Thomas P. Urbach[1], Katherine A. DeLong[1], Pia Knoeferle[2], Marta Kutas[1]; [1]University of California, San Diego, [2]Bielefield University, [3]Max Planck Institute for Psycholinguistics — Recent behavioral findings suggest that visual processing of spatial distance affects processing of conceptual similarity. For instance, words presented closer together were rated as more similar than those presented farther apart (Casasanto, 2008). Similarly, eye-tracking data showed that spatial distance affected first-pass reading times of sentences about similarity during incremental abstract language comprehension (Guerra & Knoeferle, 2012). However, the nature of such perceptual influences on conceptual processing remains poorly understood. Characterizing the timing of these processes would help to constrain potential mechanisms. Accordingly, we capitalized on the temporal precision of event-related brain potentials (ERPs) to determine how and when spatial distance influences the subsequent processing of a synonymous, antonymous, or unrelated word pair. Participants viewed word pairs from each of these three conditions and decided whether or not the two were or were not antonyms. Critically, each word pair was preceded by two cards that moved either closer together or farther apart from a common starting position. At issue was whether card distance would distinctively affect conceptual processing for synonyms and antonyms (e.g., N400 amplitude). Card distance affected the amplitude of a relatively early, visually-evoked component (P2) known to be modulated by attention to (as well as predictability of) visual word form features, and not the N400. Specifically, P2 (150-250 ms) amplitude effects differed for synonyms and antonyms, but only when the cards moved closer together. We suggest that attending to spatial distance can affect early attentional responses to words, with distinct effects depending on the semantic relationships between them.

THINKING: Development & aging

D76

COGNITIVE ABILITY AND INFLAMMATION ARE ASSOCIATED WITH BRAIN SHRINKAGE IN HEALTHY ADULTS

Ninni Persson[1,2,3], Paolo Ghisletta[5], Andrew, R Bender[3,4], Yiqin Yang[3,4], Peng Yuan[3,4], Cheryl Dahle[3,4], Naftali Raz[3,4]; [1]Department of Psychology, Stockholm University, Sweden, [2]Stockholm Brain Institute, Karolinska Institute, Sweden, [3]Institute of Gerontology, Wayne State University, Detroit, US, [4]Department of Psychology, Wayne State University, Detroit, US, [5]Faculty of Psychology and Educational Sciences, University of Geneva, Switzerland Distance Learning University, Sierre, Switzerland — Fluid cognitive abilities and pathophysiological factors (e.g., inflammation) may affect the course of brain aging. We examined the associations between volume changes in the lateral prefrontal cortex (LPFC) with the adjacent white matter (PFw), hippocampus (HC), parahippocampal gyrus (PHG), and primary visual cortex (VC), and performance on a test of fluid intelligence (gf, Cattell Culture Fair Test, Form 3B) as well as genetic and physiological markers of inflammation. The participants were 147 healthy adults (age 19-79, M = 53.58, SD = 15.11 years at baseline; N = 89 at follow-up) and were assessed twice, approximately two years apart (average delay 25 months, SD = 2.19). Latent difference score models revealed the following. Larger volumes of VC at baseline were associated with higher concurrent gf performance, after controlling for age, sex, education and multiple vascular risk factors. Higher gf at baseline predicted reduced shrinkage in LPFC, but not PFw, HC or VC. The genetic polymorphisms known to increase levels of pro-inflammatory biomarkers, methylenetetrahydrofolate reductase (MTHFR C677T), and interleukin-1Î² (IL-1Î² C-511T), were associated with increased shrinkage in PHG. Higher baseline plasma homocysteine levels predicted increased VC shrinkage. No other ROIs were affected by the genetic and blood markers of inflammation. We conclude that the rate of age-related regional brain shrinkage may depend on cognitive reserve and exposure to pro-inflammatory factors, which are potentially amenable to therapeutic intervention.

LANGUAGE: Other

D77

SWITCHING INTO A NON-DOMINANT LANGUAGE IS HARDER: AN ERP STUDY OF SIMULTANEOUS BILINGUALS

Chia-Hsuan Liao[1], Shiao-Hui Chan[1]; [1]National Taiwan Normal University, Taipei, Taiwan — Language switching is a pervasive conversational feature in a bilingual society. Theoretical models suggested that bilinguals' two languages have different activation levels, which could affect online language processing (e.g., Dijkstran & van Heuven, 2002). Previous studies, however, mainly focused on participants' performance of switching between first and a later learned language, leaving the performance of simultaneous bilinguals, people who acquire both languages from birth, rarely touched (Moreno et al., 2008). In addition, existing studies (e.g., Wang, 2008) tended to investigate switching between decontextualized stimuli (i.e., words, digits), which was not as natural as sentence ones. To fill in the gaps, the current ERP study examined how simultaneous bilinguals process language switching in sentence contexts. Participants were 21 native Mandarin-Taiwanese bilinguals, proficient in both languages but more dominant in Mandarin (the official language in Taiwan) as assessed by pre-tests. Four sentential conditions were manipulated: non-switched Mandarin (MM), non-switched Taiwanese (TT), switched from Mandarin to Taiwanese (MT) and switched from Taiwanese to Mandarin (TM). The results revealed that, switching into a less dominant language (MT vs. MM) elicited an N400, while switching into a more dominant one (TM vs. TT) did not, suggesting that the former process may encounter difficulties in lexical access or lexical integration due to the lower activation level of the less dominant language. Our finding was in line with previous studies that switching into a later learned language (usually a less dominant one) was more difficult. We suggested that language dominance should be considered in conducting bilingual studies.

LANGUAGE: Semantic

D78

EFFECT OF CONSONANT TYPE ON SHAPE ASSOCIATION

Zachary Grulke[1], Ferrinne Spector[1]; [1]Edgewood College — Young children and adults consistently match some nonsense words (e.g., kiki) to jagged shapes and other words (e.g., koko) to rounded shapes (e.g., Spector & Maurer, 2013; Maurer, Pathman & Mondloch, 2006), providing evidence for non-arbitrary sound-shape mapping. Such correspondences are typically attributed to the roundness of the vowel sound. In the present study, we investigated the influence of consonant sound on sound-shape matching in adults. During each trial, participants heard a spoken word and were given a two-alternative forced choice between a jagged shape and a rounded shape. Thirty-two nonsense words with reduplicated syllables that contained either plosive consonants (i.e. a consonant that is made by blocking airflow and then releasing it) or non-plosive consonants (i.e. a consonant that is made by channeling airflow through a narrow vocal tract) were used. Half of the words were presented with rounded vowel sounds (e.g., koko) and half with non-rounded vowel sounds (e.g., kiki). Crucially, the nonsense words were presented in a standardized video format, ensuring that every participant viewed the same stimuli. Preliminary results for a subset of the sounds spoken by an experimenter suggest that consonants m, b, p, n, f, d, and g are associated with rounded shapes while consonants t, v, z, and k are associated with jagged shapes. The results provide novel evidence for naturally biased correspondences between consonant sound and shape that builds on a growing body of literature suggesting that naturally-biased sound symbolic associations may help influence early language learning.

D79

THE EFFECT OF LEXICAL INFORMATION ON LOGICAL INTERPRETATION OF SENTENCES: EVIDENCE FROM ADJECTIVE CONJUNCTION

Eva B. Poortman[1]; [1]Utrecht University — Linguistic theories generally assume a relationship between syntactic form and logical meaning of sentences which is independent of lexical information of content words. Recent studies suggest that lexical information actually does affect logical interpretation. The current study supports this by studying sentences with adjective conjunction e.g. "The animals are big and gray", which according to formal semantics always receive a Boolean interpretation (all animals are both big and gray). We show that weaker interpretations are also attested, e.g. for "The animals are big and small". Specifically we aimed to show that lexical meanings of conjoined adjectives consistently affect logical interpretation. Subjects were presented with sentences of the form "The A's are X and Y" (A = plural noun; X, Y = adjectives) and images depicting four entities - two identical pairs, each with a value of two domains, like size (X) and color (Y). For example, pair 1 were big (X1), yellow (Y1) giraffes while pair 2 were small (X2), gray (Y2) mice. Test sentences contained either across-domain adjectives (The animals are big and gray) or within-domain adjectives - resulting in lexical incompatibility (The animals are big and small). Results of a truthvalue-judgment task reveal a strong effect of lexical compatibility: sentences with within-domain adjectives are highly acceptable for the image, while those with across-domain adjectives are not. This indicates that when lexical properties of adjectives contradict a boolean interpretation, a weaker interpretation is accepted - suggesting the need for a theory of conjunction which takes into account lexical knowledge.

D80

SECOND-LANGUAGE VOCABULARY TRAINING STRATEGIES AND THEIR IMPACT ON LEARNING OUTCOMES AND BRAIN FUNCTION

Kiera O'Neil[1], Max Hauser[1], Vivian Eng[1], Cheryl Frenck-Mestre[2], Aaron J. Newman[1]; [1]Dalhousie, [2]Université Aix-Marseille — The goal of the current study was to assess the efficacy of two second-language (L2) vocabulary training strategies on learning outcomes and brain activation. Words in a language novel to participants (Spanish) were taught using LANGA (Copernicus Studios, Halifax, NS), a set of computer games using automated speech recognition. A vocabulary of 84 words (none of which were English cognates) were taught over 9 half-hour sessions. Half the words were taught via paired association (i.e. a picture paired with an individual spoken Spanish word) and half were taught contextually (i.e. visual representation paired with 3-word spoken Spanish sentences), with word assignment balanced

across participants. Participants were assessed on Spanish vocabulary knowledge before and after training using both a picture naming task and a picture-word match/mismatch task. ERPs (event-related potentials) were recorded during the latter task. As the N400 is an index of lexical access, we predicted a N400 ERP mismatch-match difference after, but not before training. After training, subjects were able to name significantly more items than before training. Mismatched picture-word pairs elicited an N400 effect after, but not before training. Initial analyses suggested that the N400 was greater for words taught contextually than for those taught by paired association. This research demonstrates the efficacy of automated speech recognition in teaching vocabulary in a new language, and suggests that contextual teaching strategies appear to foster better second language retention.

D81

DIFFERENTIAL MOTOR CORTEX INVOLVEMENT IN FIRST AND SECOND LANGUAGE SEMANTIC PROCESSING: EVIDENCE FROM MU-RHYTHM EEG OSCILLATION DYNAMICS

Nikola Vukovic[1], Yury Shtyrov[2,3]; [1]Department of Theoretical and Applied Linguistics (DTAL), University of Cambridge, United Kingdom, [2]Center of Functionally Integrative Neuroscience (CFIN), Aarhus University, [3]Centre for Languages & Literature, Lund University, Sweden — Understanding neurocognitive mechanisms supporting the use of multiple languages is a key question in language science. Recent neuroimaging studies in monolinguals indicated that core language areas in human neocortex together with sensorimotor structures form a highly interactive dynamic system underpinning native language comprehension. While the experience of a native speaker promotes the establishment of strong action-perception links in the language comprehension network, this may not necessarily be the case for L2 where, as it has been argued, the most a typical L2 speaker may get is a link between an L2 wordform and its translation equivalent. Therefore, we asked whether the motor cortex, whose role in bilingualism remains unexplored, shows differential responses depending on the language of the stimuli and their action semantics. We used EEG to dynamically measure changes in motor activity, indexed by event-related desynchronisation (ERD) of the cortical mu-rhythm, in response to L1 (German) and L2 (English) action words in a passive reading task. Analysis of motor-related EEG oscillations at the sensor level revealed an early (around 200 ms) and left-lateralised coupling between action and semantics during both L1 and L2 processing. Crucially, source-level activation in the motor areas showed that mu-rhythm ERD, while present for both languages, is significantly stronger for L1 words. This is the first neurophysiological evidence of rapid motor-cortex involvement during L2 single word reading. Our results both strengthen embodied cognition evidence obtained previously in monolinguals and, at the same time, reveal important quantitative differences between L1 and L2 sensorimotor brain activity.

D82

NEURAL MARKERS OF GRAMMAR LEARNING

Jennifer Minas[1], Amy Finn[1], Calvin Goetz[1], Tyler Perrachione[2], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Boston University — While much work has characterized the neural correlates of learning phonetic and tonal aspects of language, few studies have been able to explore the neural correlates of learning a novel grammar. To explore which regions of the brain are most responsive to growing grammatical expertise, we scanned individuals prior to and after learning a fully productive miniature artificial language (MAL). The MAL was learned in an immersion-type setting. Over the course of 4 days, participants observed a total of 360 narrated scenes on a computer and repeated the narrations while trying to learn the language. The MAL was made up of 30 nouns, 4 verbs, and 2 determiners, subject-object-verb (SOV) word order, regular determiner-word pairings, and subject-verb agreement. On each day, participants were tested for knowledge of all aspects of the language. Prior to and after learning, participants were scanned while processing sentences in the new MAL, their native language (English) and a language they didn't know nor had any exposure (Mandarin). As compared with the known language (English), learning of the MAL (post scan > pre scan) was associated with greater recruitment of both frontal (left Inferior Frontal Gyrus; IFG) and posterior (left Superior Temporal/Parietal Area) language regions. As compared with the unknown language (Mandarin), learning of the MAL (post > pre) was likewise associated with greater recruitment of frontal language regions (left IFG), with fewer differences observed in posterior regions. Data suggest that grammatical learning (early-on) is associated with greater (not more focal) recruitment of classic language regions.

D83

THE ROLE OF THE LEFT ANTERIOR TEMPORAL LOBE IN LANGUAGE PROCESSING: THE INTERACTION BETWEEN COMBINATION EFFECTS AND CONCEPT SPECIFICITY EFFECTS

Linmin Zhang[1], Liina Pylkkänen[1]; [1]New York University — The left anterior temporal lobe (LATL) has been robustly implicated for two language-relevant processes: composing basic combinatorial phrases and specifying concepts. Here we used magnetoencephalography (MEG) to investigate the following hypothesis: if these processes share a common underlying mechanism, then the two effects should localize similarly in time and space and could conceivably add up if elicited within the same design. To test this, we used modification structures of the pattern "noun modifier + noun headword" (tomato soup) and varied the specificity of the modifier and the headword (tomato/vegetable soup/dish). These combinatory stimuli were further compared with single words of high and low specificity, preceded by consonant strings that could not compose with them (qptg dish). The results showed that (i) more specific modifiers led to a larger LATL composition effect on the headword; (ii) the main effect of headword specificity was less robust than that of modifier specificity on activity elicited by the headword; (iii) the pattern obtained for single words of high and low specificity conformed with the results of previous neuropsychological and hemodynamic studies, i.e., more LATL activity was elicited by more specific headwords. These results are consistent with the hypothesis that composition and specificity effects in the LATL share a common mechanism, but also suggest that quantitatively, conceptual specificity may have a larger effect on combinatory responses than on responses to single words, given that our single word specificity effect was much weaker than our modifier specificity effect on activity elicited by the headword.

D84

EVIDENCE FOR A COMMON SEMANTIC REPRESENTATION FOR PICTURES AND WORDS

Manoj Kumar[1,2], Kara D. Federmeier[1,2], Li Fei-Fei[3], Diane M. Beck[1,2]; [1]Univeristy of Illinois at Urbana-Champaign, [2]Beckman Institute for Advanced Science and Technology, [3]Stanford University — A long-standing core question that has remained unanswered in cognitive science is: Do different modalities (pictures, words, sounds, smells, tastes and touch) access a common store of semantic information? Although different modalities have been shown to activate a shared network of brain regions, this does not imply a common representation, as the neurons in these regions could process the different modalities in completely different ways. A truer measure of a "common code" across modalities would be a strong similarity of the neural activity evoked by the different modalities. Using multivoxel pattern analysis (MVPA) we examined the similarity of neural activity across pictures and words. Specifically, we asked if scenes (e.g. a picture of a beach) and related phrases (e.g. "sandy beach") evoke similar patterns of neural activity. In an fMRI experiment, subjects passively viewed blocks of either phrases describing scenes or pictures of scenes, from four different categories: beaches, cities, highways, and mountains. To determine whether the phrases and pictures share a common code, we trained a classifier on one stimulus type (e.g. phrase stimuli) and then tested it on the other stimulus type (e.g. picture stimuli). A whole brain MVPA searchlight revealed multiple brain regions in the occipitotemporal, posterior parietal and frontal cortices that showed transfer from pictures to phrases and from phrases to pictures. This similarity of neural activity patterns across the two input types provides strong evidence of a common semantic code for pictures and words in the brain.

LONG-TERM MEMORY: Development & aging

D85

REACTIVATION-INDUCED UPDATING THAT ENHANCES AND DISTORTS MEMORY IS REDUCED IN AGING

Peggy L. St. Jacques[1], Daniel Montgomery[1], Daniel L. Schacter[1]; [1]Harvard University — Reactivation can update memory by enhancing existing representations and by incorporating relevant new information, but can also contribute to memory distortions. In a previous study in young adults we found that the quality of memory reactivation modulated these subsequent memory effects. In the current study we investigated age-related changes in reactivation-related updating contributing to subsequent true and false memories for real-world events experienced during a museum tour. Young and older adult participants encoded events they experienced during an audio-guided museum tour. Participants returned to the lab 48 hours later and reactivated memories for the museum tour cued by photos from stops they visited; on some trials reactivated memories were followed by a novel lure photo from an alternate museum tour. A recognition memory test occurred 48 hours later in which participants were shown target and lure photos that were previously presented (i.e. reactivation) or not previously presented (i.e. baseline). Because older adults exhibit reductions in recollection processes and contextual recall, which contribute to the quality of reactivation, we predicted that older adults would show a decrease in reactivation-related effects on subsequent memories. Consistent with our prediction, there was an age-related decrease in subsequent true and false memories in the reactivation condition compared to baseline. These data reveal that aging alters reactivation-related updating that supports the dynamic and flexible nature of memory.

D86

COMMON BUT IMPACTFUL GENETIC POLYMORPHISMS IN COMT & BDNF ARE ASSOCIATED STRONGLY WITH READING AND RELATED SKILLS AND ASSOCIATED PATTERNS OF NEURAL ACTIVITY

Nicole Landi[1], Sergey Kornilov[1], Peter Molfese[2], Kaja Jasinska[2], Maria Lee[3], W.Einar Mencl[2], Kenneth Pugh[2], Elena Grigorenko[3]; [1]University of Connecticut, [2]Haskins Laboratories, [3]Yale Child Study Center — In both children and adults there is large variability in reading skill, with approximately 5-10% of individuals characterized as having reading disability. These individuals struggle to learn to read despite adequate intelligence and opportunity. Although it is well established that a substantial portion of this variability is attributed to the genetic differences between individuals, specifics of the connections between reading and the genome are not well understood. I will present fMRI, SMRI, single nucleotide polymorphisms (SNPs) and combinatorial genetic polymorphisms (haplotype analyses) as well as behavioral (phenotypic) data which suggest that variation in the COMT and BDNF genes, including the COMT Val/Met polymorphism at rs4680, (previously associated with variation in higher-order cognition) and multiple SNPs in BDNF (previously associated with learning and memory) are associated with reading and language skills, at the level of both brain and behavior. I will argue that these polymorphisms, known for their broad effects on cognition, may modulate reading skill and related abilities including spelling and oral language. Moreover, recent findings with the analyses of haplotypes in COMT and BDNF suggest that phonological awareness, oral language and some aspects of higher-order cognitive abilities are strongly linked to combinations of genotypic profiles in COMT and BDNF.

D87

THE EFFECT OF AGING ON SLEEP-DEPENDENT CONSOLIDATION OF POSITIVE EMOTIONAL MEMORIES

Bethany J Jones[1], Bengi Baran[1], Kurt S Schultz[1], Rebecca M C Spencer[1]; [1]University of Massachusetts, Amherst — A large body of research indicates that sleep benefits memory consolidation, with evidence suggesting a particularly strong effect for representations with emotional salience. However, as most studies have obtained this outcome with negatively-valenced material, the effect of sleep on positive memories is less clear. Aging is associated with a decline in sleep-dependent consolidation for some types of learning. Whether age influences the effect of sleep on consolidation of emotional memories, however, remains unknown. The goal of this study was to determine the effect of aging on sleep-dependent consolidation of positive emotional memories. To this aim, young (18-30 yrs) and older (50-80 yrs) adults viewed positive and neutral pictures either in the morning (Wake groups) or the evening (Sleep groups). Twelve hours later, participants underwent a recognition task in which they viewed the previously seen pictures (targets) as well as new images and indicated whether they remembered each one. Polysomnography recordings were collected for the Sleep groups. Young adults remembered significantly more positive target pictures than neutral target pictures ($p<0.001$), with no effect of sleep on memory for either positive or neutral pictures. In older adults, the Sleep group remembered significantly more target images than the Wake group ($p=0.047$), with no effect of emotional valence. We expect memory performance in older adults to be positively related to time spent in rapid eye movement sleep. These results may indicate that positive memories are more salient for older individuals than young adults, thus compelling processing during sleep in the former.

D88

EVENT RELATED POTENTIAL INVESTIGATIONS OF ACTIVE & PASSIVE MEMORY RETRIEVAL DURING EARLY CHILDHOOD

Alison Robey[1], Tracy Riggins[1]; [1]University of Maryland, College Park — Previous studies have reported memory effects (i.e., differential responses to old versus new stimuli) using event-related potentials (ERPs) during early childhood. However the majority of these studies have used passive viewing paradigms, meaning children view pictures during ERP recording and memory responses are obtained post-recording. The goal of the present work was to determine if ERP memory effects during item and source memory tasks varied under passive versus active (i.e., responding for each trial during recording) retrieval conditions. During encoding, 4- to 5-year-old children were familiarized to items in multiple contexts. During retrieval children were shown pictures of both items they previously encountered and new items, while their brain activity was recorded. Children in the active retrieval condition gave verbal memory responses during recording; children in the passive condition viewed the images and preformed the retrieval task after recoding. Behavioral performance and ERP memory effects were similar between groups and for both the Negative Component (Nc) and Positive Slow Wave (PSW). Main effects of Group were found, with greater amplitude in the Active, compared to the Passive Group; however, no Group x Condition interactions were found suggesting that active and passive retrieval rely on a similar neural network. These results are important because they suggest memory effects can be detected during both passive and active retrieval conditions in early childhood. Moreover, given that the majority of data lost due to artifact was in the active group, it also suggests that passive retrieval paradigms may be advantageous during this developmental period.

D89

RESTING-STATE FUNCTIONAL CONNECTIVITY AND SLEEP IN YOUNGER AND OLDER ADULTS

Janna Mantua[1], Bengi Baran[1], Rebecca M.C. Spencer[1]; [1]University of Massachusetts, Amherst — Sleep is an active process beneficial for learning and memory. Functional MRI (fMRI) studies suggest hippocampal activation and connectivity with nearby and distant regions is crucial for efficient memory recall and may also be altered by sleep. Resting state fMRI shows age-related changes in brain activation and connectivity, a possible mechanism for degraded memory performance in older adults. This study sought to investigate both age-related changes in functional connectivity and changes in sleep quality. Eleven younger adults (YA:18-30 years) and 7 older adults (OA:55-70 years) underwent resting-state fMRI. A standard neuropsychological battery was administered prior to testing. Subjects underwent polysomnography for measurements of sleep quality and composition. As expected, performance of older adults was greatly reduced for tests of episodic memory. Older subjects also had significantly worse sleep efficiency (time sleeping/time in bed) than young adults ($F=4.03;p=0.05$). Consistent with previous studies, resting-state fMRI showed a positive correlation, representing coactivation, between the hippocampus and bilateral ventral cingulate cortices in both groups (YA: $T=6.04;p\text{-FDR}=0.01$; OA: $T=5.39;p\text{-FDR}=0.01$). Both groups showed a negative correlation between the hippocampus and the superior frontal gyrus (YA:$T=-3.15;p\text{-FDR}=0.04$; OA:$T=-4.33;p\text{-FDR}=0.04$) and the dorsolateral prefrontal cortex (YA: $T=-4.33;p\text{-FDR}=0.009$; OA:$T=-6.45;p\text{-FDR}=0.01$),

reflecting hippocampal activation coupled with frontal deactivation. Conversely, only the older adult group showed connectivity between the hippocampus and the posterior cingulate cortex/precuneus (T=4.43;p-FDR=0.01). These results show different patterns of functional connectivity and sleep quality between younger and older adults. We predict alterations in connectivity are mediated by changes in slow wave activity during sleep, which is crucial for long-term memory.

D90

ADULT AGE DIFFERENCES IN ERP CLUSTER-BASED PERMUTATIONS DURING IMPLICIT LEARNING IN THE TRIPLETS LEARNING TASK

Seth Kiser[1], Rebecca Fuller[1], Darlene Howard[2], James H. Howard Jr.[1,2,3]; [1]The Catholic University of America, Department of Psychology, [2]Georgetown University, Department of Psychology, [3]Georgetown University, Department of Neurology — Implicit sequence learning involves learning the likely order of events making it possible to process future events more effectively. For example, in the Triplets Learning Task (TLT) subjects observe two "cues" and respond to a third "target" by key-press on each of a series of trials. Unbeknownst to them, the first cue predicts the target on 80% of the trials (high probability targets) and another location on 20% of the trials (low probability targets). Learning is reflected in faster and more accurate responding to high than low probability targets. In the present study, event-related potentials (ERP) were captured for younger and older adults during learning in the TLT and analyzed separately using non-parametric cluster-based permutations for each of three learning sessions. Results identified significant clusters for younger and older adults representing ERP differences to event probabilities during the first session of learning, but no significant clusters were identified in subsequent sessions of the TLT for either group. Thus, the ERP findings are dissociated from behavioral results, which reveal a monotonic increase in learning across sessions for both groups. In addition, clusters in older adults are qualitatively different in topography and temporal distribution from clusters in younger adults. In particular, compared to younger adults, older adults exhibit greatly reduced posterior ERP differences to event probabilities, as well as different time-windows for clusters. These findings are consistent with previous evidence that the neural basis of implicit learning may differ with age.

D91

DYNAMIC REORGANIZATION IN THE ADULT BRAIN: A COMBINED TMS, FMRI AND DTI STUDY

David Murphy[1], Simon W Davis[1], Nichole R Lighthall[1], Sarah H Lisanby[1], Bruce Luber[1], Roberto Cabeza[1]; [1]Duke University — Although healthy aging is associated with substantial anatomical and physiological brain decline, studies using functional neuroimaging techniques such as fMRI have found that the aging brain does not endure these changes passively. We propose that the aging brain actively attempts to counteract these deleterious processes through a process of functional reorganization. However, it is difficult to study this reorganization without a dynamic, causal manipulation of the neural detriments. We investigated this dynamic reorganization using a novel combination of imaging measures which allowed us to dynamically introduce a need for functional reorganization. We measured neural activity associated with subsequent memory both before and after inhibitory or excitatory rTMS to left middle frontal gyrus (MFG). After inhibitory rTMS, older adults showed no group deficits in memory performance. This null effect was explained by the neural response to rTMS. After inhibitory rTMS, subjects demonstrated increases in right hippocampus relative to a baseline memory run, and the degree of activity in this region predicted faster memory retrieval. In contrast, after excitatory rTMS, encoding-related activity increased in left MFG and left hippocampus and was also associated with faster memory. Furthermore, individual differences in the functional connectivity during successful memory trials between these regions was positively related to white matter connectivity through the uncinate fasciculus, a major white matter tract connecting frontal and MTL regions. These results suggest that older adults utilize flexible frontotemporal architecture in order to maintain cognitive performance, and that this flexibility is supported by white matter architecture.

D92

ALZHEIMER'S DISEASE FAMILY HISTORY IS ASSOCIATED WITH DIFFERENTIAL ERP ACTIVITY DURING FACE-NAME RECOGNITION

Jessica Dodd[1,2], Meghan Mitchell[1,2], Steven Shirk[1,2], Donald McLaren[1,2], Brandon Ally[3], Alireza Atri[1,2]; [1]Bedford VAMC, [2]Massachusetts General Hospital, [3]Vanderbilt University — High-density event-related potential (ERP) EEG data has shown promise as a potential biomarker of memory function and processing changes in aging and Alzheimer's disease (AD). Previous work in PSEN1 mutation carriers, a dominant genetic risk factor for AD, has shown altered ERP signals during recognition tasks. In this study we sought to examine potential differences in EEG activity during a face-name paired-associate recognition task between participants with (FHxAD+) and without (FHxAD-) a family history of Alzheimer's disease. Twenty-eight participants aged 19-69 (14 with a family history of AD and 14 age-and-education-matched controls without a family history of AD) studied 72 face-name pairs, of which 36 were presented four times (4R) and 36 were only presented once (1R). Participants then made old/new judgments for 80 face-name pairs, of which 40 were old (20 were 1R and 20 were 4R) and 40 were novel (N). ERP activity during the correct identification of a face was then analyzed. FHxAD- individuals had significantly more frontal activity within the frontal pole during retrieval between 800-900 ms for N vs. 1R than the FHxAD+ individuals ($p<0.05$). This finding supports results from the literature to suggest that ERP activity profiles during performance of memory tasks, in this case face-name recognition, may hold promise as potential non-invasive endophenotypic markers of AD risk or trait in clinically cognitively normal adults.

D93

AGE DIFFERENCES IN MEMORY BASED DECISIONS: THE ROLE OF ASSOCIATIVE AND STRATEGIC COMPONENTS

Anika Josef[1], Mata Rui[1], Shing Yee Lee[1], Pachur Thorsten[1], Hertwig Ralph[1]; [1]Max Planck Institute for Human Development — Memory ability is essential for successful decision making in everyday life. In such situations, associative binding of information but also the strategic retrieval of complex memories are crucial processes in determining decision success. Yet, age-related cognitive decline due to disruption of medial-temporal, hippocampal, and frontal regions may especially compromise associative memory ability but also cognitive control mechanisms necessary for effective decision making. In a set of studies, we investigated the role of memory demand on age-differences in decisions from memory. More concretely, we asked young and older adults to make decisions in two decision situations with varying memory demand. In two studies, age-differences in decision performance increased with the memory demand, with older adults performing significantly worse relative to younger adults. In addition, increased memory demand forced participants, in particular older adults, to select simpler decision strategies that use fewer pieces of information. But how do age-related changes in the ability to strategically execute decision strategies in memory contribute to this effect? We conducted a third study in which we asked young and older adults to execute previously instructed decision strategies varying in their memory demand. The results show that, in comparison to young adults, older adults show more pronounced deficits in strategic monitoring and selection of information. We conclude that older individuals are forced to select simpler decision strategies in decision situations with high memory demand due to both deficits in associative as well as strategy execution components.

D94

REMEMBERING FACES AND NAMES: AGE-RELATED ERP EFFECTS

Meghan Mitchell[1], Steven Shirk[1], Donald McLaren[1], Jessica Dodd[1], Ali Ezzati[2], Alireza Atri[1]; [1]Bedford VA Medical Center & Harvard Medical School, [2]Albert Einstein School of Medicine — Previous research has established the validity and reliability of the face-name paired-associate memory paradigm to yield differential patterns of task-related BOLD fMRI activity in bilateral medial temporal lobe structures across the age and Alzheimer's disease spectrum. In this study we aimed to examine in cognitively normal old and young adults potential differences in frontal and parietal time-sensitive event-related potential (ERP) activity during performance of a face-name recognition task. Thirty-three participants (16 young adults aged 18-39 and 17 older adults aged 55-69) studied 72 face-name pairs, of which 36 were

presented four times (4R) and 36 were only presented once (1R). Participants made old/new judgments for 80 face-name pairs, of which 40 were old (20 1R and 20 4R) and 40 were novel. ERP activity during the correct identification of a face was then analyzed using analysis of variance methods applied to a priori regions of interest (ROI). Planned contrasts showed a significant difference between age groups in early frontal ROI activation (300-500 ms) for N vs. 1R ($p<.05$). A significant difference between the two age groups was also observed in parietal ROI activation (500-800 ms) for 4R vs. 1R ($p<.05$). Findings complement robust spatial resolution fMRI signals of activity in the medial temporal lobes with temporal resolution frontal and parietal ERP signals that show classic old/new effects; these results suggest that multimodal assessment of associative memory processes using a combination of task-related fMRI and ERP data may provide complementary information regarding the dynamics of memory function and cognitive aging.

D95

THE EFFECTS OF EMOTION AND HEALTHY AGING ON STRUCTURAL AND FUNCTIONAL CONNECTIVITY Jaclyn Ford[1], Elizabeth Kensinger[1]; [1]Boston College — Prior research has shown that emotion can alter functional connectivity during retrieval, and that these alterations may differ as a function of age. These age-related changes may reflect differences in the cognitive mechanisms supporting emotional memory retrieval. However, it is unclear how these changes relate to documented degradations of white matter tracts. The current study addressed this question by examining the effect of aging (treated as a continuous variable) on functional connectivity during retrieval of emotional information and structural connectivity (measured using fractional anisotropy, FA). As prior studies have suggested that prefrontal regions may guide emotional memory search and regulate emotions via functional connections with the amygdala, the current analysis focused on functional and structural connectivity between the left ventrolateral prefrontal cortex (vlPFC) and the left amygdala. Prior to scanning, participants encoded positive, negative, and neutral images paired with neutral titles. After a thirty minute delay, while undergoing fMRI, participants viewed the neutral titles and indicated whether the title had been presented with an image during study. An emotion-by-FA interaction revealed that FA predicted functional connectivity during retrieval of negative memories, but not positive or neutral. Specifically, individuals with higher structural integrity exhibited a stronger negative connectivity between the vlPFC and amygdala. Furthermore, an age-by-emotion-by-FA interaction revealed that this relationship was more pronounced for older adults. These findings are consistent with theories that older adults may engage regulatory strategies during the retrieval of negative memories if they have the structural pathways to allow them to do so.

LONG-TERM MEMORY: Episodic

D96

DAMAGE TO THE MEDIAL PREFRONTAL CORTEX IS ASSOCIATED WITH ABNORMAL MUSIC-EVOKED AUTOBIOGRAPHICAL MEMORIES Amy M. Belfi[1], Daniel Tranel[1]; [1]University of Iowa — Music is strongly intertwined with memories - for example, hearing a song from your wedding can transport you back in time, triggering the sights, sounds, and feelings of that night. Neuroimaging research has identified the medial prefrontal cortex (mPFC) as a region involved in music-evoked autobiographical memories (Janata, 2009). The mPFC tracks musical structure, is involved in emotional processes, and supports autobiographical memory retrieval. Therefore, this region may be crucial in associating music, emotion, and autobiographical memory. Here, we used a neuropsychological approach to test the necessity of the mPFC. Patients with damage to the mPFC and comparison participants listened to 30 popular songs from the years when the participants were between 15-30 years old. For a comparison, participants viewed 30 faces of individuals who were famous during the same years as the songs that were selected. After each stimulus, participants described memories that were evoked. Memory descriptions were coded to quantify the amount of episodic and semantic details in each (Levine et al., 2002). In normal and brain-damaged comparison participants, music-evoked memories were more vivid - specifically, music-evoked memories had a higher ratio of episodic/total details than face-evoked memories. In patients with mPFC damage, music-evoked memories were not more vivid than face-evoked memories; also, these patients had significantly less vivid music-evoked memories. These findings extend previous functional imaging work and indicate that the mPFC is necessary for normal music-evoked autobiographical memories. This is consistent with the theory that the mPFC is a key region for binding music, emotion, and autobiographical memories

D97

CHARACTERIZING AUTOBIOGRAPHICAL AND SPATIAL MEMORY IN A CASE OF TOPOGRAPHICAL DISORIENTATION Jessica Robin[1,2], Josée Rivest[3,4], Morris Moscovitch[1,2,3]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest Hospital, [3]Psychology Department, Baycrest Hospital, [4]Glendon College, York University — Topographical disorientation describes the inability to find one's way in a familiar environment. This is frequently seen in cases of dementia or diffuse brain damage, but can also occur as a result of focal lesions (Hashimoto, Tanaka, & Nakano, 2010). In the present study, we studied the relationship between topographical disorientation and memory in a man (LH) who, after suffering a traumatic brain injury, began exhibiting severe topographical disorientation. LH is only able to navigate with the help of a dynamic map on his smartphone. We tested his spatial and autobiographical memory abilities based on personally-known landmarks of varying familiarity. We found that although LH retained knowledge of the directional relationships between familiar landmarks, he was impaired at visually recognizing those same landmarks. When asked to describe these landmarks from memory, LH was only able to produce general descriptions lacking in specific perceptual details. Consistently, LH was able to retrieve and describe autobiographical episodic memories based on landmark cues, but these too were lacking in detail. Furthermore, unlike in controls (Robin & Moscovitch, 2013) his memories did not appear to benefit from increased spatial contextual familiarity. These results suggest that the ability to recognize and remember detailed spatial scenes may be dissociable from map-like directional knowledge, but may be related to the ability to recall autobiographical memories.

D98

CAN EYE MOVEMENTS BIAS MEMORY RECALL? Andrea L Wantz[1], Fred W Mast[1], Janek S Lobmaier[1]; [1]University of Bern, Switzerland — A large body of research suggests that when we retrieve visual information from memory, we look back to the location where we encoded these objects. It has been proposed that the oculomotor trace we act out during encoding is stored in long-term memory, along other contents of the episodic representation. If memory recall triggers the eyes to revisit the location where the stimulus was encoded, is there also an effect in the reverse direction? Can eye movements trigger memory recall? In Experiment 1 participants encoded two faces at two different locations on the computer screen. Then, the average face (morph) of these two faces appeared in either of the two encoding locations and participants had to indicate whether it resembles more the first or second face. In Experiment 2 the morph appeared in a new location, but participants had to repeat one of the oculomotor traces that was used during encoding. Participants' morph perception was influenced both by the location and the eye-movement it was presented with. Our results suggest that eye-movements can bias memory recall, but only in a short-lasting and rather fragile way.

D99

VOLUMETRIC ANALYSIS OF MEDIAL TEMPORAL LOBE SUBFIELDS IN THE ATYPICAL FORM OF ALZHEIMER'S DISEASE, LOGOPENIC VARIANT OF PRIMARY PROGRESSIVE APHASIA. Khaing Win[1,3], John Pluta[2], Paul Yushkevich[2], David Wolk[1], Murray Grossman[1,3]; [1]Neuroscience Graduate Group, University of Pennsylvania, [2]Penn Image Computing and Science Lab, University of Pennsylvania, [3]Penn Frontotemporal Degeneration Center, Hospital of the University of Pennsylvania — Medial temporal lobe (MTL) is one of the earliest brain structures affected in Alzheimer's disease (AD). To date, no study has examined the degree to which MTL subfields are compromised in the logopenic variant of primary progressive aphasia (lvPPA), characterized by poor repetition and limited naming, and often associated with AD pathology. Here, we examined the differential involvement of MTL subfields in lvPPA patients (n=11) in comparison to the cognitively normal elderly controls (n=33) and amnestic mild cognitive impairment (aMCI) patients (n=31), generally enriched in patients with

prodromal AD and MTL involvement. All subjects underwent high resolution (0.4x0.4mm in-plane, 2.6mm slice thickness) T2-weighted MRI, allowing visualization of the dark band separating cornu ammonis (CA1) from dentate gyrus (DG). A multi-atlas algorithm was applied to automatically label CA1, DG, entorhinal cortex, BA35 and BA36. Groups were matched in gender, education, and intracranial volume, but not for age. Both aMCI and lvPPA patients were matched in Mini-Mental State Examination. Analysis of covariance (covarying for age), and post-hoc tests showed distinct patterns of atrophy: greater atrophy in bilateral CA1 and subiculum, and right BA35 in lvPPA compared to controls; greater atrophy in bilateral CA1 and DG, and left BA35 in aMCI compared to controls; and greater atrophy of bilateral subiculum in lvPPA compared to aMCI. Thus, despite the relative sparing of memory in lvPPA, significant MTL involvement was found; the distinct distribution of MTL atrophy in lvPPA relative to aMCI may contribute to the different cognitive profiles of these patient groups.

D100

THE DURATION EFFECT IN FORCED-CHOICE RECOGNITION OF SCENES

Fahad Ahmad[1], William Hockley[1], Morris Moscovitch[2]; [1]Wilfrid Laurier University, [2]University of Toronto — Konkle et al. (2010) examined recognition of a large number of studied photographs of scenes in a forced-choice test. The difference in recognition performance between novel (i.e. old scene and new scene of difference category) and exemplar test (i.e. old scene and new scene of same category) conditions increased with the number of exemplar scenes presented at study. However, observers were capable of distinguishing between scene exemplars with a modest impairment as number of scene exemplars increased. Ahmad, Hockley and Moscovitch (2013) examined whether duration of presentation of scene at study would reduce recognition performance in exemplar compared to novel test conditions. In their first experiment, half of scenes in study list were presented one at a time for one second whereas other half presented for four seconds. A total of 128 scenes comprising 8 exemplar scenes from one of 16 categories were presented at study. Ahmad et al. (2013) found a significant reduction in performance in scene recognition with shorter duration, but no difference in recognition between novel and test conditions in both short and long duration conditions. In their second experiment with a short duration of 500 ms, there was a reduction in recognition performance, however there was no difference in recognition between novel and exemplar conditions for both duration conditions. We argue that global and some local perceptual processing at study for even a short presentation duration as in 500 ms is sufficient to maintain enough details in memory to distinguish old scenes and exemplar scenes.

D101

PARAHIPPOCAMPAL INVOLVEMENT IN SOURCE ENCODING: DOES SEX MAKE A DIFFERENCE?

Eva Stening[1], Jonas Persson[1], Kristin Nordin[1], Johan Wikström[2], Hedvig Söderlund[1]; [1]Uppsala University, [2]Uppsala University Hospital — In previous research, a female advantage has been found in object location tasks, assessing item and spatial source memory. The parahippocampus is believed to have a specific role in source memory, with the anterior part being involved in item processing and the posterior part in processing of contextual information. However, findings are not ubiquitous, and the aim of the current study was to assess whether potential sex differences in performance may be reflected in a difference in parahippocampal engagement, possibly clarifying parahippocampal involvement in source memory. Men and women studied objects placed in one of four possible locations on a screen while scanned with fMRI. During post-scan recognition, they made old/new judgments and, if old, in which location the object had been presented (i.e. source). No sex difference was observed in performance for either item or source. Women showed anterior and posterior bilateral parahippocampal activation during the encoding of subsequently remembered items and their location compared to forgotten items, and right anterior parahippocampal activity for subsequent source memory compared to item memory. No parahippocampal activity was observed in men overall. Although men and women did not differ in performance, they differed in parahippocampal activity, suggesting there are different ways to successfully encode spatial source, not necessarily engaging the parahippocampal gyrus.

D102

AGE-RELATED CHANGES IN SOURCE MEMORY RETRIEVAL: DOES ANTICIPATION MATTER?

Jiangyi Xia[1], Giulia Galli[1], Leun J. Otten[1]; [1]University College London — The ability to remember events from a particular time and place typically declines with age. This deficit may in part be explained by changes in the way control processes are used during the retrieval of source information. Here, we investigated how aging affects neural activity leading up to a source memory probe, and how such activity relates to memory performance. Electrical brain activity was recorded during a source memory task in which healthy younger and older participants memorized visual word pairs. In each pair, an object word (e.g. pigeon) was preceded by a location word (e.g. garden) that served as the to-be-retrieved source information. At test, only object words were presented, intermixed with new words. Test items were preceded by a neutral warning cue. The task was to decide whether an object had been presented earlier and, if so, what location had been paired with the object. A sustained negative-going event-related potential deflection preceded object words whose associated location could be remembered. This effect was especially pronounced in older individuals, and its size correlated positively with the number of source hits in this group. These findings indicate that aging affects the use of control processes during the anticipation of a source memory probe. Older individuals appear to engage preparatory activity before a test probe to a larger extent, especially when their performance is relatively poor. When the ability to recall source information is compromised, engaging anticipatory mechanisms just before having to recall may help retrieval.

D103

EXPLORING THE NEURAL CORRELATES OF TRUE AND FALSE MEMORY FOR CONCEPTUAL PICTURES

Christina E. Johnson[1], Indira C. Turney[1], Nancy A. Dennis[1]; [1]The Pennsylvania State University — False memories elicited from thematic contexts have been posited to rely on conceptual gist, or memory for the meaning or theme of an event absent of specific details. The current study sought to investigate the neural basis of this theory, examining both true and false memories for conceptual information using fMRI. Participants viewed thematic scenes (i.e. Christmas, bathroom, camping) and were tested on their memory for the content of the scene, including targets that were related and unrelated to its theme, new related items, and new unrelated items. Analyses focused on both similarities and differences in neural recruitment supporting true and false memories related to the scene's theme. True memories were associated with increases in neural activity in the typical retrieval network, including left prefrontal, parietal, occipital, and parahippocampal regions. False memories were associated with increases in neural activity in a more limited network including left middle prefrontal cortex and middle and inferior temporal gyrus. Taken together, results suggest that while true retrieval is mediated by retrieval of visual details and general reconstructive processes, false retrieval relies on semantic or categorical processing, potentially associated with the scene's theme. A direct comparison between the two types of memories supported this conclusion, finding greater activity in early occipital cortex for true compared to false memories and middle temporal gyrus for false compared to true memories. Results will be discussed within the framework of false memories more generally, as well as in relation to the Fuzzy Trace Theory.

D104

TRUE MEMORY BUT NOT FALSE MEMORY FOR SHAPE ACTIVATES THE LATERAL OCCIPITAL COMPLEX

Jessica M. Karanian[1], Scott D. Slotnick[1]; [1]Boston College — Previous work suggests that true memory produces greater activity than false memory in earlier sensory cortical regions, while both true memory and false memory produce activity in later cortical regions (such as language processing cortex). Of importance, this pattern of activity was observed during retrieval of non-detailed visual information. As such, false memories in previous studies may have lacked sufficient detail to activate earlier visual processing regions. The present fMRI study was conducted to assess whether detailed false memory for shape would activate the lateral occipital complex (LOC), a region involved in processing this feature. At encoding, participants were presented with colored abstract shapes that were either intact or scrambled. At retrieval, colored disks were presented and participants indicated whether the cor-

responding shape was previously "intact" or "scrambled". LOC was localized by contrasting intact shapes versus scrambled shapes at encoding. True memory for shape was isolated by contrasting accurate memory for intact shapes versus inaccurate memory for intact shapes (i.e., "intact"/intact > "scrambled"/intact; hits > misses). False memory for shape was isolated by contrasting inaccurate memory for scrambled shapes versus accurate memory for scrambled shapes (i.e., "intact"/scrambled > "scrambled"/scrambled). Consistent with previous findings, preliminary analysis suggests true memory but not false memory for shape produced activity in LOC, while both true memory and false memory produced activity in higher-level cortical regions (including language processing cortex and the dorsolateral prefrontal cortex). The present results suggest that false memories do not activate earlier sensory cortical regions, even under conditions of detailed retrieval.

D105

STRIATAL INTEGRITY INFLUENCES RULE-DRIVEN, BUT NOT RELATIONAL MEMORY IN OLDER ADULTS

Patrick Watson[1], Hillary Schwarb[1], Chris Shander[1], Jim Monti[1], Gillian Cooke[1], Arthur Kramer[1], Neal Cohen[1]; [1]Beckman Institute of Science and Technology, University of Illinois at Urbana-Champaign — Recent research has begun to tie hippocampal memory processing to more distributed memory networks including the PFC (Simons & Spiers 2003, Zeithamova, Dominich, & Preston, 2012), and has linked age-related memory declines to changes in hippocampal volumes (Raz 2005) and frontal function (West, 1996). However, patient and animal studies have shown consistent dissociations between hippocampal "relational" and striatal "habit" strategies, suggesting that these two brain regions additionally produce competing memory representations (Hartley et al. 2003, Lee, Duman, & Pittenger 2008). We investigated this competition within a novel context-dependent associative learning task. In this task, participants studied face-location associations within two distinct contexts. Within each context, each face appeared in a unique location determined by an underlying contextual rule structure (e.g., male faces on the left, females on the right). Behavioral and eye-tracking measures demonstrated that older adults and college-aged participants were able to successfully encode the multiple context-dependent associations, but that older adults were less likely to identify and flexibly apply the appropriate contextual rule, resulting in lower overall performance. Further, older adults' striatal volume, but not hippocampal volume, was related to measures of "rule stickiness" (i.e., tendency to apply the same contextual rule repeatedly). These data suggest hippocampal involvement in memory for specific associations, and striatal involvement in the application of contextual rules.

D106

HIPPOCAMPAL INVOLVEMENT IN RETRIEVAL OF ASSOCIATIVE AND SOURCE MEMORY

Cheryl Abellanoza[1], Heekyeong Park[1]; [1]University of Texas at Arlington — Previous research has investigated the neural correlates of associative memory and source memory. However, most studies have examined them separately or focused on encoding; therefore, it has not been established if neural correlates overlap for retrieval of associative and source memory. The present fMRI study (n=19) investigated neural correlates of associative and source memory during retrieval. Participants were presented picture pairs and instructed to engage in one of two semantic tasks. During test, participants were asked to make associative memory judgments by determining if picture pairs were "intact" (both pictures presented in the same study pair), "rearranged" (both pictures presented during study but paired differently), or "new". Participants also made source recognition judgments by identifying the task for studied pairs. Associative memory regardless of source judgment recruited activity in the left inferior frontal gyrus and left occipito-parietal regions. However, neural activity for associative memory differed by source judgment. Retrieval of associative memory with correct source context was identified in the left inferior frontal cortex, left parietal cortex, and left anterior hippocampus, while retrieval of associative memory without correct source context was found only in left inferior frontal and lateral parietal cortical regions. The results demonstrate that the anterior hippocampus involves in veridical recognition of associative memory accompanied by accurate contextual source information. These findings suggest that retrieval of associative memory with accurate source context recruits an additive activity in the hippocampus.

D107

BEHAVIOURAL AND NEURAL CORRELATES OF AUTOBIOGRAPHICAL MEMORY AND FUTURE THINKING IN DEPRESSION

Donna Rose Addis[1], Sylvia Hach[1], Lynette J Tippett[1]; [1]The University of Auckland, New Zealand — Depression is associated with a decrease in the specificity of past and future events. When engaged in autobiographical memory (AM) or future thinking (FT) tasks, depressed individuals generate more generic events compared to non-depressed individuals. The CaRFAX model proposes that reduced event specificity results from a combination of rumination, functional avoidance and executive dysfunction. We tested the contribution of these elements to the specificity of AM and FT in depression and explored whether there are differences in the neural correlates of AM and FT. Participants completed measures of rumination, avoidance and executive function (working memory, inhibition, set-shifting and strategy use). While undergoing fMRI, the AM and FT tasks were also completed. Depressed participants were more ruminative and avoidant than controls, and generated fewer specific events during the AM and FT task. However, there were no group differences in executive function. Regressions revealed that measures of strategy use (e.g., CVLT semantic clustering and category fluency) were associated with specificity over and above depression severity, rumination and avoidance. fMRI analyses showed that both groups engaged regions typically associated with AM and FT. However, reduced activity and connectivity in key regions such as the hippocampus were present for depressed participants. This was accompanied by increased activation of frontal regions and greater functional connectivity between the right hippocampus and frontal areas, which may reflect greater executive demands and/or compensatory activation. These results suggest that strategic abilities and neural changes both play an important role in the generation of specific AM and FT in depression.

D108

MEMORY SCRAMBLE: THE IMAGINATION INFLATION EFFECT FOR AUTOBIOGRAPHICAL MEMORY CONJUNCTION ERRORS

Aleea Devitt[1], Daniel L. Schacter[2], Donna Rose Addis[1]; [1]The University of Auckland, [2]Harvard University — Autobiographical Memory (AM) conjunction errors are a type of false memory that can arise following the incorrect recombination of details from different veridical memories. AM conjunction errors increase following imagination of conjunction events. This imagination inflation effect could be driven by source confusion due to an increase in phenomenological quality and/or processing fluency. To elucidate the contributions of these processes to the imagination inflation effect for AM conjunction errors, both an imagination and a non-imagination exposure condition were employed in this study. Conjunction lures were constructed by recombining person, place and object details taken from veridical AMs, and were divided between imagination and association conditions. In the imagination condition, participants imagined a novel past event involving the details, while in the exposure condition participants ranked details based on subjective pleasantness. On a subsequent source monitoring test, conjunction errors occurred when conjunction lures were incorrectly judged as depicting real memories. Imagined conjunction lures were falsely accepted as indicative of a real memory more often than exposure conjunction lures, indicating that fluency alone cannot fully account for this inflation effect. Conjunction errors were rated as intermediate between real events and correctly identified imagined events on a number of phenomenological characteristics, suggesting that source confusion could have occurred due to phenomenological similarity between conjunction events and authentic memories. These results may have practical implications for applied situations in which memory authenticity is of high importance, such as in eyewitness testimony.

D109

NEURAL CORRELATES OF EMOTIONAL SOURCE MEMORY RETRIEVAL OF PERSONAL BELIEFS: AN EVENT-RELATED FMRI STUDY

Vijeth Iyengar[1], Carla Pais-Vieira[2], Roberto Cabeza[1]; [1]Center for Cognitive Neuroscience, Duke University, [2]University of Aveiro — While studies have identified regions crucial for remembering emotional materials, the majority of these studies have used stimuli that evoke emotion automatically. To date, few studies have examined the neural mechanisms underlying emotional memory in cases where emotion is self-generated. To explore this

question, we conducted an fMRI study in which participants were scanned during alternating runs of encoding and retrieval. At encoding, participants were presented with unfamiliar face-belief (e.g. "Thinks homeless people should not receive federal assistance") pairs and judged beliefs on a scale ranging from strongly disagree to strongly agree. At retrieval, participants viewed previously encoded face-belief pairs (intact) and pairs with faces presented with beliefs from other faces (recombined) and made an intact/recombined judgment with confidence. Behaviorally, source memory was better for pairs initially associated with strongly agree/disagree judgments relative to pairs associated with moderate agree/disagree judgments. Retrieval success activity was found in the medial temporal lobes including the parahippocampal gyrus, along with the posterior cingulate, and angular gyrus, while greater amygdala activity was found for high (strongly agree/disagree) vs. moderate arousal pairs. In addition, the medial prefrontal cortex (mPFC) was active for successfully retrieved items initially associated with agree judgments. These findings are consistent with the amygdala's and mPFC in emotional memory and self-referential processing respectively, and highlight the importance of investigating self-generated emotional influences on memory in addition to affective processes driven primarily by inherent stimulus properties.

D110

SIMILARITIES AND DIFFERENCES BETWEEN EPISODIC AND SEMANTIC MEMORY: AN FMRI STUDY

Wei-Chun Wang[1], Nadia Brashier[1], Erik Wing[1], Elizabeth Marsh[1], Roberto Cabeza[1]; [1]Duke University — Declarative memory is typically understood to consist of separate episodic and semantic systems. Episodic memory (EM) encompasses the recovery of previously experienced events, while semantic memory (SM) corresponds to the retrieval of general knowledge (Tulving, 1972). The hallmark of SM is activity in left anterior temporal regions, while EM is often marked by medial temporal, posterior cingulate, and posterior parietal activations. The present study directly compares the two retrieval modes using identical verbal stimuli. Participants incidentally encoded factual statements outside the scanner. Pilot data confirm that these statements were either well-known (e.g., The fastest animal on Earth is the cheetah) or obscure (e.g., The smallest fish species is the paedocypris). In the scanned retrieval session, participants alternated between rating oldness (EM task) and truthfulness (SM task) for old and new statements. Episodic retrieval success (hits > correct rejections) corresponded with a canonical network of regions, including the posterior cingulate, lateral parietal areas, and dorsolateral prefrontal cortex. In contrast, semantic retrieval success (known > unknown statements) was associated with activity in left temporal and dorsomedial frontal regions. The conjunction of these contrasts revealed common frontoparietal, anterior cingulate, and medial temporal regions supporting both episodic and semantic retrieval. These data suggest that EM and SM are spatially distinct processes, but that there is also considerable overlap in their neural correlates.

D111

IS RECONSOLIDATION MEDIATED BY TOP-DOWN OR BOTTOM-UP NEURAL PROCESSES? FMRI EVIDENCE.

Katharine Newman-Smith[1], Lynn Nadel[1], Rebecca Gomez[1], Paige Scalf[1]; [1]University of Arizona, Tucson — Consolidated memory traces can be reactivated--returned to a labile state, and subsequently modified - a process known as reconsolidation. Using a modified object-learning paradigm (Hupbach et al., 2007), we demonstrate distinct neural signatures and connectivity mediating this effect. Participants learn 20 ordinary objects (Set 1). Two days later, participants are scanned during 1) Set 1 reactivation and 2) administration of a novel list of 20 objects (Set 2). After another two days, a recognition test is administered to determine the extent to which Set 2 learning affects the Set 1 memory. Hupbach et al. demonstrated unidirectional memory modification in which some Set 2 items intruded into the Set 1 memory. Here, during Set 1 reactivation, participants exhibiting minor Set 1 modifications showed greater BOLD signal in the DLPFC and increased functional connectivity between bilateral hippocampus and the restrosplenial cortex, possibly reflecting an attended, explicit re-engagement of the Set 1 memory. Those showing strong memory-modifications displayed greater BOLD signal during Set 1 reactivation in the bilateral occipital poles and increased functional connectivity between the bilateral hippocampus, bilateral LOC, and basal ganglia, reflecting both top-down and bottom-up activation of these Set 1 object representations. During Set 2 administration, neural activity was greater in the same regions engaged during the reactivation phase in the two-seconds prior to the presentation of Set 2 items later intruded into Set 1 memory. When these sensory neural processes are recruited before administration of a particular Set 2 item, this item's likelihood of intruding into Set 1 increases.

D112

THE MEDIAL TEMPORAL LOBES SUPPORT BINDING ACROSS LONG-TERM AND SHORT-TERM MEMORY: EVIDENCE FROM AMNESIA

Liz Race[1], Margaret Cadden[1], Mieke Verfaellie[1]; [1]VA Boston Healthcare System and Boston University School of Medicine — Although short-term memory (STM) and long-term memory (LTM) have traditionally been considered cognitively distinct, it is known that STM can improve when to-be-remembered information appears in contexts that make contact with existing LTM representations. For example, verbal STM is enhanced when to-be-remembered information is presented in familiar visuospatial contexts that have existing representations in LTM (Darling et al., 2012). This visuospatial bootstrapping effect suggests a more interactive relationship between LTM and STM. An important outstanding question is whether integrating across STM and LTM critically depends on binding functions supported by the medial temporal lobes (MTL). To investigate this question, we tested whether digit span performance in amnesic patients with MTL damage improves when digits are presented in a familiar visuospatial context (a telephone keypad array) compared to an unfamiliar visuospatial context (a random keypad array). In contrast to controls, whose digit span improved in the familiar visuospatial context, amnesic patients' digit span performance did not differ in the familiar vs. unfamiliar contexts, indicating an inability to leverage visuospatial LTM to benefit verbal STM. We then confirmed that this bootstrapping impairment in amnesia occurred despite intact LTM representations of a telephone keypad by demonstrating that both groups demonstrate equivalent reaction time facilitation when typing visually-presented numbers into a familiar keypad compared to an unfamiliar keypad. These results demonstrate that MTL processes play a critical role in integrating across LTM and STM.

D113

HIPPOCAMPAL INTEGRITY INFLUENCES RELATIONAL, BUT NOT RULE-DRIVEN MEMORY IN OLDER ADULTS

Hillary Schwarb[1], Patrick D. Watson[1], Chris Shander[1], Jim M. Monti[1], Gillian E. Cooke[1], Arthur F. Kramer[1], Neal J. Cohen[1]; [1]Beckman Institute of Science and Technology, University of Illinois at Urbana-Champaign — While the hippocampus is critical for declarative (relational) memory (e.g., Cohen & Eichenbaum, 1993; 2001), recent research implicates its involvement in a larger network of memory structures including the PFC (e.g. Zeithamova, Dominich, & Preston, 2012) and striatum (e.g., Hartley et al. 2003). As we age, both hippocampal volume (e.g., Raz, 2005) and frontal function (e.g., West, 1996) decline making older adults an ideal population for understanding MTL-PFC involvement in context guided relational memory. To investigate this relationship, we developed a novel, context-dependent association-learning task in which face-location associations are learned in two distinct contexts. Within each context, each face is studied in a unique room and face location is determined by an underlying rule structure that differs between the two contexts (e.g., males on left, females on right). This task afforded us the opportunity to investigate both unique and shared contributions of MTL and PFC to associative-memory and rule-learning. Behavioral and eye-tracking data show that older adults learned the contextual rule structure, but were unable to flexibly apply these rules to aid performance; and rule-learning and hippocampal volume were unrelated. However, older adults were frequently able to place faces in previously studied locations, and hippocampal volume was related to improved associative-memory performance especially when the faces were placed in contextually inappropriate studied locations.

METHODS: Neuroimaging

D114

REDUCED WHITE MATTER INTEGRITY IN INFANTS AT RISK FOR DEVELOPMENTAL DYSLEXIA

Barbara Peysakhovich[1], Nicolas Langer[1,2], Jennifer Zuk[1], Marie Drottar[1], Danielle D. Sliva[1], Sara Smith[1], Bryce Becker[1], P. Ellen Grant[1,2,3], Nadine Gaab[1,2,4]; [1]Boston Children's Hospital, Boston, MA, [2]Harvard Medical School, Boston, MA, [3]Massachussetts General Hospital, Boston, MA, [4]Harvard Graduate School of Education, Cambridge, MA — Developmental dyslexia (DD) is characterized by deficits in reading and reading-related skills such as spelling, decoding and fluent word recognition. Familial occurrences and twin studies strongly support a genetic basis for DD. Studies in children/adults with DD revealed white matter abnormalities, particularly in left posterior language areas, that seem to underlie these reading difficulties. However, no studies to date have examined how early on the developmental trajectory these structural white matter alterations emerge. The present study investigated white matter structure of the bilateral arcuate fasciculus (AF) in 14 infants with (FHD+) and 18 without (FHD-) a familial risk of DD. Diffusion scans were acquired during the infants' natural sleep and the Mullen Scales of Early Learning was also administered. Tractography for the bilateral AF was manually reconstructed in TrackVis using a two-ROI approach. Furthermore, automated fiber quantification was used to reconstruct the left and right AF and to further calculate fractional anisotropy (FA) at 100 equidistant nodes along the tracts, allowing for a more precise localization of group differences along each tract. The analyses revealed significantly lower FA values in the central portion of the left AF for FHD+ compared to FHD- infants. Moreover, the expressive language subtest of the Mullen positively correlated with mean FA values in the left AF across both groups. These results suggest that white matter abnormalities observed in children/adults with a diagnosis of DD or kindergartners at risk for DD may already be present at birth or develop within the first few months of life.

D115

NEUROPSYCHIATRIC BIOMARKERS HIDDEN IN GLOBAL SIGNAL: FOCUS ON SCHIZOPHRENIA AND BIPOLAR ILLNESS

Genevieve Yang[1,2], John D. Murray[3], Grega Repovs[4], Michael W. Cole[5], Aleksandar Savic[1,2,6], Matt Glasser[5], John H. Krystal[1,2,7], Xiao-Jing Wang[3], Godfrey D. Pearlson[1,8], David C. Glahn[1,8], Alan Anticevic[1,2,7]; [1]Yale University School of Medicine, [2]Abraham Ribicoff Research Facilities, Connecticut Mental Health Center, [3]New York University, [4]University of Ljubljana, [5]Washington University in St. Louis, [6]University Psychiatric Hospital Vrapce, University of Zagreb, [7]NIAAA Center for the Translational Neuroscience of Alcoholism, [8]Olin Neuropsychiatry Research Center, Institute of Living, Hartford Hospital — Schizophrenia is a severe mental illness associated with extensive neural abnormalities, ranging from synaptic alterations to higher level disruptions in functional connectivity observed in resting state fMRI studies. We therefore hypothesized that cortical computations in this illness may be broadly disrupted, in a manner measurable at the global brain signal (GS) level and specific to schizophrenia as opposed to other mental disorders. To pursue this hypothesis, we obtained resting state fMRI studies on two independent groups of patients suffering from chronic schizophrenia (N=90 & N=71) and on a group of bipolar patients (N=73), along with healthy comparison subjects (HCS) matched to each clinical group (N=220). We found evidence that GS in schizophrenia patients is significantly increased in power and variance compared to HCS; this effect was positively correlated with patient symptoms and was not seen in bipolar patients. Furthermore, voxel-wise variance was also broadly increased in schizophrenia patients and not in HCS or in bipolar patients. Results suggest that GS, which is often discarded in functional connectivity fMRI studies as a meaningless nuisance variable, can on the contrary carry distinct, meaningful information across psychiatric conditions. We additionally show that GS removal can obscure important differences between patient and healthy populations. To examine potential neurological mechanisms of these findings, we utilized a parsimonious, biophysically-based computational model of shared and non-shared signal propagation throughout multiple parcellated brain regions. On basis of our empirical findings, we explore the model's potential to generate rationally-designed hypotheses about clinical populations with broadly distributed signal abnormalities.

D116

DIFFERENTIAL ACTIVATION OF THE DEFAULT MODE NETWORK IN JET LAGGED INDIVIDUALS

Kristina Hernandez[1], Amanda Henderson[1], Joana Coutinho[2], Liliana Maia[2], Adriana Sampaio[2], Derek Gosman[1], April Krowel[1], Lauren Young[1], Kristin Perrone-McGovern[1], Stephanie Simon-Dack[1], Oscar Gonzales[2]; [1]Ball State University, [2]Universidade do Minho — Long-term exposure to transmeridian flights has been shown to impact cognitive functioning, however the short-term cognitive deficits of jet lag have not been clearly identified. The Default Mode Network (DMN) was examined to investigate the impact of short term jet lag on the brain's resting activity. Participants consisted of two groups, a group of individuals who were recently on a transmeridian flight and a control group. A BOLD fMRI sequence was performed in a Philips Achieva 3T. The preprocessing of the fMRI data was performed using Data Processing Assistant for Resting-State fMRI (DPRASF) and then spatial Independent Component Analysis was performed in GIFT software to extract the Default Mode Network (DMN) maps. For each subject the DMN component was identified by selecting the one with the highest spatial correlation to the default network template. Statistical analysis was performed to test for differences in the DMN activation between groups. We found that participants from the jet lag group presented decreased activation in the anterior nodes of the DMN, more specifically in bilateral medial prefrontal cortex and anterior cingulate cortex involved in different self-referential processes such as introspection (Gusnard et al, 2001). These results were corrected for multiples comparisons using FDR. No DMN areas of increased activation for the jet lag group were found. Decreases in the DMN for the jet lag group may be suggestive of an impact on the brain´s resting state activity.

D117

INTEGRATION OF FMRI AND MEG FOR OPTIMIZED SPATIAL SENSITIVITY TO NEURAL ACTIVITY

Sean McWhinney[1], Timothy Bardouille[2], Ryan D'Arcy[1,2,3], Aaron Newman[1,2]; [1]Dalhousie University, [2]IWK Health Centre, [3]Simon Fraser University and Surrey Memorial Hospital — Functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) are two widely used neuroimaging techniques which operate on different mechanisms to measure brain activity, and possess unique spatial sensitivity profiles. Studies that examine activity in both deeper structures, to which MEG shows reduced sensitivity, and structures near air-tissue interfaces, in which fMRI signal can be distorted or lost, may benefit from integration of the two imaging techniques. The present study optimized sensitivity to neural activity by integrating fMRI and MEG data sets, using a novel method of weighting the inputs from the two modalities by a data-driven, voxel-by-voxel measure of quality. The method of integration was demonstrated using data from a visual object recognition task. MEG data were localized using beamforming to produce maps of activity comparable to fMRI activation maps. Data quality (contrast-to-noise ratio) was calculated at each voxel for each modality and was used to weight the contribution of that modality to the multimodal activation map. The resulting maps reflected both activations that were observed in one but not the other modality (e.g., hippocampus only in fMRI), and critically showed increased sensitivity to activation that was common to both modalities. This increased sensitivity resulted in detection of activations that were present, but below threshold, in both single-modality statistical maps. This demonstrates an improvement over both simple averaging of maps from two modalities, which leads to reduced sensitivity, and over fMRI-constrained MEG source localization, which negates any unique sensitivity of MEG.

D118

PRECUNEUS ACTIVATION IN LOW EMOTIONAL DOMINANCE RELATED TO EXTROVERSION

Amanda J Khan[1], Alyson Negreira[1], David Gansler[1], Matthew Jerram[1]; [1]Suffolk University — Introduction: Emotions have been conceptualized on a three dimensional model consisting of valence, arousal, and dominance. Previous studies have reported activation in the precuneus in response to shifting dominance. Extroversion has been associated with assertiveness and increased activity, which are conceptually linked to dominance. The current study aims to examine the relationship between extroversion and functional activation during low dominance. Methods: FMRI data were acquired for fourteen healthy adult males viewing IAPS images in an event related design. Normative IAPS

ratings were used to create the two conditions: passive viewing of neutral valence, neutral dominance and top down processing of neutral valence, neutral dominance where the participant was instructed to make themselves feel less dominant. FreeSurfer was used to contrast the conditions and the resulting statistical map was regressed with NEO-FFI extroversion scale scores. Results: Analyses showed significant inverse correlations ($p < .05$) of activation in the left and right precuneus between top down processing and extroversion scores. Discussion: As predicted, the precuneus showed significantly reduced activation in more extroverted individuals. Precuneus is associated with self-reflection, consciousness, and theory of mind (Buckner et al., 2008; Jeannerod, 2007). Also, precuneus is associated with person-perspective taking and experience of agency (Cavanna and Trimble, 2006). Recently, Jerram et al., (2013) found support for the association of precuneus activation during top-down processing of active dominance. The precuneus in extroverts may be less reactive as these individuals may generally experience relatively more emotional dominance, even in low dominance situations.

D119

CONTRIBUTION OF THE "MOTOR LOOP" TO COGNITION IN PARKINSON'S DISEASE: AN FMRI STUDY

Anna R. Schönberger[1,2], Klara Hagelweide[1,4], Esther A. Pelzer[1,2], Gereon R. Fink[1,3], Ricarda I. Schubotz[1,2,4]; [1]University Hospital Cologne, Germany, [2]Max Planck Institute for Neurological Research, Cologne, Germany, [3]Research Centre Jülich, Germany, [4]University of Muenster, Germany — Cognitive deficits in Parkinson's disease (PD) are commonly attributed to frontal lobe dysfunction, due to dopamine deficiency in the frontostriatal loops. Although recent studies point to a close interplay between motor and cognitive abilities in PD, the contribution of the so-called "motor loop" (i.e., supplementary motor area (SMA), putamen) to cognition remains to be elucidated. Traditionally, the SMA is assigned a role in memory-driven rather than in stimulus-driven motor control, whereas the opposite holds for the lateral premotor cortex (PMC). Imaging-studies reveal reduced SMA-activity in PD-patients performing motor tasks which further decreases "off" medication. When external cues are provided, the patients' motor-skills improve. The latter is associated with increased PMC-activation suggesting compensatory processes. In our study we investigated whether similar mechanisms exist for cognitive processes. We accordingly tested 16 male PD-patients "on" and "off" dopaminergic medication and 16 age-matched male healthy controls with the serial prediction task (SPT0) in an fMRI-study. A parametric modulation was implemented that caused shifts from stimulus- to memory-based prediction (SPT+). Patients revealed an impaired performance compared to controls combined with a decreased activity in the motor loop (SMA&putamen). Patients "off" compared to "on" medication exhibited no differences in performance but revealed increased PMC-activity for SPT+ > SPT0. Furthermore, PMC-activity correlated with patients' performance "off" medication, compatible with the view of a putative compensatory role. In summary, in patients suffering from PD we showed a contribution of the motor loop to cognition and compensatory mechanisms via the premotor system similar to those known from motor tasks.

D120

DIRECTED INTERACTIVITY OF LARGE-SCALE BRAIN NETWORKS: INTRODUCING A NEW METHOD FOR ESTIMATING RESTING-STATE EFFECTIVE CONNECTIVITY MRI

Nan Xu[1], R. Nathan Spreng[1], Peter C. Doerschuk[1]; [1]Cornell University — Resting-state functional MRI is widely used to non-invasively study brain networks and network dynamics. Recently, graph theory analytic measures have been used to assess the functional associations between regions of interest (ROIs) and determine pairwise connectivity by computing the correlation between BOLD signal time series data. However informative, this approach cannot capture the causality and the direction of information flow. The goal of this work is to characterize the pairwise relationship among brain regions, as well as their directionality, to determine information flow in the brain. In a discovery and replication sample (both n's = 66, age range 25-30 years old), we assessed resting-state functional MRI BOLD signals from 264 ROIs previously identified as putative functional areas. We estimated a causal linear time-invariant time-evolution model, which included the possibility of temporal delay, to predict the signal at the i-th ROI from the signal at the j-th ROI. Information flow from the j-th to the i-th ROI was then quantified as the correlation between the i-th BOLD signal and its prediction. The impulse response duration of the model was determined via Information Criteria in Matlab. Sub-network interactions were then computed using graph analytical techniques. The directed information flow in the functional network was examined. Using this approach, we successfully replicated the previously observed modular organization of the brain, and identified multiple large-scale networks, including the sensory-motor, perceptual, executive and default networks. The results may provide unique insight into the movement of information within and between these large-scale brain systems.

PERCEPTION & ACTION: Audition

D121

EEG MU WAVE DESYNCHRONIZATION DURING EMOTION JUDGMENTS OF HUMAN ACTION

Lucy McGarry[1], Jaime A. Pineda[2], Frank A. Russo[1]; [1]Ryerson University, Toronto, Ontario, [2]University of California, San Diego, San Diego, California — The extended mirror system in humans, consisting of motor execution and perception areas in the frontal, parietal, and temporal lobes, appears responsible for the execution and perception of meaningful action and is hypothesized to be linked to simulation of emotional actions of others. Areas of the extended MS are activated during one's own execution of an action, as well as during perception of the same action by other agents. Additionally, these same neurons will fire towards the execution and perception of different actions that convey similar intentions. The current study examined the role of the human mirror system in the emotional perception of action. We wished to determine whether sung musical intervals perceived with a top-down focus on emotional expression versus pitch distance would lead to a greater amount of MS activation. EEG measurement of alpha and beta mu waves was used to examine MS responsiveness, as fluctuations in mu wave power are thought to reflect downstream regulation of the motor cortex from frontal and parietal MNS areas. An independent components analysis revealed a cluster of components in the left superior temporal gyrus (STG) that exhibited greater desynchronization in the alpha mu wave during emotional vs. structural perception of song. The STG is a part of the extended MS that is involved in visual and auditory observation of biological movement in humans. This finding suggests that the STG is involved to a greater extent in emotion-focused than non-emotion-focused action processing.

D122

NEURAL PROCESSING OF PHONETIC AND TALKER INFORMATION IN A TONE LANGUAGE: AN FMRI STUDY

Caicai Zhang[1], Kenneth R. Pugh[2,3,4], W. Einar Mencl[2,3], Peter J. Molfese[2], Stephen J. Frost[2], James S. Magnuson[2,4], Gang Peng[1], William S-Y. Wang[1]; [1]The Chinese University of Hong Kong, [2]Haskins Laboratories, [3]Yale University, [4]University of Connecticut — A fundamental question in speech perception is how phonetic and talker information are retrieved from speech signals. Importantly, phonetic and talker processing appear to be interdependent, which is evidenced by the observations that listeners adapt to talker-specific vocal characteristics in order to correctly map speech signals to words (talker information influencing phonetic processing) and that native speakers outperform nonnative speakers in talker identification (phonetic information influencing talker processing). Neurobiologically, studies in non-tone languages like English have shown that left posterior STG/STS, which is activated in speech recognition, also exhibits sensitivity to vocal tract length that differentiates talker identity/size; fundamental frequency (F0), which correlates with talker differences but is not phonetically contrastive, only activates areas adjacent to primary auditory cortex. In this fMRI study, we investigate phonetic and talker processing in Cantonese, a tone language where F0 distinguishes lexical meanings. We examined neural responses to stimuli that change in tone category or in talker identity/gender, while eighteen listeners performed speech discrimination (same/different tone judgment) and talker discrimination (same/different talker judgment) tasks. Right parahippocampal gyrus and thalamus were activated to stimuli with talker changes in the talker discrimination task, which we speculate to be related to on-line learning of talker-specific characteristics. Importantly, STG activated bilaterally in response to stimuli with tone changes in the talker discrimination task

and to stimuli with talker changes in the speech discrimination task. This finding further supports the role of STG in interdependent/integrated phonetic and talker processing irrespective of specific language parameters.

D124

DISTRIBUTED REPRESENTATIONS OF PHONETIC FEATURES DURING SPEECH PERCEPTION: INVESTIGATING THE ROLES OF THE MOTOR AND AUDITORY CORTICES

Jessica Arsenault[1,2], Bradley Buchsbaum[1,2]; [1]Rotman Research Institute, [2]University of Toronto — While studies of speech perception using functional magnetic resonance imaging (fMRI) have often found elevated activity in the motor system (e.g. Broca's area and premotor cortex), we still know little about what information is encoded in the activity of both the auditory and premotor/motor cortices. Multivoxel pattern analysis (MVPA) can provide a more informative description of brain activation patterns than the standard univariate approach to imaging data. This study explored the activity patterns associated with the auditory perception of syllables that share varying levels of feature similarity and acoustic confusability. Rather than simply identifying activation of the motor cortex during speech perception, the goal was to identify how the similarity of consonants as assessed by acoustic confusability (e.g. /m/ is confusable with /n/ but not /k/) is mirrored by the similarity among patterns of brain activation in the motor and auditory cortices, respectively. Sixteen consonant-vowel syllables were aurally presented one at a time to participants in the fMRI scanner. Using both a whole-brain searchlight and an ROI-based mulitvoxel pattern classifier, MVPA was performed on categories of three different features - place of articulation, manner of articulation, and voicing. Results suggest a distributed pattern of activation throughout auditory cortex for syllabic stimuli compared to baseline. In contrast, phonetic feature categories could not be reliably classified in motor or premotor cortex. These results lend support to the claim that auditory cortex is the primary locus of the representational code underlying acoustic-phonetic information relevant for the perception of consonants.

D125

FUNCTIONAL CONNECTIVITY NETWORKS ASSOCIATED WITH GLOBAL AND LOCAL AUDITORY MMN

Lizzy Blundon[1], Lawrence Ward[1]; [1]University of British Columbia — We used high-density EEG, independent component analysis (ICA), and phase locking value to study functional connectivity in the brain networks associated with the auditory MMN. Stimuli included two different five-tone patterns: "flat runs" consisted of five identical 50-ms tones at 100 ms ISI; in "change runs" the final tone, the local deviant, was different in pitch from the preceding four. Either run type could serve as an oddball, or global deviant, amongst a collection of the other type. Subjects pressed a button when they detected the oddball run type (global deviant). The change run always produced a robust local MMN from 180-250ms after the onset of the last tone (compared to the last tone in the flat run), regardless of whether it was a global standard or a global oddball/deviant. Global deviants of either type produced a frontal negativity and posterior positivity from 300-600ms after the onset of the last tone. IC sources over all stimuli were localized to bilateral auditory cortices, bilateral inferior frontal gyri, right middle frontal gyrus (MFG) BA 9, bilateral MFG BA 6, and anterior cingulate. Phase locking analysis during the MMN period revealed greater fronto-temporal functional connectivity for the deviant stimulus compared to the standard, between right hemisphere sources only in the local deviant condition, and bilaterally in the global deviant condition. These results confirm the importance of fronto-temporal connectivity in auditory change detection, and demonstrate differential inter- and cross-hemisphere communication involved in detecting local or global changes in the auditory environment.

D126

THE LIMITS OF INTELLIGIBILITY: ELECTROCORTICOGRAPHIC RESPONSES TO TIME-COMPRESSED SPEECH

Ido Davidesco[1,2], Christopher J Honey[1], Thomas Thesen[2], Lucia Melloni[2,3,4], Werner Doyle[2], Orrin Devinsky[2], Oded Ghitza[5], Charles E Schroeder[3,6], David Poeppel[2], Uri Hasson[1]; [1]Princeton University, [2]New York University, [3]Columbia University, [4]Max-Planck Institute for Brain Research, [5]Boston University, [6]Nathan S. Kline Institute for Psychiatric Research — Human listeners understand speech over a wide range of rates. It is not established how this tolerance to temporal variability is achieved at the neural level and why spoken language becomes unintelligible above certain rates. We addressed these questions using electrocorticography (ECoG) recordings in 7 epileptic patients. The patients rated the intelligibility of sentences presented at speeded-up rates (33%, 66%), at the original rate (100%), and at a slowed-down rate (150% of the original sentence duration). Sentences were repeated twice at each speech rate. We examined whether the neural responses elicited by slowed-down and speeded-up sentences could be linearly compressed or stretched to match the neural responses to the original speech rate. Neural responses over the superior temporal gyrus showed significant speech tracking for all speech rates, in the low frequency band-passed voltage (1-7Hz) and in the broadband gamma power modulations (70-150Hz). Temporal scaling was observed only for intelligible speech rates (66% and 150%) but was absent for the rate (33%) at which intelligibility was behaviorally sharply reduced. We propose that auditory processing can rescale according to the rate of incoming speech only within the restricted range that underpins intelligibility.

D127

ALTERED WHITE MATTER MICROSTRUCTURE IN FRONTAL REGIONS AND IN AUDITORY RADIATIONS UNDERLIES LISTENING DIFFICULTIES IN CHILDREN SUSPECTED OF AUDITORY PROCESSING DISORDER: A DTI STUDY

Rola Farah[1], Vincent J. Schmithorst[2], Scott K. Holland[1], Robert W. Keith[3]; [1]Cincinnati Children's Hospital Medical Center, [2]Children's Hospital of Pittsburgh, [3]University of Cincinnati — Objective - Identification of biomarkers is a priority for children presenting with listening difficulties (LiD) suspected of auditory processing disorder (APD). Behavioral studies have documented impaired cognitive and/or attention abilities in children referred to APD assessment rather than a pure sensory processing deficit. The purpose of this study was to investigate whether children with LiD/ APD demonstrate white matter (WM) abnormalities using diffusion tensor imaging (DTI) Methods - Twelve children with LiD/ suspected APD, manifesting an atypical left ear advantage (LEA) in dichotic listening and twelve age-and gender-matched typically developing children underwent DTI. Using voxel-based analysis, fractional anisotropy (FA), mean diffusivity (MD), axial and radial diffusivity (AD, RD) maps were contrasted between the groups Results - Children with LiD/ APD showed decreased FA (accounted for by Increased RD and decreased AD) in frontal multifocal white matter regions centered in prefrontal cortex bilaterally and left anterior cingulate white matter. In addition, LiD was associated with increased MD in the posterior limb of the internal capsule (sublenticular part of the internal capsule) and was accounted for by increase in both RD and AD. Conclusions - Our results suggest that LiD/ APD represent a disorder of altered structural connectivity of the brain, revealed by frontal distributed atypical white matter microstructure. Furthermore, results suggest delayed myelination in frontal multifocal white matter tracts and in the region of auditory radiations (auditory input is transmitted between the thalamus and the auditory cortex). Together, our findings reveal that both sensory and supramodal deficits may underlie the differences between the groups.

D128

TOP-DOWN GUIDED LEARNING: EVIDENCE FROM SIMULTANEOUS BRAINSTEM AND CORTICAL AUDIOTRY-EVOKED POTENTIALS

Erika Skoe[1,2], Jennifer Krizman[2], Emily Spitzer[2], Nina Kraus[2]; [1]Univeristy of Connecticut, [2]Northwesern University — The auditory system is sensitive to regularities, such as frequently-occurring sounds and sound combinations, in the environment. Evidence of this can be seen in how neurons adapt their response to the statistical properties of the soundscape. It has been theorized that the ability to respond to statistical regularities emerges as a higher-order property in the auditory cortex that trickles down to subcortical structures (Nelken, Ulanovsky, 2007). However, empirical evidence for this theory using animal models has been mixed (Antunes, Malmierca, 2011; Bauerle et al., 2011). Here, we add to the discussion surrounding this theory using a human model that supports a top-down theory of statistical learning. To capture how different brain areas interact in the process of learning stimulus statistics, far-field activity from the auditory brainstem and cortex was simultaneously recorded while young adults listened to recurring patterns embedded within novel sound streams. After 15 minutes, participants were tested on how well the sound patterns were learned.

Our findings revealed a mismatch in how cortical and subcortical structures index statistical information. For the cortical response, changes from baseline were observed, even in the condition where the statistical structure was difficult to learn. In contrast, for the brainstem response, we found a change from baseline only for the condition where the stimulus statistics were reliably learned. We theorize that cortical and subcortical structures provide distinctive contributions to early and late stages of auditory-based statistical learning, with cortical sensitivity preceding subcortical sensitivity in a cascade of neural events that coordinates learning.

D129

EVENT-RELATED POTENTIAL (ERP) CORRELATES OF INTERVAL AND SUB-SECOND TIMING Brenden Tervo-Clemmens[1], Mallory Grosso[1], Matthew Matell[1]; [1]Villanova University, Pennsylvania — Traditionally, time perception has been divided into sub-second (perceptual) and seconds to minutes (interval) ranges. We investigated whether distinct event-related potential (ERP) correlates represent the two ranges. Using an auditory oddball task, the mismatched negativity component (MMN) was measured for increments and decrements in duration. All stimuli (standard/deviant) were 300 ms in duration. Four experimental blocks were created by varying the length of the interstimulus interval (ISI) of the standard stimuli (250ms, 500ms, 1s, 2s). During each block, an oddball was created by reducing the ISI of the standard stimuli by 50%. The amplitude of MMN was calculated by subtracting the ERP of the standard from the deviant presented in the same block. We found a larger frontal representation of MMN for longer durations. The result provides evidence for a distinct cognitive timing circuit involved in the seconds to minutes range.

D130

SLOW ACOUSTIC FLUCTUATIONS ENTRAIN LOW-FREQUENCY NEURAL OSCILLATIONS AND DETERMINE PSYCHOACOUSTIC PERFORMANCE Molly Henry[1], Björn Herrmann[1], Jonas Obleser[1]; [1]Max Planck Research Group "Auditory Cognition", Max Planck Institute for Human Cognitive and Brain Sciences — Neural oscillations can be "entrained" by environmental rhythms across a wide range of time scales. Recently, entrainment of neural oscillations by acoustic fluctuations corresponding to the syllable or prosodic envelopes of natural speech has been suggested to support speech perception. In our recent human electroencephalography (EEG) work, we characterized entrainment of low-frequency neural oscillations in the classical delta (1-4 Hz) and theta (4-8 Hz) frequency bands, and assessed the psychophysical consequences using a gap-detection task. Stimuli were narrow-band noises, to which we applied frequency modulation (FM, 3.1 Hz) or simultaneous frequency (3.1 Hz) and amplitude modulation (AM, 5.075 Hz). Gaps were placed systematically with respect to the phase of the modulations, falling equally often into the rising or the falling phase of AM, and falling uniformly with respect to FM phase. Spectral analyses of the EEG signal confirmed that neural oscillations were entrained by the acoustic frequency and amplitude fluctuations. For simple FM entrainment, gap-detection hit rates depended on the entrained 3.1-Hz neural phase, and were highest for the "optimal" phase of the oscillation. For simultaneous FM-AM entrainment, our data indicated a joint optimal phase of the two entrained neural oscillations where gap detection performance was best. Moreover, the effects of 3.1-Hz neural phase on overall performance were modulated by 5.075-Hz neural phase. The results support current conceptualizations of entrainment as a supporting mechanism for speech perception, and further characterize the perceptual consequences of entrainment of potentially interacting neural frequency bands by complex environmental rhythms.

PERCEPTION & ACTION: Other

D131

AN EMBODIED MECHANISM UNDERLYING STUDENT UNDERSTANDING OF PHYSICS: MOTOR RESONANCE AFTER SENSORIMOTOR TRAINING PREDICTS UNDERSTANDING Carly Kontra[1], Sian Beilock[1]; [1]University of Chicago — Data collected in our lab suggest that sensorimotor experience with torque and angular momentum facilitates comprehension of physics exam questions. Here we ask why physical experience enhances understanding of these concepts. Guided by theories of embodied cognition, whereby offline cognition (occurring in the absence of relevant environmental input) is grounded in sensorimotor processes, we propose that students' understanding of torque and angular momentum is supported by activation of sensorimotor brain systems that were previously involved in physically producing and experiencing forces. We use fMRI to test our hypothesized embodied learning mechanism. In a pre-posttest design, participants made relative judgments about the magnitude of forces in a Torque Judgment Task (TJT). During a training module, we manipulated participants' experience with a pair of bicycle wheels on an axle (some received motor experience with the wheels and others only visual experience). Participants completed the TJT-posttest in the scanner and a follow-up quiz 24 hours later. A series of brain regions involved in action planning and production showed more activity during the TJT-posttest after motor experience relative to visual. These regions, known to be sensitive to previous motor experience, included bilateral premotor cortex, bilateral primary motor cortex, and left superior parietal lobe. Across training groups (motor/visual), activation in the region extending from left primary motor into somatosensory cortex significantly predicted quiz performance. Sensorimotor experience (relative to visual) leads to increased activation of motor systems important for representing dynamic physical concepts. This activation, in turn, relates to students' understanding of torque and angular momentum.

D132

UNDERSTANDING CHANGES-OF-MIND IN DECISION MAKING THROUGH VISUALLY-GUIDED ACTION AND ELECTROENCEPHALOGRAPHY Jeff Moher[1], Maro Machizawa[1], Joo-Hyun Song[1]; [1]Brown University — People often change their mind even after an initial decision has been reached, continuing to evaluate evidence as a motor plan is being generated to execute the initial decision. We used a visually-guided action approach to examine these changes of mind in decision-making. Specifically, we examined whether observers adjust their decision thresholds based on anticipated energy and time costs associated with changing their mind. Participants saw dynamic random dot displays presented on a distal screen and judged the direction of dot motion, indicating their response by reaching towards one of two response boxes presented on either side of fixation while three-dimensional hand position was continuously recorded. We varied the energy and time costs associated with changes of mind by varying the distance between response boxes. Changes-of-mind were defined as trials where movement trajectories were initially directed towards one response box before ultimately ending up at the opposite response box. We observed that when response boxes were far apart, increasing time and energy costs, changes-of-mind were less frequent and response initiation latency was longer. This outcome suggests that participants were changing the decision processes based on anticipated motor-related time and energy costs. As changes of mind may reflect internal awareness of an error being made in the initial decision, cognitive neural substrates of error monitoring might be associated with the occurrence of a change-of-mind. In line with this prediction, we found that changes-of-mind produced an error-related negativity (ERN) component, suggesting that they recruit similar neurophysiological mechanisms as error responses.

D133

NEURAL MECHANISMS OF GOAL-DIRECTED BEHAVIOR: OUTCOME-BASED RESPONSE SELECTION IS ACCOMPANIED BY INCREASED FUNCTIONAL COUPLING OF THE ANGULAR GYRUS Katharina Zwosta[1], Hannes Ruge[1], Wolfensteller Uta[1]; [1]Technische Universität Dresden, Germany — Goal-directed behavior requires building and using associations between a certain action, a certain situation and the resulting outcome, thereby enabling flexible response selection in different situations according to the current goal. In this fMRI study we aimed at identifying the neural mechanisms that support this outcome-based response selection and disentangling this process from the mere experience of action-contingent outcomes. We compared an outcome-based condition where subjects were explicitly instructed to produce a specific outcome to an otherwise identical stimulus-based condition where stimulus-response mappings were instructed and added a control condition with random outcomes. We found increased activation in the right angular gyrus if outcomes were contingent on a response in a certain situation compared to a control condition where outcomes were unpredictable. The actual integration of outcomes

into response selection was accompanied by increased functional coupling of the angular gyrus with subcortical (hippocampus, caudate head), prefrontal (lateral orbitofrontal cortex, rostrolateral prefrontal cortex) and cerebellar areas, which we suggest represent different explicit and implicit processes of goal-directed action control. Together, these results suggest that explicit goal-directed behavior is accompanied by increased functional connectivity between angular gyrus, involved in computing action-outcome contingencies, and areas related to different aspects of goal-directed behavior.

D134

IDENTIFYING AN EEG SPECTRAL RESPONSE TO PREFERRED MUSIC Mari-Anne Rosario[1], Hiroko Nakano[1], Constanza de Dios[2]; [1]Saint Mary's College of California, Moraga, CA, USA, [2]University of South Florida, Tampa, FL, USA — This study reports a spectral analysis of the electroencephalograhic (EEG) activity associated with processes of listening to preferred music. Participants listened to instrumental musical excerpts of preferred music pieces (jazz, classical music, tango), of music from alternate genres (jazz, classical music, tango, foxtrot), and silence while EEGs were measured. Spectral analysis was performed on the EEG data by calculating the relative change in spectral power between the music and silence conditions for each participant. A two-way repeated measure ANOVA with factors Music (Preferred vs. Alternate) and Electrodes (30) yielded a main effect of Music for the gamma and beta bands, indicating that preferred music elicited higher spectral power compared to alternate music in these bands. The same results were found for analyses using separate groups for jazz, classical music, and tango enthusiasts, suggesting that the effect is music genre independent. In a behavioral measurement, participants gave higher enjoyment scores to each of their preferred music pieces compared to each alternate musical piece. The increased power in the high frequency bands that occurred while listening to preferred music is in accordance with the theories that the beta band reflects cognitive arousal, and gamma the integration of perceptually meaningful stimuli.

D135

ADAPTIVE SOMATOSENSORY PLASTICITY CROSSES THE HAND-FACE BORDER BUT DOES NOT SPREAD WITHIN THE HAND AREA. Dollyane Muret[1], Hubert R. Dinse[2], Alessandro Farnè[1], Karen Reilly[1]; [1]Lyon Neuroscience Research Center, ImpAct Team, INSERM U1028, CNRS UMR5292, Lyon, France, [2]Institute for Neuroinformatics, Neural Plasticity Laboratory, Ruhr-University Bochum, 44780 Bochum, Germany — Today people commonly speak about harnessing the plastic capacity of the adult brain to improve function. Despite the potential impact of this type of adaptive plasticity very little is known about its mechanisms and limits. Plastic changes can be induced in the somatosensory system using repetitive somatosensory stimulation (RSS) protocols that synchronously stimulate several cutaneous receptive fields on a fingertip. These changes correlate with adaptive somatosensory changes at this fingertip. We recently showed that RSS-induced perceptual improvements at the right (stimulated) index fingertip transfer to both sides of the upper-lip area, but not to the left index fingertip (Muret et al, 2012 SfN Abstract number 883.09). Here we report data from several studies testing whether adaptive perceptual changes also transfer to other fingertips. A two-point discrimination (2PD) task was used to assess spatial discrimination thresholds on the left and right sides of the face and left and right fingertips before and after three hours of RSS of the right index fingertip. As in our first study, we found that RSS significantly decreased 2PD thresholds at the right index fingertip and at both sides of the upper-lip area. But no perceptual changes were found at any other fingertips. These results suggest that RSS-induced adaptive plasticity can cross the hand/face boundary but is somehow prevented from crossing interdigit boundaries, maybe due to lateral inhibitory connections between finger representations. Further studies are needed to understand the mechanisms that permit adaptive changes to cross the hand-face border but prevent transfer within the hand region.

D136

PREDISPOSITION TOWARDS UNHEALTHY FOODS LINKED WITH INCREASED GREY MATTER IN THE CEREBELLUM Olga Tkachenko[1], Mareen Weber[1,2], Hannah Gogel[1], William "Scott" Killgore[1,2]; [1]Social, Cognitive & Affective Neuroscience Laboratory, McLean Hospital, [2]Harvard Medical School — The role of the cerebellum is often confined to sensory-motor function. However, growing literature suggests its implication in higher cognitive and emotional processes, particularly executive control and the salience network. Furthermore, several areas have been linked with addiction mechanisms and nicotine dependence. Yet relatively little has been done to examine cerebellum structure with regard to salience. Thirty-seven healthy right-handed adults (20 males) between the ages of 18 and 45 (M=30.3, SD=8.8) underwent structural neuroimaging at 3T and completed a Food Recognition Task. Participants viewed a series of images in the scanner of healthy and unhealthy foods. Afterwards, subjects were asked to discern whether or not they had previously viewed each image. Participants also indicated how hungry they were at the moment using a 7-point scale. A voxel-based morphometric (VBM) multiple regression analysis was conducted to explore grey matter correlates of a predisposition to better remember unhealthy foods rather than healthy foods (Unhealthy Food Recognition Accuracy - Healthy Food Recognition Accuracy). Age and gender were used as covariates, along with total food recognition accuracy, subjective hunger, body mass index, and IQ. Higher accuracy in the recognition of unhealthy foods compared with healthy foods was positively linked with increased grey matter volume in the cerebellum, particularly Crus I. Whole brain exploratory analyses indicated that grey matter volume within the Crus I was positively correlated with greater recall of unhealthy foods (1572 voxels, p=0.04, FWE corrected). In line with the literature, present results posit that the cerebellum may be implicated in salience detection.

PERCEPTION & ACTION: Vision

D137

DECEIVING THE BRAIN: VISUAL ILLUSIONS REVEAL THE NEURAL MECHANISMS OF RESCALING PERCEIVED SIZE Sylvia Kreutzer[1], Ralph Weidner[1], Gereon R. Fink[1,2]; [1]Research Institute Juelich, [2]University Hospital Cologne — Visual illusions illustrate the influence of context on size perception. Functional imaging studies have shown that this contextual information is already integrated at the level of the primary visual cortex (V1). However, receptive fields in V1 are too small to sufficiently integrate context based on feed-forward input and V1 must be modulated by re-entrant processes from higher visual areas. In the current study, two illusions, the size adaptation effect and the Ebbinghaus illusion, were combined in a factorial design to identify possible common mechanisms involved in processing illusions. In those illusions, circle size is either overestimated, after a previously shown smaller adaptation circle, or underestimated following either a larger adaptation circle (size adaptation) or surrounding larger circles (Ebbinghaus illusion). The temporal separation of illusion inducing stimuli and targets allowed the comparison of the BOLD signal of identical physical displays. Illusions were successfully induced in all participants. Functional imaging revealed that both illusions triggered activation in visual areas bilaterally, presumably encoding changes in perceived size, and in left inferior frontal gyrus, an area which has been linked to magnitude processing. Evidence for a common size-scaling mechanism came from a significant interaction of both illusions. Associated regions included left visual cortex, right supramarginal gyrus and right superior parietal cortex. These regions most likely constitute bottlenecks where illusion related processing competes for common resources with the occipital areas contributing to illusion generation and the parietal areas processing task-relevant size information.

D138

ELECTRICAL STIMULATION OF HUMAN FACE-SELECTIVE AREAS REVEALS DIFFERENTIAL ROLES OF THE RIGHT AND LEFT FUSIFORM GYRUS IN CONSCIOUS FACE PERCEPTION Vinitha Rangarajan[1], Dora Hermes[1], Brett L. Foster[1], Kevin Weiner[2], Corentin Jacques[2], Kalanit Grill-Spector[2], Josef Parvizi[1]; [1]Department of Neurology and Neurological Sciences, Stanford University, [2]Department of Psychology, Stanford University — Neuroimaging and electrophysiological studies have confirmed bilateral face-selective responses in the fusiform gyrus (FG) across species, and neuropsychological studies have documented prosopagnosia as a consequence of lesions to the human fusiform gyrus (FG). As brain imaging studies provide only correlative evidence, and lesions in human subjects often cause extensive damage beyond the FG, we designed the current study to

explore the link between electrophysiological responses to faces and the causal effects of transient lesioning of the left and right FG in face perception. We used a combination of electrocorticography (ECoG) and electrical brain stimulation (EBS) in 9 subjects implanted with intracranial electrodes in either the left (5 participants, 30 FG electrodes) or right (4 participants, 13 FG electrodes) hemispheres. We identified electrodes with face-selective ECoG responses in the FG, and recorded subjective perceptual reports during transient EBS of these sites. In line with existing literature, we found face-selective ECoG responses in both left and right FG sites. However, when the same FG locations were stimulated, we observed a striking difference between hemispheres. Only EBS of the right FG sites caused reported changes in the conscious perception of faces while stimulation of strongly face-selective regions in the left FG produced only non-face related visual changes such as flashing lights or phosphenes. This study provides rare insight into the correlative versus causal nature of ECoG and EBS studies, respectively. It also demonstrates that face-selectivity does not predict stimulation effects and examines the differential roles of the right and left FG in conscious face perception.

D139

PROCESSING FACES AND BODIES: IS THE WHOLE THE SUM OF ITS PARTS?

Elisabeth Schriewer[1], Denise A. Soria Bauser[1], Boris Suchan[1]; [1]Ruhr University Bochum, Germany — Perception of faces and bodies is commonly associated with configural processing. Previous research suggests a critical role of fusiform and occipital face areas (FFA and OFA) in face processing as well as extrastriate and fusiform body areas (EBA and FBA) in body processing. The present study aims to examine whether intact and scrambled faces and bodies (without heads) elicit distinct activation patterns in the underlying network involved in visual processing of these stimuli. A matching-to-sample task was used to present faces, bodies (without heads) and houses as well as scrambled faces, bodies and houses. Data were analyzed using a factorial design (factor 1: faces / bodies, factor 2: intact / not intact). Results showed a significant main effect for factor 1 with specific activation in the right EBA and OFA. Percent signal change was extracted from these regions yielding evidence for comparable activation for intact and scrambled stimuli. Results also suggest comparable activation patterns for intact and scrambled faces and bodies. These findings provide further evidence for a configural processing of human bodies and faces. Additionally, a repetition suppression effect could be demonstrated for all stimuli, showing that intact as well as scrambled images both depend on similar adaptation or expectation mechanisms. Our results support the assumption that similar but not identical mechanisms are used for the processing of human faces and bodies.

D140

IMPLICIT LEARNING OF SPEED-CONTINGENT TARGET LOCATION

Byung-Woo Hwang[1], Haesung Kim[1], Hye Jin Kim[1], Min-Shik Kim[1]; [1]Yonsei University, Seoul, Korea — Previous human implicit learning studies investigated implicit associations between two consecutive stimuli or between stimulus and following response. The present study investigated whether a representation of response speed distribution could be formed and if a contingency between response speed and location of following stimulus could be learned implicitly. Participants performed a dual task; they quickly responded to a target "O" in the first task and determined the orientation of a new target "T" in the second. This dual task was repeated 50 times in each block with a total of 24 blocks. For each participant, his/her RT distribution of the first task in the previous block was divided into four ranges (very fast, fast, slow, very slow). In the second task of the following block, each of the four possible target locations was assigned one of the four RT ranges and the location of the target was determined based on the first task RT. For instance, if the participant responded to "O" at a very fast speed, the new target "T" appeared in the upper-right corner. The results showed that participants learned the contingency between RT to "O" and the location of "T" without conscious awareness; they searched "T" more efficiently as the experiment progressed. When the target appeared in a random location, this efficient search disappeared. These suggest that participants might form the representation of their RT distribution and use the relative speed of their own response as a predictive cue to guide spatial attention to upcoming target locations.

D141

EARLY AND LATE BRAIN MECHANISMS UNDERLYING PREDICTION ERROR DETECTION

Rahim Malekshahi[1], Zenon Mathews[2], Amalia Papanikolaou[3], Niels Birbaumer[4], Paul F.M.J. Verschur[5], Andrea Caria[6]; [1]Institut für medizinische Psychologie und Verhaltensneurobiologie. Graduate School of Neural & Behavioural Sciences, International Max Planck Research School Universität Tübingen, Tübingen, Germany, [2]SPECS, Universitat Pompeu Fabra, Barcelona, Spain, [3]Max Planck Institute for Biological Cybernetics. Graduate School of Neural & Behavioural Sciences, International Max Planck Research School, Tübingen, Germany, [4]Institut für medizinische Psychologie und Verhaltensneurobiologie, Universität Tübingen, Tübingen, Germany. Ospedale San Camillo, Istituto di Ricovero e Cura a Carattere Scientifico, Venezia Lido, Italy, [5]SPECS, Universitat Pompeu Fabra, Barcelona, Spain, [6]Institut für medizinische Psychologie und Verhaltensneurobiologie, Universität Tübingen, Tübingen, Germany. Ospedale San Camillo, Istituto di Ricovero e Cura a Carattere Scientifico, Venezia Lido, Italy — In the framework of visual cognition and predictive coding models, we tested the hypotheses that visual prediction influences detection of stimuli violating expectation, and that early and late (conscious) behavioral and brain responses to deviant stimuli are related to processing of different aspects of prediction error. To this aim combined recordings of saccadic eye movements and fMRI data were performed on twelve participants performing a visual detection task. Participants were required to detect moving stimuli that were suddenly displaced with respect to their current trajectory (deviant stimuli). Displacement varied in amplitude and orientation. Psychophysical reverse correlation analysis evidenced different perceptual levels of prediction error processing. Analysis of conscious responses revealed reduced detection of visual inputs for stimuli with small deviation from expected behavior with respect to large deviant stimuli as indicated by increased eccentricity of the psychophysical kernel. fMRI data analysis showed that higher-level late conscious processing, mainly associated with cortical activity in fronto-parietal areas as well as subcortical regions such as caudate nucleus and thalamus, seems to be required to detect prediction error and to assess the degree of violation of expectations. Lower-level early processing, associated with dorsal activity in the right angular gyrus, also enables detection of violation of prediction but it does not permit discrimination among large and small deviating stimuli as indicated by almost null eccentricity of psychophysical kernel. These findings highlight at least two primary brain mechanisms, an early and a late stage, subserving detection of visual inputs deviating from perceptual expectations.

D142

EFFECT OF DISTRACTORS ON THE ATTENTIONAL BLINK

Michael Niedeggen[1], Anja Kuehnel[1], Michael Lars[1], Winther Gesche[1]; [1]FU Berlin, Dept. of Experimental Psychology and Neuropsychology — The detectability of a visual target (T) embedded in a rapid serial visual presentation (RSVP) stream can be significantly reduced if its onset is preceded by visual distractors sharing the features of the target. Behavioral and electrophysiological data indicate a cumulative suppression process: Increasing the number of distractors affects the detection rate, and triggers a frontal ERP negativity starting at about 250ms (Niedeggen et al., 2012, JOCN 24(6)). The frontal suppression process did not affect the visual processing of the upcoming target, but appears to prevent its updating the working memory. In this study, we examined whether the behavioural and ERP signature of the suppression effect can also be identified in the Attentional Blink (AB). RSVP streams of black letters (40/trial) were presented at 10 Hz to our participants (n=15). A single white letter served as T1, and was to be identified. A letter "X" following T1 served as T2, and its presentation was to be detected. The occasional presentation of the letter "X" preceding the onset of T1 served as distractor. Confirming the AB, T2 detection was significantly reduced at early T1/T2-lags (100 - 400ms). If more than two distractors preceded T1, the AB was significantly enhanced. The ERP response to distractors indicated a cumulative effect: A frontal negativity at about 300ms was generated if the number of distractors was increased within the RSVP stream. The results indicate that conscious access to the second target in the AB paradigm also depends on the visual characteristics of the pre-T1-stimuli.

THINKING: Decision making

D143

SATISFICING DECISION-MAKING UNDER TIME PRESSURE

Hanna Oh[1], Pingping Zhu, Kim Rafie, Marc Sommer, Silvia Ferrari, Jeffrey M. Beck[1], Tobias Egner[1]; [1]Duke University — The study of rational decision-making has traditionally focused on small-world scenarios, where decision-makers are assumed to have perfect knowledge of all possible choices, their respective probabilities and values, and ample time and computational resources to optimally integrate this information. In real life, we are instead faced with large-world scenarios, where some of the relevant information is unknown or highly uncertain, and decision-making is bounded by limited time and mental resources. Humans are thought to overcome such limitations through satisficing , fast but good-enough heuristic decision-making that prioritizes some sources of information while ignoring others. However, the manner in which satisficing is triggered and accomplished remains poorly understood. Here, we developed a novel protocol to induce and track such shifts in decision-making strategies by modifying the weather prediction task . On each trial, participants chose between two stimuli that represented combinations of 4 different binary cues with varying reward probabilities. We manipulated the amount of decision time available, and employed logistic regression to determine the weights that participants assigned to each cue in making their decisions. We show that under low time pressure, participants performed like naïve Bayesians , correctly weighting and integrating all cues to arrive at near-optimal decisions. With increasing time pressure, however, subjects gradually shifted their decision strategies by taking only a subset of the most predictive cues into account to arrive at fast yet good-enough decisions. These results, documenting adaptive re-weighting of cue values to compensate for limited decision time, are supportive of bounded rationality models of human decision-mak

D144

EXECUTIVE CONTROL- AND REWARD-RELATED NEURAL PROCESSES UNDERLYING VOLUNTARY DECEPTION

Xiaoqing Hu[1], Narun Pornpattananangkul[1], Robin Nusslock[1]; [1]Department of Psychology, Northwestern University — Recent neuroimaging studies have started to examine the neurocognitive processes underlying voluntary deception, choices involving dishonesty made in experimental situations where participants are completely free to make their own moral decisions. However, the neuro-temporal dynamics of such moral decision-making remains poorly understood. Employing event-related potentials (ERPs), we measured executive control and reward-related processes during an incentivized coin-guess task in which participants could voluntarily engage in dishonest behavior by over-reporting their wins to maximize earnings. We report three primary findings: 1) having the opportunity to deceive engaged executive processes such as conflict monitoring and conflict resolution, as evidenced by a higher frontocentral N2 and a smaller parietal P3; 2) processing the outcome of coin-flips implicated motivated outcome evaluative processes, indicated by a larger medial feedback-negativity (MFN) for incorrect (i.e. loss) than for correct (i.e. gain) guesses; and 3) such outcome-valence sensitive neural signals can not only predict one's overall voluntary deception but also one's moral behavioral adjustment on a trial-by-trial basis (i.e. heightened likelihood of participants' deception on subsequent trials given a previous trial's loss). The present findings inform our understanding of the executive control and reward-related processes associated with voluntary dishonest decision makings, and provide the first evidence of neural processes moderating behavioral adjustment in moral decision making.

D145

EMOTIONAL FACES REGULATE BEHAVIORAL RESPONSE, PARAMETERS IN REINFORCEMENT LEARNING, AND EVENT-RELATED POTENTIALS DURING REWARD-BASED DECISION MAKING

Hung-Hsiang Liu[1,2], Chia-Tzu Li[1], Ming H. Hsieh[2], Yung-Fong Hsu[1,3,4], Wen-Sung Lai[1,3,4]; [1]Department of Psychology, National Taiwan University, Taipei, Taiwan, [2]Department of Psychiatry, National Taiwan University Hospital, Taipei, Taiwan, [3]Graduate Institute of Brain and Mind Sciences, National Taiwan University, Taiwan, [4]Neurobiology and Cognitive Science Center, National Taiwan University, Taiwan — Emotional experience pervades our daily life and usually has significant impact on our decision making. However, its underlying mechanism remains much unclear. Taking advantage of facial expression database and our newly developed feedback-based dynamic-rewarding task, we aim at investigating how emotional faces (i.e. angry, happy, & neutral faces) regulate decision-making process from behavioral, model-fitting, and event-related potentials (ERPs) approaches in this study. Each subject was randomly assigned into one of the following 3 groups: the angry, happy, and neutral groups. Subjects in each group were required to briefly and randomly expose to either one of the 3 predetermined emotional faces or a neutral face before making decisions on a trial-by-trial basis in the dynamic-rewarding task. Individual trial-by-trial choice data were further fit with a standard reinforcement learning model using Bayesian estimation. Individual ERPs were recorded and analyzed to reveal temporal resolution of brain activity. Our preliminary data revealed that the neutral group gained more rewards than the other two groups. Our model-fitting result indicated that the neutral group also had the lowest learning rate but the highest perseveration, suggesting small reward prediction errors. For ERPs, the analysis of feedback-related negativity (FRN) revealed a similar pattern as our model-fitting data. We also found that the neutral group formed more un-biased expectation about the reward through the analysis of FRN expectancy effect (Violated FRN - Expected FRN). Collectively, our findings suggest that both positive and negative emotional states would interfere reward sensitivity, and interrupt the process of reward-expectation through over-weighting negative feedbacks.

D146

MODULATION OF RISK TAKING BEHAVIOR UNDER AMBIGUITY BY SEROTONIN TRANSPORTER POLYMORPHISM

Noa Eilat[1], Idan Aderka[1], Ofri Koren[1], Rachel Tomer[1]; [1]Psychology Department, University of Haifa, Israel — In situations that offer opportunity for rewards but also involve some risk of punishment, the willingness to take risks differs considerably among individuals. However, in ambiguous situations, characterized by an uncertainty regarding the probabilities of the outcome of one's choices, most individuals display a risk averse response style. Previous studies suggest that, with repeated trials, this risk averse behavior tends to change over time and subjects become more willing to increase risk as the task progresses, but whether or not such change in risk averse behavior is a universal characteristic is not known. In the present study we tested the hypothesis that genetically mediated differences in serotonergic function may modulate the increase in risky choices under ambiguity. Young healthy adults, divided according to the 5-HTTLPR genotype ("Long", "Short") performed the Balloon Analogue Risk-taking Test (BART). Although the two groups did not differ significantly in overall level of risk taking, as expected, variations in the 5-HTTLPR genotype predicted different patterns of risk taking over time: Whereas long allele carriers displayed the expected increase in risk taking as the task progressed, individuals carrying the short variant genotype did not, but rather showed a steady rate of risk taking behavior throughout the task. These results suggest that increased attention to negative consequences, which has been reported to characterize short allele carriers, interferes with their ability to develop tolerance for the ambiguity inherent to this task, thus resulting in sustained risk aversion.

D147

THE IMPACT OF SOCIOECONOMIC STATUS ON REWARD LEARNING IN THE MEDIAL-FRONTAL CORTEX

Ashley Howse[1], Marcel Peloquin[1], Shannon Doherty[2], Cameron Hassall[1], Olave Krigolson[1]; [1]Dalhousie University, [2]King's College London — While there is strong evidence that a system within the human medial-frontal cortex plays a prominent role in learning, there is still a lot to learn about the factors that impact the functional efficacy of the medial-frontal learning system. For instance, it is still unclear how external factors such as socioeconomic status (SES) impact neural learning systems. Research suggests that socioeconomic status can impact cognitive achievement, educational attainment, physical and mental health, as well as the functional capabilities of the underlying neural systems, possibly by disrupting normal development (e.g., Kishiyama et al., 2011). Here, we used event-related brain potentials (ERPs) to demonstrate that childhood SES impacts reward processing within the medial-frontal system. Participants completed a learnable gambling task while electroencephalographic data was recorded. In line with previous work, we found that reward and loss feedback elicited a feedback error-related negativity (fERN; Miltner et al., 1997). Further, and importantly, we found that the

amplitude of the fERN correlated with our computed measure of SES. While correlation does not equal causation, we suggest that coming from a low SES background reduces the functional efficacy of the medial-frontal reward processing system - and thus reduces the amplitude of the fERN. In sum, our results suggest that coming from a low SES background may impair the functional efficacy of the neural systems that underlie human learning.

D148

SURE WINS AND SURE LOSSES: OPPONENT PERCEPTION ACTIVATES REWARD PROCESSING WITHIN MEDIAL-FRONTAL CORTEX

Ralph S. Redden[1], Meg E. South[1], Chelsey C. Michaud[1], Ashley D. Howse[1], Cameron D. Hassall[1], Olav E. Krigolson[1]; [1]Dalhousie University — A series of recent studies (Krigolson & Holroyd, 2006, 2007a, 2007; Krigolson et al., 2008) suggest that a reinforcement learning system within medial-frontal cortex may underlie motor learning. Here, we sought to further that work by examining how expertise modulated reward evaluation by the medial-frontal system. More specifically, we were interested in whether learned knowledge of an opponent's skill level would impact reward processing (i.e. amplitude of the neural response to the presentation of the opponent). In the present study we had participants play rock, paper, scissors against a series of virtual "opponents" while electroencephalographic (EEG) data was recorded. In the key manipulation, participants played three opponents - one who was skilled highly (won 70% of games), skilled poorly (won 15% of games), and skilled moderately (won 33% of games). A post experiment analysis of the EEG data revealed that a reward positivity was elicited when participant wins were contrasted with losses (Holroyd et al., 2008). Further, and importantly, after participants had learned their opponents' ability (i.e., had a detectable knowledge of win - loss ratios versus the opponent), viewing "bad" opponents faces relative to "good" opponents faces also yielded a reward positivity. This supports our theory that individuals process opponents differently based on their history of wins and losses against them. These outcomes also support the theory that reward positivity is not only evoked by outcomes, but also modulated by stimuli that predict outcomes, as indicated by a differentiation in medial-frontal activity at the earliest indication of potential reward.

D149

FDA CIGARETTE WARNING LABELS REDUCE CRAVING AND ELICIT FRONTOLIMBIC ACTIVATION IN ADOLESCENT SMOKERS

Kathy Do[1], Adriana Galván[1]; [1]University of California, Los Angeles — Tobacco dependence is the leading preventable cause of disease and death, with over 80% of adult smokers becoming addicted by age 18. Efforts to reduce teenage smoking in the U.S. have been relatively unsuccessful. Other countries have successfully implemented prominent graphic warnings on cigarette packaging to reduce smoking. In 2010, the U.S. Food and Drug Administration (FDA) stated that graphic labels containing warnings about different harms of smoking would appear on tobacco products. Although litigation claims have delayed its implementation, determining the behavioral and neurobiological response to graphic warning labels in adolescents is a critical question. This study investigated the neurobiology of cue reactivity to the proposed FDA warning labels in adolescent (13-18 years; n = 39) and adult (25-30 years, n = 41) smokers and nonsmokers. While undergoing fMRI, subjects rated their cigarette craving following presentations of warning labels paired with either neutral or emotionally graphic FDA labels. Compared to neutral labels, graphic labels reduced in-the-moment craving and post-scan urges in smokers (an effect that was stronger in adolescent smokers), and also elicited differential recruitment in the amygdala, insula, and DLPFC between adolescents and adults. Adolescent smokers exhibited greater amygdala and DLPFC activity to the graphic cues than adults; both adolescent and adult smokers exhibited greater insula activation to graphic versus neutral labels, which was associated with greater nicotine dependence. These findings suggest that the FDA labels are more effective in adolescent versus adult smokers and that frontolimbic circuitry exhibits more robust activation in adolescents versus adult smokers.

THINKING: Development & aging

D150

MODULATING NEUROPLASTICITY IN THE ATYPICALLY DEVELOPING BRAIN TO ENHANCE MATHEMATICAL LEARNING AND COGNITION

Chung Yen Looi[1], Jenny Lim[2], Mihaela Duta[1], Alexander Avramenko[3], Roi Cohen Kadosh[1]; [1]University of Oxford, [2]Fairley House School, London, [3]University of Cambridge — Learning difficulties due to atypical development can negatively affect one's academic achievement, and socioeconomic status. Unfortunately, existing interventions are mostly costly and time-consuming, with little evidence of success. Here, we examined whether transcranial random noise stimulation (tRNS), a novel, painless, inexpensive, and non-invasive brain stimulation technique, coupled with cognitive training could enhance numerical learning and competence in children with mathematical learning difficulties. Twelve children aged 8.5-10.5 trained on a 20-minutes maths video game for 9 sessions at school. Our game is unique, as children move their bodies physically from side-to-side to map numbers on a virtual number line. Moreover, it is adaptive to children's performance, and has engaging features such as interactive graphics and immediate feedbacks to optimise learning. All children wore a wireless tRNS cap during training (6 sham). Participants in the real stimulation group received 0.75mA tRNS to the dorsolateral prefrontal cortex, a key area implicated in mathematical learning. We balanced participants across both groups according to their mathematical achievement at pre-test. Our findings revealed that, compared to sham, tRNS further improved performance after the first 5 training sessions, and facilitated an overall steeper learning during training. Importantly, we found positive transfers; better performance during training led to greater improvements in a standardised, diagnostic maths assessment ($r=.79$, $p<.004$), and higher mathematical age gains according to the national curriculum ($r=.75$, $p<.002$). Ultimately, our findings offer a novel method to effectively modulate neuroplasticity during cognitive training to enhance learning and cognition in children with atypical development, with real-life translational impact.

D151

CONSUMER CHOICE IN OLDER ADULTS: WHAT HAPPENS WHEN MEMORY MATTERS?

Nichole Lighthall[1], Kyle Rand[1], Eileen Lu[1], Homa Boms[1], Eric Huang[1], Scott Huettel[1], Roberto Cabeza[1]; [1]Duke University — Decision making is a complex cognitive process that relies on several, more basic domains of information processing. In particular, short-term memory is likely to play a significant role in everyday economic decisions as people often learn new information about competing products that they later retrieve during purchasing decisions. Aging is associated with changes in consumer decision making, and age differences in economic decision making may be partly explained by deficits in memory (Henninger et al., 2010; Yoon et al., 2009) and learning from outcomes of recent choices (Mata et al., 2011). The current study sought to determine the neural correlates of a simple choice task in which value information for pairs of competing products were presented at different delays. The study examined age differences in this functional network during choice processing. Healthy younger and older adults completed the consumer choice task during functional MRI data collection. In both age groups, accurate choices were associated with recruitment of fronto-parietal networks, visual processing regions, and regions responding to the magnitude of product values (e.g., intraparietal sulcus). Across age groups, faster correct responses were associated with greater functional recruitment from bilateral hippocampus, amygdala and the ventromedial prefrontal cortex. However age differences were observed such that, at choice, older adults showed less activation in regions associated with product-value encoding, but greater activation in the ventromedial prefrontal cortex at longer delays. These findings suggest a functional posterior-anterior shift in aging for choices involving retrieval of recently learned value information, particularly at longer delays.

D152

DEVELOPMENTAL TRAJECTORY OF FUNCTIONAL CONNECTIVITY OF THE DEFAULT NETWORK

Elizabeth DuPre[1], Hilary A. Marusak[2], Ian H. Gotlib[3], Moriah E. Thomason[2], R. Nathan Spreng[1]; [1]Cornell University, [2]Wayne State University, [3]Stanford University — Over development, substantial changes occur in the structural and functional architecture of the human

brain. In this study, we examined the trajectory of developmental changes in the default network using resting-state functional connectivity MRI (RSFC) in a cross-sectional sample of 130 children/adolescents (58 boys; age range=7-16y; M=12.4y, SD=2.2y). First, we identified posterior and anterior components of the default network using group independent components analysis. Participants' images were then correlated with age and this matrix was decomposed using partial least squares. The results yielded a shared pattern of RSFC as well as an age-related RSFC interaction for the posterior and anterior default network. The development of both the posterior and anterior default network were associated with increases in connectivity in medial prefrontal cortex, mid-cingulate, precuneus, and right inferior frontal gyrus, and with decreasing connectivity in superior parietal lobule, visual cortex, and other regions. In analyzing the age-related interaction, increases in connectivity in the posterior default network were found in lateral prefrontal and parietal cortex, and decreases in connectivity were obtained in the medial temporal lobes and thalamus; the opposite pattern of connectivity was observed in the anterior default network. Overall, these results indicate that patterns of RSFC follow three broad trends. First, connectivity within the default network increases with age. Second, there are differential changes that include decreases in local RSFC and increases in long-range RSFC. Finally, there are age-related changes in the connectivity of the default network with other brain systems, including the frontoparietal control network.

Poster Session E

ATTENTION: Auditory

E1

RIGHT HEMISPHERE DOMINANCE FOR AUDITORY SELECTIVE ATTENTION REVEALED BY LATERALIZED PARIETOTEMPORAL OSCILLATORY PHASE SYNCHRONIZATION Samantha Huang[1], Wei-Tang Chang[1], John Belliveau[1,2], Matti Hämääinen[1,2], Jyrki Ahveninen[1]; [1]Harvard Medical School - Athinoula A. Martinos Center for Biomedical Imaging, [2]Harvard-MIT Division of Health Sciences and Technology — Previous studies and observations in human neurological patients suggest that visual spatial attention is dominated by the right parietal cortex, having a bilateral representation of space, whereas the left parietal cortex represents only the right spatial hemifield. Here, we studied whether analogous lateralization applies to auditory spatial attention as well. Combined magnetoencephalography, EEG, and fMRI were utilized to investigate hemispheric lateralization of auditospatial attention by comparing the differences in cross-hemispheric functional coupling between parietal and auditory areas during a dichotic-listening task. Subjects were asked to shift attention to the cued ear where a task-relevant target was likely to follow. Our results showed significantly stronger oscillatory phase locking between the right intraparietal sulcus (IPS) and left auditory cortex (AC) neurons activated by attended right-ear sounds than between the left IPS and right AC neurons activated by attended left-ear sounds. In other words, the connectivity to sensory neurons representing the ipsilateral auditory spatial field appeared to be stronger in the right than left parietal cortex, consistent with right-hemisphere dominance of auditory spatial attention. The present phase-locking differences concentrated at 7-13 Hz, and peaked in Heschl's gyrus and posterior non-primary ACs (planum temporale, posterior superior temporal gyrus). Our data, thus, also adds support to theories positing that phase-coupling at theta and alpha frequency ranges is specifically crucial for attention. Finally, while the distribution of AC effects supports a view that posterior non-primary areas are more strongly modulated by spatial attention than anterior areas, attentional influences are also evident in primary "core" AC areas.

E2

SENSORY GATING IN HEARING LOSS Lauren Durkee[1], Hannah Glick[1], Julia Campbell[1], Jessica Peterson[1], Anu Sharma[1]; [1]University of Colorado at Boulder — Sensory gating is considered an index of the brain's ability to filter out irrelevant stimuli and focus on information that is pertinent. Sensory gating is measured using an auditory paired-click paradigm where a reduction in amplitude of the P1 component between the first and second click serves as a clinical biomarker of gating deficits, and is used in the diagnosis of schizophrenia. Our recent research has shown that adults with hearing loss show an increase in amplitude of obligatory CAEP components relative to normal, which may be associated with a gating deficit. More recently, disruptions in gating have been observed in individuals with tinnitus although it remains unclear whether these gating deficits are attributable directly to tinnitus or to hearing loss concomitant with tinnitus. Moreover, gating research to-date has focused primarily on the P1 component while largely ignoring later components of the obligatory CAEP waveform. The goal of this study was to examine the role of all obligatory CAEP components (P1, N1, P2) in adults with normal hearing and in hearing loss in a sensory gating paradigm. A 128-channel electrode net was used to obtain EEG responses to an auditory paired-click stimulus. Results revealed that obligatory CAEP components including the N1 and P2 showed significant gating ratios. This evidence suggests that changes in N1 and P2 amplitude may provide a sensitive index of sensory gating in patients with hearing loss. Research supported by NIH NIDCD R01 06257

E3

EFFECTS OF ATTENTION ON TONOTOPY IN SCHIZOPHRENIA Thomas Ragole[1], Erin Slason[1], Peter Teale[1], Martin Reite[1], Donald Rojas[1]; [1]University of Colorado School of Medicine — A disorganization of tonotopy in the auditory cortex has been described in schizophrenia. Subjects with schizophrenia show little to no spatial organization of responses to different tone frequencies in the auditory cortex. Previous studies have shown that attending to auditory stimuli alters tonotopic distributions in healthy controls. This study examines if attention to tone affects auditory cortex tonotopy in schizophrenia. The tonotopic organization for 400Hz and 4,000Hz sound in 19 patients with schizophrenia and 11 comparison subjects was determined using MEG by examining the M100 auditory-evoked magnetic field dipole in primary auditory cortex. The tonotopic organization for the same frequencies was determined while the subjects attended to pitch or laterality. The equivalent current dipole locations were then mapped and compared. In subjects with schizophrenia, attention to tone frequency or laterality had no effect on tonotopic organization in auditory cortex. The distribution of auditory evoked magnetic field dipoles is unchanged from control in this group. Further, we replicate previous results of dynamic enhancement of distance between auditory evoked dipoles in the comparison subjects when attending to different frequencies. The lack of tonotopic organization of the auditory cortex in patients with schizophrenia, even while attending to auditory stimuli, suggests that the architecture underlying tonotopy in the auditory cortex is not responsive to top-down, task relevant reorganization in the same manner as in healthy subjects. This alteration in organization of the auditory cortex may in turn influence higher order cognitive processes by altering the perception of incoming auditory stimuli.

E4

POSITIVE AND NEGATIVE TONES CAN ATTRACT ATTENTION IN AN EARLY STAGE OF AUDITORY PROCESSING: ENHANCED N1 AMPLITUDE FOR TASK-IRRELEVANT EVALUATIVE TONES Timea Folyi[1], Dirk Wentura[1]; [1]Saarland University — In visual modality, a growing body of evidence shows that evaluative (positive and negative) stimuli are processed more efficiently compared with neutral ones. A suggested mechanism of this preferential processing is that an involuntary shift of selective attention facilitates the encoding of evaluative stimuli. However, little is known about how positive and negative stimuli are processed in auditory domain. We report two experiments using event-related potential (ERP) method based on the hypothesis that evaluative tones attract selective attention at an early (i.e., perceptual) stage of auditory processing. If so, we can expect attention-related effects on the ERPs of initial sound processing, e.g., an amplitude enhancement of the auditory N1 ERP. In order to overcome possible perceptual confounds, we induced valences experimentally in a learning phase by assigning positive, negative, and neutral valence to tone frequency in a balanced design. In a subsequent test phase, ERPs were recorded while these tones were presented in a task-irrelevant channel. In a second experiment, attentional demand in the task-relevant channel was increased. Results of the first experiment showed N1 amplitude enhancement for evaluative tones compared with neutral ones indicating enhanced attention to these tones. This effect did not show selectivity for positive or negative valence suggesting that the general relevance of evaluative tones governs attentional processes. In the second experiment, attentional enhancement for evaluative tones was strongly reduced. This pattern of results suggests that evaluative tones can be processed preferentially but this effect is sensitive to the level of control over one's voluntary attention.

E5

DYNAMIC CHANGES IN ATTENTION TO FAMILIAR AND NOVEL STIMULI IN NEWBORN INFANTS Cathryn S. Cortesa[1], Dennis L. Molfese[1]; [1]University of Nebraska-Lincoln — This study aimed to determine whether infants are able to discriminate familiar from novel stimuli, and to model trial-by-trial changes in event-related potential (ERP) amplitude as an index of attention. ERPs were recorded from infants, tested at 1-2 days old, using a high-density 128 electrode array. Newborns were familiarized with 40 presentations of a monosyllabic speech sound. Subsequently, they listened to the familiar and a novel sound, presented with equal probability. A temporal principal component analysis (PCA) and analysis of variance (ANOVA) were used to identify a temporal window in the average ERP response sensitive to stimulus condition. One component, peaking at 628 ms post stimulus onset significantly discriminated familiar from novel,

in interaction with hemisphere. The condition effect was significant in both hemispheres, which indicated differential lateralized processing of speech sounds at birth, with a polarity reversal at the midline. Multilevel models estimated trial-by-trial changes in ERP amplitude for the peak component of interest. Results indicated a dynamic time course of familiarization, with the largest amplitude differences between stimulus conditions at the start of the test. The effect of familiarization persisted throughout the test, but was reduced over time. Dynamic changes in component amplitude were significant only in interaction with hemisphere and stimulus condition, and thus were not due solely to fatigue or reduced attention. By tracking meaningful trial-by-trial changes in ERP amplitude within a single test, we can track the dynamic plasticity of infant cognition and attention, and better understand how novel stimuli are processed from birth.

E6

FUNCTIONAL CONNECTIVITY OF DORSAL AND VENTRAL FRONTOPARIETAL SEED REGIONS DURING AUDITORY ORIENTING Stephanie Rossi[1], Samantha Huang[1], Sharon C. Furtak[1,2], John W. Belliveau[1,3], Jyrki Ahveninen[1]; [1]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Charlestown, Massachusetts, USA, [2]California State University, Sacramento, CA, USA, [3]Harvard-MIT Division of Health Sciences and Technology, Cambridge, Massachusetts, USA — Few previous studies have investigated functional connectivity across brain regions during auditory attention shifting in humans. Here, we employed psychophysiological interaction (PPI) analyses of auditory functional MRI data, to compare functional connectivity patterns of distinct frontoparietal cortex seed regions during cued (or "voluntary") auditory attention versus novelty-driven (or "involuntary") orienting. There were many similarities across PPI patterns with the different posterior parietal seed regions between these two attention conditions. However, the anterior supramarginal gyrus (aSMG) and frontal eye field (FEF) seeds demonstrated stronger PPI with auditory cortices, and more widespread connectivity to other frontoparietal regions, during cued attention than novelty-triggered orienting. In contrast, the more inferior/posterior angular gyrus (AG) seed regions, as well as the precuneus and the left anterior insula (AI) seeds, demonstrated broader PPI patterns beyond auditory cortices during novelty-triggered orienting than cued attention shifting. Consistent with previous observations regarding lateralization of attentional control, the PPI patterns associated with cued attention shifting tended to be more widespread for the right parietal seeds, whereas the broadest novelty-triggered orienting PPI patterns emerged for the left-hemisphere seeds. The present results provide indices of anatomically distinct functional connectivity patterns related to voluntary and involuntary orienting of auditory attention, with certain right superior frontoparietal seeds (FEF, aSMG) being most clearly associated with goal-driven attentional modulation of auditory cortex.

ATTENTION: Spatial

E7

AGE-RELATED CHANGES IN ALPHA LATERALIZATION DURING TOP-DOWN CONTROL OF VISUAL SPATIAL ATTENTION Xiangfei Hong[1,2], Junfeng Sun[1], Jesse Bengson[2], George Mangun[2], Shanbao Tong[1]; [1]School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China, [2]Center for Mind and Brain, University of California-Davis, Davis, California — Previous studies have demonstrated age-related deficits in visual spatial attention. However, how normal aging changes the electrophysiological correlates of visual spatial attention remains unclear. In this study, we collected scalp EEG from healthy younger and older adults in a spatial-cueing attention paradigm. We found that the older adults showed a prominent deficit in posterior alpha (8-13 Hz) power lateralization in response to an attention-directing cue. Furthermore, for both younger and older adults, we observed a cue-induced increase of alpha-specific functional connectivity between frontal recording sites and bilateral posterior sites. Interestingly, this long-range connectivity became lateralized within different time periods between the two groups. Younger adults showed stronger functional connectivity between medial frontal cortex and posterior cortex contralateral to the attended visual field during the late period of the cue-target interval (CTI) (800-1200 ms post-cue), but older adults showed this lateralized connectivity over a broader time window than younger adults, with significant effects in both the 400-800 ms and 800-1200 ms CTIs. Taken together, our results suggest that during top-down spatial attention: (i) older adults have a prominent deficit in modulating posterior alpha power during the pre-target anticipatory state; (ii) the cue-induced lateralization of frontoposterior functional connectivity was preserved during aging, and probably even more robust for older adults. Based on these findings, we infer that younger and older adults engage partially different neural mechanisms during top-down control of visual spatial attention, possibly as the results of compensatory changes in brain attention systems with aging.

E8

THE EFFECT OF NARRATIVE CONTENT OF SUSPENSEFUL FILMS ON NEURAL CORRELATES OF ATTENTIONAL TUNING Matthew Bezdek[1,2], Richard Gerrig[2], William Wenzel[2], Jaemin Shin[3], Kathleen Pirog Revill[3], Asha Kumar[1], Eric Schumacher[1]; [1]Georgia Institute of Technology, [2]Stony Brook University, [3]Center for Advanced Brain Imaging, Atlanta, GA — People often report being transported to narrative worlds, in a way that makes them feel detached from the real external world. In fact, behavioral evidence suggests that attention to extra-narrative stimuli during "hot spots" (i.e., time points when potential negative outcomes are most salient) is suppressed during natural viewing of suspenseful film scenes (Bezdek, 2012). The current study investigates the brain mechanisms for this effect. We measured blood oxygen level-dependent (BOLD) activation as participants passively viewed centrally presented suspenseful film excerpts while an irrelevant checkerboard pattern flashed in the periphery. Peripheral visual processing areas along the calcarine sulcus (identified with a separate visual localizer task) demonstrated decreased activity at suspenseful hot spots compared to less suspenseful "cold" spots. Whole-brain analyses revealed narrative increases in suspense were also associated with increases in BOLD signal in some brain areas (e.g., right lateral prefrontal cortex) and decreases in others (e.g., default-mode network nodes in medial prefrontal and posterior cingulate cortex). These results provide evidence of narrative-induced attentional tuning effects using complex realistic stimuli.

E9

INTACT REFLEXIVE BUT DEFICIENT VOLUNTARY SOCIAL ORIENTING IN AUTISM SPECTRUM DISORDERS Megan Kirchgessner[1], Neeti Mehta[1], Stuart Red[2], Anne Sereno[2]; [1]Rice University, [2]University of Texas Health Science Center — Impairment in social interactions is a primary characteristic of people with autism spectrum disorders (ASDs). Although these individuals tend to orient less to naturalistic social cues than do typically developing (TD) individuals, laboratory experiments testing social orienting in ASDs have been inconclusive, possibly because of a failure to fully isolate reflexive (stimulus-driven) and voluntary (goal-directed) orienting processes. The purpose of the present study was to separately examine potential reflexive and/or voluntary social orienting differences in individuals with ASDs relative to TD controls. Subjects (ages 7-14) with and without high-functioning ASDs completed three gaze cueing tasks on an iPad in which they briefly saw a face with averted gaze followed by a target after a variable delay. Two tasks were 100% predictive with either all congruent (target appears in gaze direction) or all incongruent (target appears opposite from gaze direction) trials, respectively. Another task was non-predictive with half congruent and incongruent trials intermixed randomly. Response times (RTs) to the target were used to calculate reflexive (incongruent condition RT - congruent condition RT) and voluntary (non-predictive condition RT - predictive condition RT) gaze cueing effects. Results indicate that subjects with ASDs demonstrate intact reflexive gaze following. However, their voluntary cueing effects differed significantly from those of the TD controls, suggesting problems in using social cues in a goal-directed fashion. These results indicate preserved reflexive social orienting and deficient voluntary social orienting in individuals with ASDs. Such findings may be critical for understanding social dysfunctions in ASDs and for developing future interventions.

E10

CONCURRENT FNIRS-ERP REVEALS ATTENTIONAL PREPARATORY HBO ACTIVITY CORRELATES WITH N2PC DURING COVERT VISUOSPATIAL ATTENTION

Jing Huang[1], Fang Wang[1], Hao Li[1], Yan Song[1]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing 100875, China — By combining a spatial cuing paradigm with a visual search task, we used concurrent fNIRS-ERP recording to investigate whether the cued-elicited anticipatory modulation in fNIRS signals is linked to the ERP components assumed to reflect the subsequent attentional selection in the visual search. We manipulated on a block-by-block basis advance information about whether a target would appear on the cued side or a distractor would simultaneously appear on the opposite side to the target. Our data showed that expecting a target could lead to preparatory activation of the visual cortex with a larger increase of HbO response over the hemisphere contralateral to the upcoming target, which could predict the subsequent target-evoked ERP N2pc component. While anticipation concerning a competing distractor presence resulted in a large and prolonged preparatory HbO signals not only in the visual cortex contralateral to the target, but also in the visual cortex contralateral to the distractor, suggesting that salient distractor may be actively suppressed by preparatory top-down attentional control before the actual presentation of stimuli. However, the pre-suppressed distractor still captured a part of attention in the subsequent visual search as revealed by the decreased N2pc, which was predicted by the increment of preparatory HbO signals contralateral to the distractor. These findings indicate that specific components of preparatory visual attention may be devoted to enhancements of target processing and minimizing the impact of distractor respectively, which would both act on subsequent allocation of attention in the search display.

E11

TASK INSTRUCTIONS DETERMINE THE VISUO-SPATIAL AND VERBAL-SPATIAL NATURE OF NUMBER-SPACE ASSOCIATIONS

Carrie Georges[1], Christine Schiltz[1], Danielle Hoffmann[1]; [1]University of Luxembourg — Evidence for number-space associations comes from the spatial-numerical association of response-codes (SNARC) effect, consisting in faster reaction times (RTs) to small/large digits with the left/right hand respectively. Classically, they are thought to result from numerical coding along a left-to-right-oriented mental number line (visuo-spatial account; Dehaene et al., 1993). Recently, an association between the verbal concepts "small"/"left" and "large"/"righ" has been suggested as an alternative explanation (verbal-spatial account; Gevers et al., 2010). Since the predominance of these accounts remains debated, we aimed to determine whether task instructions influence their extent of explaining the SNARC effect. A magnitude comparison task where the verbal labels "left"/"right" were displayed on the left/right response side alternatively allowed us to directly contrast the two accounts by comparing verbal SNARC slopes (based on differences in RTs to the labels "left" and "right") with classical spatial SNARC slopes (based on differences in RTs to the left and right response side). In the verbal condition, participants (41 students, 20 female, mean age=21.6) responded to the assigned labels irrespective of their side of appearance, whereas the spatial condition required responding to the left or right response side irrespective of the displayed label. Under verbal instructions, only the verbal slope was significantly negative (verbal slope=-67.54, spatial slope=-4.82). Conversely, no significant difference was observed between verbal and spatial slopes under spatial instructions - both slopes being significantly negative (verbal slope=-15.12, spatial slope=-29.39). Taken together, number-space associations arise from verbal coding regardless of task instructions, while spatial coding only occurs under spatial instructions.

E12

CHANGE DETECTION-BASED INVESTIGATIONS OF MECHANISMS FOR ATTENDING TO SINGLE AND MULTIPLE VISUAL LOCATIONS IN COMPLEX VISUAL SCENES

J. Daniel Bireley[1], Maya L. Rosen[1], David C. Somers[1]; [1]Boston University — Previous research has debated whether or not visual spatial attention is limited to a single "potlight" (e.g., Posner et al., 1980; Jans et al., 2010) or whether it can be deployed in multiple spotlights to distinct locations (Awh & Pashler, 2000; McMains & Somers, 2004, 2005; Cave et al., 2010). We employed a one-shot change detection paradigm using outdoor scenes to investigate the mechanisms that support attention to single or multiple locations. Expt. 1: Eriksen & St. James (1986) proposed that a single spotlight of attention could act as a "zoom lens" to encompass multiple locations. Here, we contrasted multiple-location change detection performance with two forms of spatial cueing: "zoom lens" vs. "split spotlight". Subject performance (N=31) was significantly greater for split spotlight cueing than for zoom lens cueing (d: 1.26 vs 0.61). Expt. 2: Posner's (Posner et al., 1980) well-known spatial cueing study indicated that humans could only direct attention to a single location. Here, we developed a spatial cueing paradigm for a change detection task to investigate the efficiency of dividing attention to two locations versus a single (valid) location. We observed (N=25) that while d was greater for the single cued condition (d at 150ms probe duration: 1.69 vs 1.37), capacity (Cowan's K) was greater for the multiple-cued condition (.91 vs .51). Summary: Both experiments demonstrate higher capacity for change detection when employing split spotlight attention than when employing single spotlight or zoom lens attention. This work was supported by the National Institutes of Health (NIH R01EY022229).

E13

AGING-RELATED CHANGES IN COVERT SPATIAL ATTENTION DURING VISUAL SEARCH TASK

Meirong Sun[1], Encong Wang[2], Jing Huang[1], Xixi Zhao[2], Li Sun[2], Yan Song[1]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing 100875, China, [2]Peking University Institute of Mental Health, Key Laboratory of Ministry of Health (Peking University), Beijing 100191, China — Humans deploy covert attention routinely in many everyday situations, such as searching for objects, driving, crossing the street and playing sports. Covert attention allows us to monitor the environment and guides our eye movements to locations of the visual field where salient and/or relevant information is. However, few studies have attempted to delineate the development of covert attention strategies and mechanisms in children. In the present study, we investigated the covert attention development by comparing event-related potentials (ERPs) between adults (27 subjects, 20-28 years old) and primary school children (17 subjects, 9-12 years old) in classical pop-out visual search task. A spatial pre-cue, prior to the actual presentation of the search array, was absent (Experiment 1) or present to subjects (Experiment 2) with the information about the visual side in which the upcoming target would appear. The results showed that, compared to the children group, the adult group responded faster with higher accuracies and lower variance of reaction times in both experiments. Then, our ERP data showed that, no matter whether the spatial pre-cue was present or not, the N2pc (a marker of attention target selection) emerged later and was much smaller in children group than in the adult group, suggesting that children need more time to allocate spatial attention onto the target even when advance knowledge about target location is provided. Our results indicate the covert spatial attention is still undergoing significant development during primary school stage and contribute to the understanding of the development of covert spatial attention.

E14

CATCH TRIALS CATCH SPATIAL ATTENTION WHEN TARGET ABSENCE IS RELEVANT

Cassie Ford[1], Joseph Hopfinger[1]; [1]University of North Carolina at Chapel Hill — Previous studies of contingent attentional capture have suggested that items trigger a reflexive orienting of spatial attention only when the cue stimuli are congruent with task-relevant features of the target stimuli. Here, we tested a novel type of contingency that goes beyond features of the stimuli; specifically, whether a non-predictive and non-congruent cue will capture attention when subjects are required to make a "no-target-was-present" button-press response on catch trials. In 2 behavioral experiments, we show that even when a cue stimulus shares no critical features with the target stimulus, a reflexive capture of attention is triggered to the spatial location of this cue, but only when a behavioral response to catch trials is required. These results provide new evidence that the ability of a stimulus to capture attention goes beyond the contingency of congruency between cue and target features. When the cue display, regardless of any location or feature, becomes a behaviorally relevant temporal marker of the trial sequence, attention is captured to the spatial location of the cue. When the exact same trial sequence occurs but without the requirement of response to the catch trials, no capture occurs. In an ERP experiment, we find faster RTs and enhanced P1 and N2pc ERP components for

validly-cued targets, and an Ipsilateral Invalid Negativity (IIN), associated with disengagement, for invalidly-cued targets. Compared to participants who were not required to respond to the catch trials, participants who responded to these trials show enhanced sensory components and a later and longer P3 component.

EMOTION & SOCIAL: Emotion-cognition interactions

E15

HOW ENCODING PROCESSES INFLUENCE EMOTIONAL MEMORY CONFIDENCE AND VIVIDNESS

John Ksander[1], Katherine Steinmetz[2], Elizabeth Kensinger[1]; [1]Boston College, [2]Wofford College — Memories vary in their subjective confidence and vividness. This study examines how processes engaged at encoding may relate to these memory qualities, and whether the delay after which memory is assessed may impact this relation. Because emotional memories are often associated with higher confidence and vividness, this study also examines the effect of emotion on the relation between encoding processes and memory confidence and vividness. Twenty-four participants studied positively, negatively, and neutrally valent items during an fMRI scan. All participants performed two recognition tasks with a modified Memory Characteristics Questionnaire, one immediately after scanning and another 24 hours later. Parametric analyses of the fMRI data were conducted and, at the group level, results examined the effects of emotion, delay, and their interaction on the relation to confidence and vividness. Analyses revealed a main effect of emotion in the amygdala, but unexpectedly, increasing activity tracking with confidence and vividness ratings for neutral items more than emotional items. The analyses also revealed a main effect of emotion in the hippocampus, but this pattern differed for confidence and vividness. Analysis of confidence ratings showed neutral items tracked more strongly with hippocampal activity than emotional items. Conversely, hippocampal activity tracked with vividness for negative items more than positive items. These results reveal that item valence crucially affects neural processes underlying participants' memory confidence and vividness ratings. The results also confirm that confidence and vividness are not redundant constructs, as there is a distinction between the neural processes involved in these two subjective memory ratings.

E16

GOING 'ABOVE AND BEYOND': PRO-SOCIAL BEHAVIOUR IN GROUPS HIGH AND LOW IN AUTISTIC TRAITS

Leila Jameel[1], Karishma Vyas[1], Giulia Bellesi[1], Victoria Roberts[1], Shelley Channon[1]; [1]University College London — Autism spectrum disorder (ASD) is a neurodevelopmental condition characterised by difficulties in both social and non-social domains. In recent years researchers have begun to move towards a continuum approach, and measuring autistic traits present in the general population has proved useful in elucidating their effect on various cognitive domains. However, relatively little work has focused on how impairments associated with high levels of autistic traits translate into difficulties in everyday social behaviour. This study investigated pro-social behaviour in students scoring high and low on a self-report measure of autistic traits, using a novel scenario task: "Above and Beyond". Each scenario involved balancing the needs of a main character against the participants' own interests. Participants with high levels of autistic traits generated verbal responses that were less pro-social in nature than those with low levels of autistic traits, and performance did not improve when task demands were reduced. The groups also differed in satisfaction experienced when helping others. The implications of reduced pro-social behaviour in everyday life for those with high levels of autistic traits are considered. The potential clinical applications of tasks with greater ecologically validity are also discussed.

E17

NEGATIVE EMOTION MODULATES PREFRONTAL CORTEX ACTIVITY DURING A WORKING MEMORY TASK: A NIRS STUDY

Sachiyo Ozawa[1], Goh Matsuda[2], Kazuo Hiraki[3]; [1]The University of Tokyo, JST, CREST, [2]The University of Tokyo, JST, CREST, [3]The University of Tokyo, JST, CREST — This study investigated the neural processing underlying the cognitive control of emotions induced by the presentation of task-irrelevant emotional pictures before a working memory task. Previous studies have suggested that the cognitive control of emotion involves the prefrontal regions. Therefore, we measured the hemodynamic responses that occurred in the prefrontal region with a 16-channel near-infrared spectroscopy (NIRS) system. In our experiment, participants observed two negative or two neutral pictures in succession immediately before a 1-back or 3-back task. Pictures were selected from the International Affective Picture System. We measured the changes in the concentration of oxygenated hemoglobin (oxyHb) during picture presentation and during the n-back task. Consequently, the emotional valence of the picture affected the oxyHb changes in the ventromedial and ventrolateral prefrontal cortex during the n-back task; the oxyHb changes during the task were significantly greater following negative stimulation than after neutral stimulation. There were no effects of emotion on oxyHb changes during picture presentation or on n-back task performance. Previous studies with similar experimental designs have revealed that cognitive processing during a working memory task can inhibit negative emotions. Therefore, the effects of emotion during the n-back task observed in this study likely reflected the inhibition of negative emotion by cognitive processing. Although further studies are necessary to confirm this interpretation, our findings suggest that NIRS can be used to investigate neural processing during emotional control.

E18

REGULATION OF CRAVING IN OBESE CANDIDATES FOR BARIATRIC SURGERY

Rebecca Boswell[1], Godfrey Pearlson[1,2], Michael Stevens[2], Beth Anderson[2], Janet Ng[2], Kasey O'Neil[2], Andrea Stone[2], Pavlos Papasavas[2], Darren Tishler[2], Pawel Skudlarski[2], Haley Yarosh[1], Hedy Kober[1]; [1]Yale University, [2]Hartford Hospital Interdisciplinary Center on Obesity Research — Cognitive regulation of craving attenuates neural responses to drug-related cues and helps predict successful treatment outcomes in substance use disorders. In contrast, no previous work has investigated obese individuals' regulation of craving in response to food cues. As part of a larger, ongoing, longitudinal study, we administered the Regulation of Craving (ROC) task to pathologically obese individuals prior to bariatric surgery (N = 14; BMI = 45.73 ± 4.37) using functional magnetic resonance imaging on a Siemens Skyra wide-bore 3T scanner. On each trial, participants were presented with photographs of high-calorie foods and instructed to adopt various cognitive strategies: (1) NOW: "think of the positive sensory qualities of the food", (2) LATER: "think of the long-term negative consequences of consuming the food", or (3) LOOK: "respond naturally". Then, they rated their craving. Imaging data were collected using a novel multi-band acquisition sequence (MB=8, TR= 475ms, 3x3x3 voxels). Consistent with prior findings in addiction, regulatory success (LATER > NOW) was associated with increased recruitment of prefrontal executive control regions, and reduced striatal activation. However, striatal activation during regulatory success was positively correlated with BMI ($r = .57$, $p = .001$). These results suggest that obese individuals may exhibit heightened reward-related neural activation to high calorie foods, which increases with BMI. Nevertheless, when instructed to do so, obese individuals were able to regulate craving as a group. Our findings have important clinical and public health implications and applications, including the potential to predict treatment outcomes for bariatric surgery.

E19

IS IT A MATTER OF EMPATHY? PERFORMANCE MONITORING DURING ACTIVE AND OBSERVATIONAL LEARNING IN MAJOR DEPRESSION

Patrizia Thoma[1], Christine Norra[2], Georg Juckel[2], Boris Suchan[2], Christian Bellebaum[2]; [1]Ruhr-University Bochum, Bochum, Germany, [2]Ruhr-University Bochum, LWL University Hospital, Bochum, Germany — Previous literature established a link between Major Depressive Disorder (MDD) and altered reward processing as well as between empathy and (observational) reward learning. The aim of the present study was to assess the effects of MDD on the electrophysiological correlates of active and observational reward processing and to relate them to trait cognitive and affective empathy. In our analyses of event-related potentials, we focused on the feedback-related negativity (FRN) and the P300. Eighteen patients with MDD and 16 healthy controls performed an active and an observational probabilistic reward-learning task and were assessed with regard to self-reported cognitive and affective trait empathy. Relative to healthy

controls, patients with MDD showed generally attenuated FRN amplitudes, irrespective of feedback valence and learning type (active vs. observational), but comparable P300 amplitudes. In the patient group, but not in controls, higher trait perspective taking scores were significantly correlated with lower FRN amplitudes for punishment and reward in the active condition and for reward during observational learning. The pattern of results suggests impaired reward prediction and a negative effect of higher trait empathy on feedback-based learning in patients with MDD. This may have implications for the question which patients might benefit from individual and group therapy treatment settings.

E20

ATTENTIONAL PRIORITIZATION OF THREAT MAY BE DRIVEN BY PERCEPTUAL CHANGES Emma Wu Dowd[1], David M. Monroe[1], Kevin S. LaBar[1], Stephen R. Mitroff[1]; [1]Duke University — Attentional prioritization of threat, a heightened assessment of potentially dangerous stimuli, occurs in both normal and anxious populations. The amygdala is hypothesized to mediate this facilitation of attention via direct connections to sensory cortices, suggesting that changes in perceptual processing might underlie this attentional effect. To test whether attentional prioritization of threat occurs via perceptual processes, we combined previously established effects of fear generalization (see Dunsmoor & LaBar, 2013) with a visual search task. Delay conditioning was used to create a threatening stimulus; one color was paired with electrical shock (conditioned stimulus, CS+) and another color was explicitly unpaired (non-conditioned stimulus, CS–). The CS+ was always the intermediate value in a 5-point blue-green gradient, while the CS– was either the blue or green endpoint. After conditioning, participants completed a visual search task that presented targets and distractors inside colored circles, one of which could be one of the five blue-green colors. Participants then identified the CS+ along the blue-green gradient. Fear conditioning was successful; skin conductance responses were greater for the CS+ versus the CS–. Reaction times indicated that attention was preferentially deployed towards threat-associated colors. Consistent with fear generalization shifts, this attentional effect generalized across the blue-green gradient, peaking not at the CS+ but rather at an unreinforced color further away from the CS–. Participants were also more likely to incorrectly identify that unreinforced color as the CS+. These 'peak shift' effects suggest that attentional prioritization of threat may be driven by changes in perception.

E21

HERE COMES TROUBLE: EXPECTATION OF THREATENING STIMULI ENHANCES PERCEPTION Tamara J. Sussman[1], Anna Weinberg[1], Akos Szekely[1], Greg H. Proudfit[1], Aprajita Mohanty[1]; [1]Stony Brook University — Emotional stimuli exist in a visually complex environment and their detection is critical for survival. Existing research has focused on bottom-up stimulus-related characteristics in the prioritized perception of threatening stimuli. However, top-down factors like expectations and goals play a key role in perception. According to the predictive coding hypothesis, the brain anticipates the forthcoming sensory environment, generating a template against which observed sensory evidence is matched. Here we test the hypothesis that the expectation of an emotional stimulus, rather than a physical encounter with it, may be a key factor in improved threat detection. After viewing fear (F) and neutral (N) cues, 19 participants detected perceptually degraded fearful and neutral faces presented at their pre-determined perceptual threshold in a two-alternative forced-choice perceptual discrimination task. Signal detection measures of behavior and evoked response potentials (ERPs) of brain activity were recorded. Threat-related cues enhanced perceptual sensitivity (d-prime;$t = 4.50, p < .001$) and led to faster detection of upcoming stimuli($F(3, 60) = 105.68, p < .001$). The late positive potential (LPP), an ERP component associated with enhanced perceptual processing of emotional stimuli, was larger for F compared to N cues($F(1,18) = 5.85, p < .05$). Furthermore, a larger LPP for F cues predicted greater face processing during face viewing (indexed by larger vertex positive potentials;$F(2,16) = 3.89$, $p < .05$) and greater identification accuracy for fear faces (indexed by accuracy;$r = .47, p < .05$). These findings represent a conceptual advance in the field, establishing the importance of top-down factors in the perceptual prioritization of emotional stimuli, and support predictive coding as a neural mechanism that enhances speed and accuracy of threat perception.

E22

EYE-MOVEMENTS AND EMOTIONAL MEMORY: GENDER DIFFERENCES IN THE EFFECTS OF EMOTION ANTICIPATION ON ATTENTIONAL PROCESSES DURING ENCODING Anne Hermes[1], Aoxiang Xu[2], Patricia Bauer[2]; [1]Duke University, [2]Emory University — Enhanced memory for emotional information is widely studied, and many cognitive processes interact during encoding to contribute to this phenomenon. For example, attentional processes are implicated - research suggests that attention narrows to negative information and broadens in response to positive information. Other research has found that when individuals, particularly females, anticipate an emotional event, neural activity before the event is predictive of subsequent memory, implying that emotion anticipation also alters stimulus processing in mnemonically important ways. Unknown are the effects of emotion anticipation on attentional processes during encoding and their gender differences. To investigate this interaction, in the present research, 42 adults (23 female) viewed emotional images while their eye movements were recorded. Anticipation of emotion was manipulated between subjects, with half of participants receiving a cue indicating the emotional valence of each upcoming image. Participants completed a recognition task one week later as a measure of subsequent memory. Emotion anticipation weakened the effects of emotion on encoding processes in females, but lead to heightened attention to emotional information as an encoding mechanism in males. Specifically, for females, focusing eye-gaze on emotionally salient information during encoding was related to enhanced memory for negative items and worse memory for positive items. However, the anticipation of emotion diminished these effects. Males' memory for neutral items was related to focusing eye-gaze on salient information, but when anticipating emotion, focusing on negative information was related to enhanced memory. Implications of the findings for theories of emotion effects on attention and memory will be discussed.

E23

PROSOCIAL BEHAVIOUR IN GROUPS HIGH AND LOW IN PSYCHOPATHIC TRAITS Karishma Vyas[1], Leila Jameel[1], Shelley Channon[1]; [1]University College London — Psychopathy is a personality disorder characterised by significant impairments in emotional empathy, with preserved cognitive empathy. Although a substantial body of work has examined cognitive and emotional functioning in psychopathy, this has typically been carried out using abstract laboratory tasks. Moreover, there is limited work investigating how impairments associated with psychopathy influence prosocial behaviour in everyday social interactions. In order to investigate this, the present study examined how university students high and low in self-reported psychopathic personality traits performed on a novel measure of everyday social behaviour. Participants were presented with a series of social scenarios ending with an awkward request posed by a main character. Participants had to provide verbal responses and also rate the awkwardness of the situation. Verbal responses were categorised into social strategies, signifying the extent of compliance with the main characters' requests. As predicted, the high psychopathic trait group employed fewer prosocial strategies than the low psychopathic trait group and rated the situations as less awkward. The findings are discussed in relation to the postulated dissociation between intact cognitive empathy and compromised emotional empathy. The potential long-term implications of the findings for increasing prosocial behaviour in individuals with psychopathic traits are considered.

EMOTION & SOCIAL: Emotional responding

E24

INTEROCEPTION AND EMOTIONAL AWARENESS Evelyn Ramirez[1,2], Jin Fan[1]; [1]Queens College at the City University of New York, [2]CUNY Graduate Center — Interoception, the awareness of internal changes in one's own body, has long been implicated in the experience of emotion. Various theories of emotion argue that conscious awareness of emotion (emotional awareness), is greatly dependent on one's interoceptive ability. However, there is little empirical evidence assessing the extent to which interoception influences awareness of one's own emotions, as well as the emotions

of others. The current study aimed to examine the relationship between these two constructs by measuring interoceptive and emotional awareness abilities in healthy participants. The Interoceptive Awareness Scale (IAS), and Breathing Detection Task (BDT) were employed as self-report, and behavioral measures of interoception, respectively. Emotional awareness was quantified using the Levels of Emotional Awareness Scale (LEAS) and the Toronto Alexithymia Scale (TAS-20). Correlational analyses of data for 32 participants (14 males, 18 females; mean age = 23.5, SD = 1.6) revealed a significant positive relationship between breathing detection accuracy on the BDT, and the ability to identify and describe emotional experiences within the self and others based on the LEAS ($r = .40$, $p = .02$). Consistent with our behavioral findings, self-report measures of interoception on the IAS also positively correlated with one's level of emotional awareness ($r = .31$, $p = .04$). These results support the notion that there is a relationship between bodily awareness and the subjective experience of emotion, this link may have important implications for clinical populations with deficits in emotional awareness.

E25

THE IMPACT OF THE BLACK AND WHITE STYLIZATION OF VIDEO ADVERTISEMENTS ON EMOTIONAL IMPRESSION

Yuri G Pavlov[1]; [1]Ural Federal University — When creating TV ads designers often use discoloration technic to improve the products promotion efficiency. The principal aim of this study was the research of psychophysiological correlates of emotions that occurs during watching video advertisements in chromatic (in color) and in Ð°chromatic (in black and white) versions. The participants were sixteen adults (8 males). Four video advertisements of the perfumery products were used as stimulus. All videos were performed in two versions. The first experimental group watched video advertisement number 1 & 3 in achromatic version, 2 & 4 in chromatic version. Conversely, the second group has seen 2 & 4 in achromatic version and 1 & 3 in chromatic version. EEG data, skin conductance responses (SCR), heart rate and pulse wave amplitude by photoplethysmogram were collected. Subjective values of advertisements measured by questionnaire. The analysis didn't reveal any significant differences between experimental groups' results. This means that chromaticity of clips did not influenced on the subjective evaluations, as well as on physiological indicators. At the same time we found that the data were changing in depending on the videos' content and sex of the participants. ANOVA RM found the significant main effect of number of video for the scale «general impression» as well as for the theta power in F3 and alpha power in P4. Women more positively evaluated all videos and had significant greater overall EEG power values in time of perception of each stimulus. SCR amplitude was changing in depending of the target audience (gender) of advertisements.

E26

THE EFFECT OF SOCIAL INFLUENCE ON EMOTIONAL REACTIVITY

Rebecca Martin[1], Yvette Villanueva[1], Peter Franz[1], Kevin Ochsner[1]; [1]Columbia University — Famous experiments like the Asch line paradigm have examined how group behavior can profoundly shape an individual's beliefs and perceptions. Few studies however, have examined how group attitudes can impact an individual's emotional state. In the current study, we examined the effects of social influence on emotional reactivity. Participants rated positive, negative, and neutral images on a 1 to 7 scale to indicate how bad or good the image made them feel. Following their rating, participants either received feedback and were shown what they believed to be a group rating from a sample of approximately 100 peers, or they received no feedback at all. After a rest period, participants then rated the images again, this time without peer feedback. We assessed social influence by comparing the degree to which participant ratings changed as a function of the peer ratings. We found a robust conformity effect, i.e. participants significantly changed their responses to conform to the peer ratings. Interestingly, there was a positivity bias such that participants' ratings changed the most when peer ratings were more positive. There was no significant change in ratings when participants received no peer feedback, nor when their ratings matched the peer ratings. Future directions include using fMRI to assess the neural underpinnings of social conformity, and how it might attenuate or enhance neural circuitry associated with emotional reactivity.

E27

THE EMOTIONAL REGULATION AND ALTRUISTIC BEHAVIORS IN HEALTHCARE THERAPISTS WITH DIFFERENT TRAINING PROFILES

Jasin Wong[1], Chien-Te Wu[1]; [1]School of Occupational Therapy, College of Medicine, National Taiwan University — Empathy-altruism hypothesis posits that altruistic behaviors are primarily motivated by empathy; however, the relationship between empathy and altruistic behaviors seems to be more complicated in healthcare contexts. Several controversial findings suggest that empathy levels of healthcare practitioners declines as the duration of clinical practice increases, which seems to be ironically due to emotional distress caused by long-term empathy. Furthermore, how does the empathy declination influence their altruistic behaviors remains unclear. In the current study, we aim to address this issue by investigating the influence of different professional training profiles upon people's empathetic and altruistic behaviors. We included four groups of participants: trained occupational therapists (OT, N=30), trained non-healthcare professionals (N=30), untrained OT student (N=30), and untrained non-healthcare-related college freshmen (N=30). In Exp1, we used a modified Emotional Stroop paradigm to implicitly evaluate how do active empathizing processes modulate participants' responses to emotional conflicts within different emotional contexts (medical vs. non-medical). In Exp2, we used a computerized Zurich Prosocial Game and a donation paradigm to implicitly evaluate participants' prosocial behaviors. Our results suggest that, compared to other groups, trained OT showed significantly reduced emotional interference from medical related negative contexts while maintaining high levels of altruistic behaviors. The observed emotional regulation patterns in trained therapists may be an adjustment mechanism that prevents them from emotional distress caused by "required" long-term empathetic states. Therefore, the empathy-altruism hypothesis may not be sufficient to explain the altruistic behavior of people who works in an emotionally negative environment for a long period.

E28

DOES CEREBELLUM CONTRIBUTE UNCONSCIOUS EMOTIONAL PROCESSING? A PILOT FMRI STUDY.

Kyota Inagaki[1], Keiichi Onoda[1], Shuhei Yamaguchi[1]; [1]Department of Neurology, Faculty of Medicine, Shimane University — The cerebellum has an important role in the control and coordination of movement. In recent years, clinical and neuroimaging studies have provided compelling evidence for a cerebellar role in the processing of emotion. However it is not clear that the cerebellum is also related to neural processes underlying unconscious emotion. The object of this study is to investigate whether the cerebellum is involved in unconscious emotional processing. We used functional magnetic resonance imaging (fMRI) to identify neural activity patterns within the cerebellum in 20 healthy human volunteers (mean age 26.0 +/- 2.2 years old, 10 females) as they categorized images that elicited one of the two primary emotions: happiness and anger. Each participant was presented at a time either of angry, happy, neutral, or neutral faces with transiently masking affective (angry/happy) pictures. Participants instructed to make an angry/happy judgment for each face. There was no participant who can percept the masking emotional faces. The fMRI results showed that the cerebellum elicited stronger activation for conscious happy faces compared to the other types of stimuli. No regions of the cerebellum showed stronger activation for unconscious affective faces than the others. These results suggest that the cerebellum is involved in conscious but not unconscious emotional processing.

E29

NEURAL CORRELATES OF AFFECTIVE PROCESSING IN MALE COLLEGE STUDENTS WITH HIGH AND LOW PSYCHOPATHIC TRAITS

Amy Medina[1,2], Kevin Constante[2], Danielle diFilipo[1,2], Elvira Kirilko[2], Jill Grose-Fifer[1,2]; [1]The Graduate Center, CUNY, [2]John Jay College of Criminal Justice, CUNY — Affective deficits are a core feature of psychopathy; however, few studies have examined the neural correlates of psychopathic traits in college students. We used the Psychopathic Personality Inventory-Revised (PPI-R) to categorize college-aged males into two groups with either high or low psychopathic traits. We recorded ERPs while they viewed complex unpleasant, pleasant, and neutral IAPS images, and we assessed differences in attentional processing by comparing LPP amplitudes between groups

and across conditions. The early part of the LPP reflects initial attentional capture, whereas later portions index more elaborate, deliberative processing. As we predicted, compared to those with low PPI-R scores, individuals with high PPI-R scores had reduced LPP amplitudes in response to emotional stimuli. This relationship was evident in the later portion of the LPP. However, in the early window, both groups showed similar increases in LPP amplitudes for emotional images compared to neutral. Our results suggest that although college students with relatively high levels of psychopathic traits show initial attentional capture by affective stimuli, they fail to engage in more extended, higher-order processing of this kind of information. Taken together, these findings may help to address the current debate about whether affective deficits in psychopathy are primarily attentional in nature.

E30

AN EXPLORATORY STUDY OF SOCIAL REJECTION AND PATHOLOGICAL AGGRESSION Karla Fettich[1], Jason Chein[1], Lauren Uyeji[1], Mitchell Berman[2], Michael McCloskey[1]; [1]Temple University, [2]Mississippi State University — Social rejection is associated with increased hostility and aggression, and decreased prosocial behaviors. While there are many studies demonstrating negative effects of social rejection in general, very little is known regarding the neural mechanisms underlying social rejection in individuals with pathological levels of aggression. Intermittent explosive disorder (IED) is characterized by aggressive impulses that the individual is unable to control, often resulting in assaults or destruction of property. The present study assessed the neural correlates of rejection sensitivity using a social exclusion paradigm (Cyberball) in adults with IED, in which a virtual ball was tossed between the participant and two fictitious players. We hypothesized that, compared to healthy controls (N=15), individuals with IED (N=15) would: 1) report greater sensitivity to rejection, as measured by the Rejection Sensitivity Questionnaire (RSQ), 2) report stronger feelings of social rejection and display increased neural activation (as measured by BOLD signal) in regions including the anterior and posterior cingulate cortex (PCC, ACC), insula, and amygdala. While in the scanner participants completed 4 games of Cyberball (2 exclusion games). Group contrast results indicate that the IED group reported greater rejection sensitivity than healthy controls, and displayed increased activation (as measured by BOLD signal) in the PCC. Furthermore, within the IED group, the exclusion condition also activated regions in the ventromedial and medial superior PFC, regions implicated in emotion regulation. These findings suggest that individuals with IED respond differently to social rejection and help inform prevention and treatment strategies to reduce aggression related to social rejection.

E31

PROBABILISTIC REINFORCEMENT LEARNING IN ADOLESCENTS WITH BIPOLAR DISORDERS Tate Halverson[1], Snezana Urosevic[1], Monica Luciana[1]; [1]University of Minnesota – Twin Cities — Reward sensitivity (RS) is implicated as a risk factor for the first-time onset of bipolar disorders (BP; Alloy et al., 2012a) and conversion from less to more severe bipolar diagnoses (Alloy et al., 2012b). There is a paucity of studies assessing RS in BP during adolescence, a developmental period with normative increases in RS (Urosevic et al., 2012). A probabilistic learning (PL) task (Frank et al., 2004) yields indices of sensitivity to recent reinforcement feedback during the learning phase and of cumulative learning of reinforcement value during the testing phase. Empirical studies and computational models suggest generalization of reinforcement learning in the PL task may rely on striatal dopamine functioning (e.g., Frank et al., 2004), a key system implicated in BP (e.g., Depue & Iacono, 1989). Thus, PL is a valuable tool, but to date untapped, for assessing RS in BP. Adolescents, ages 13 - 19 (M = 15.93, SD = 1.59), were recruited into either BP (n = 21) or healthy control (n = 27) groups. Diagnostic interviews confirmed each group's inclusion criteria. Participants completed the PL task along with cognitive assessments and self-report measures of RS. There were significant associations between self-report RS measures and PL indices. During the learning phase of the PL task, there were significant group differences in sensitivity to recent feedback. During the PL's testing phase, there were significant group by gender effects on indices of cumulative learning. The results are relevant but do not neatly conform to RS models of BP.

EMOTION & SOCIAL: Person perception

E32

IMPAIRED CORTICAL DISCRIMINATION OF SOCIALLY CONDITIONED FACES IN SOCIAL ANXIETY Lea M. Ahrens[1], Andreas Mühlberger[2], Matthias J. Wieser[1]; [1]University of Würzburg, Germany, [2]University of Regensburg, Germany — Though aversive social learning experiences may play a major role in the onset of social anxiety disorder (SAD), recent studies which applied disorder nonspecific unconditioned stimuli (US) failed to prove enhanced general conditionability in social phobics compared to healthy controls. Thus, this study used socially relevant US to develop an etiologically highly valid model capable of explaining the development and maintenance of SAD. 24 high socially anxious (HSA) and 23 low socially anxious (LSA) subjects were conditioned to three different faces (CS) flickering at a frequency of 15 Hz which were paired with auditory presented insults, compliments or neutral comments (US). The face-evoked electrocortical response was measured via steady-state visually evoked potentials (ssVEPs) and subjective measures of valence and arousal were obtained. Results revealed a significant interaction during conditioning with LSA showing highest cortical activity to faces paired with insults and lowest activity to faces paired with compliments, while HSA did not display any distinctions in the ssVEP amplitude, but generalized their conditioned electrocortical response to all faces. However, no group differences were discovered in the ratings. The finding that HSA learned to discriminate between the three conditions on the subjective level, but did not react with different cortical activation indicates an impaired ability to differentiate between relevant and irrelevant social stimuli and might be a perpetuating factor of social anxiety disorder.

E33

FACES ALTER CONTEXT: STEADY-STATE VISUALLY EVOKED POTENTIALS DURING CONTEXT CONDITIONING FOR HIGH AND LOW SOCIALLY ANXIOUS INDIVIDUALS Anna K. Kastner[1], Paul Pauli[1], Andreas Mühlberger[2], Matthias J. Wieser[1]; [1]University of Würzburg, Germany, [2]University of Regensburg, Germany — Social stimuli are found to capture attention and to be preferentially processed, possibly modified in threatening contexts. Context conditioning, which leads to an increased state of anxiety due to the unpredictability of unconditioned stimuli (US), could provide such a context. Two pictures of different office rooms, presented for a longer duration, served as contexts. In one office room an unpleasant noise was presented unpredictably (CTX+) while the noise was never presented in the second context (CTX-). In the test phase a social agent with happy, neutral or angry expression was presented in both contexts. Context and agents were presented in flickering mode. Cortical activation in response to context and agents was assessed separately by steady-state visually evoked potentials (ssVEP) using frequency tagging. The influence of social anxiety was taken into account. Results showed enhanced ssVEP amplitudes for CTX+ compared to CTX- in an occipital cluster during acquisition. This was also true for the test phase but only for subjects aware of the context-US-contingency. Similarly, only aware subjects showed higher amplitudes for CTX+ when a distractor was present. High socially anxious (HSA) but not low socially anxious (LSA) individuals showed higher ssVEP activation for both contexts when an angry face was present compared to other expressions. Results suggest that context conditioning was successfully implemented with facilitated cortical processing of fear-associated contexts. Moreover, processing of context seems to vary between HSA and LSA such that social anxiety leads to enhanced processing of the environment when a potentially threatening stimulus is present.

E34

THE EFFECTS OF MEDIA VIOLENCE ON THE NEURAL CORRELATES OF EMOTIONAL FACIAL PROCESSING: AN ERP INVESTIGATION Laura Stockdale[1], Robert Palumbo[1], Matt Kmiecik[1], Rebecca L. Silton[1], Robert G. Morrison[1]; [1]Loyola University Chicago — Decades of research on the effects of media violence have shown a clear association between exposures to media violence, increased aggression, and decreased prosocial behavior and empathy. For example, participants who played a violent video game for 20 minutes more quickly and accurately identified angry faces as

opposed to happy faces. Researchers have shown that facial processing and behavioral regulation are important cognitive processes underlying empathetic behavior and aggression, however no known research has examined the influence of media violence on the neural correlates of face processing and behavioral regulation. Sixty undergraduate students were randomly assigned to watch a 10-minute movie clip which was either dominantly violent or nonviolent. Movies were previously shown to be equally engaging and arousing and in our study both conditions resulted in an equal increase in negative affect. After watching the film, participants completed a stop-signal task using equally arousing fearful and happy faces while their brain waves were recorded using EEG. Participants were asked to identify if faces were male or female with no explicit mention of emotion. Preliminary results suggest that exposure to the violent film resulted in a delayed N170 ERP. This effect was strongest in right posterior electrodes, usually associated with the N170 to faces. Delays in N170 latency have frequently been associated with a shift from natural holistic processing of faces to a more feature based approach. We believe this is the first study to show that exposure to media violence can modulate the mechanisms underlying emotional face processing.

E35

PERCEIVING CROWD ATTENTION: ENSEMBLE PERCEPTION OF A CROWD'S GAZE Timothy Sweeny[1], David Whitney[2]; [1]University of Denver, [2]University of California, Berkeley — Each time we encounter a person, we gather a wealth of socio-visual cues useful for understanding behaviors and intentions. This sensitivity, in turn, can rapidly and automatically guide our own behavior. Intriguingly, social information is most effective in directing behavior when it is perceived in crowds. For example, the shared gaze of a crowd is more likely to direct attention than an individual's gaze. Is this curious sensitivity to social information in crowds ingrained in our visual processing, or is a crowd's behavior only understood after an inferential process or cognitive deliberation? Here, we provide the first evidence that the visual system uses a direct mechanism - ensemble coding - to efficiently encode the "gist" of a crowd's attention. When people viewed a group of faces, they pooled information from multiple individuals to perceive the crowd's collective gaze, all at once. This integration was rapid, occurring in as little as 200 msec. Ensemble perception of the crowd was diminished when faces were inverted, suggesting an origin in high-level stages of visual processing, with gaze perceived as an emergent combination of information from multiple faces and eyes. These findings reveal a direct mechanism for assessing crowd gaze, which could underlie our ability to perceive group intentions, orchestrate joint attention, and guide behavior. More generally, our results show that in order to understand even the most basic visual processes, it is vital to consider the social pressures and group behaviors with which we evolved, and vice versa.

E36

TRUST DEPENDS ON CHANGES IN OTHER'S PUPIL SIZE VIA PUPIL SYNCHRONIZATION Mariska Kret[1], Agneta Fischer[1], Carsten de Dreu[1]; [1]University of Amsterdam — Humans cooperate with, and extend trust to both familiar and unfamiliar others, thus enabling ancestral groups and contemporary institutions to function and prosper. Yet to avoid betrayal and exploitation, humans must be prepared to withhold cooperation and trust, and punish those who betray. Whether recurrent or one-shot, humans need to assess whether partners are worthy of one's trust, or instead likely to exploit one's cooperative effort. For that purpose, humans attend to each other's eyes, mimic facial expressions, follow gaze and there are indications that they synchronize pupil-size. The communication of such delicate eye-signals must have become adaptive among individuals who trusted and not abused each other. Seeing a partners' pupils dilate signals safety, permitting cooperation and trust; perceiving small pupils, in contrast, inhibits a pro-social approach. A possible mechanism is that the own pupils that synchronize with the partners', provide immediate neural feedback that the interaction environment is benign. To test the supposed relation between pupil-synchronization and trust, we designed three experiments in which participants played trust-games with virtual trustees whose pupils contracted, remained static or dilated. We observed that contracting pupils undermined trust. Participants' pupils synchronized with trustees' dilating pupils, especially when from an in-group member and expressing happiness. Participants' pupil-size decreased following trustees' contracting pupils, especially when anger was expressed by the outgroup. The more participants synchronized with dilating pupils, the more they trusted. We just finished fMRI data collection to test our hypothesis that the ventral striatum is involved in the link between pupil-synchronization and trust.

E37

GENDER AND CARE-GIVING TENDENCIES DRIVE SELECTIVE SENSITIVITY IN THE FUSIFORM FACE AREA TO DIFFERENT AGED FACES Rodrigo A. Cardenas[1], Carlos O. Garrido[1], Caitlin R. Bowman[1], Reginald B. Adams, Jr.[1]; [1]The Pennsylvania State University — Recent work suggests that the collective care of human infants has substantially shaped human psychology, especially empathic and altruistic behavior. Here, we examined whether a core structure in the neural representation of faces, the face fusiform area (FFA), responds selectively to age cues and whether this response depends on known sex-differences in interest-in-infants. We used an fMRI block-design to present to 23 participants (13 women) with infant, younger adult, older adult faces, and objects. Participants also completed behavioral measures of interest-in-infants, which replicated sex-differences in interest-in-infants (with women showing more interest than men). Next, we localized the FFA using a standard contrast of young adult faces compared to non-face objects. A 2 (participant's sex) x 3 (face's age) x 2 (left or right FFA) ANOVA revealed a two-way interaction, $F(2,42) = 4.025$, $p = .025$, such that women showed similar FFA activation across faces, whereas men showed lower FFA activation to both infant and older adults compared to young adult faces. Thus, the FFA responded to age cues in a direction consistent with our measure of interest-in-infants. Further, interest-in-infants was significantly correlated with left-FFA activation for infant faces ($r = .6$, $p = .004$). Surprisingly, interest-in-infants was also correlated with younger ($r = .61$, $p = .003$) and older adult ($r = .59$, $p = .005$) faces. This result suggests that the interest-in-infants measure taps into a more general care-giving construct. Overall, these results reveal sex-differences in FFA responses in what appears to be due to individual differences in care-giving tendencies.

E38

DEFAULT NETWORK ACTIVITY DURING FREE VIEWING OF SEMI-NATURALISTIC SOCIAL INTERACTIONS DIFFERS IN AUTISM Lisa Byrge[1], J. Michael Tyszka[2], Julien Dubois[2], Ralph Adolphs[2], Daniel P. Kennedy[1,2]; [1]Indiana University, Bloomington, [2]California Institute of Technology — Autism is characterized in part by atypical social behaviors, yet attempts to understand their neural bases through neuroimaging studies have been largely restricted to using static and often artificial stimuli. Functional neuroimaging during free viewing of semi-naturalistic stimuli is emerging as an important complement (Hasson et al., 2004), whereby measures of neural response similarity across individuals (i.e., inter-subject synchronization of BOLD-fMRI responses) can reveal typical or atypical response profiles. Only two previous studies have used this approach with individuals with autism (Hasson et al., 2009; Salmi et al., 2013); yet, none so far have examined the temporal patterns of evoked activity at the level of brain networks despite known resting-state network abnormalities in autism. Here, we scanned 19 high-functioning adults with autism and 21 matched controls while they watched an episode of the television sitcom The Office (NBC Universal), which prominently features interpersonal interactions. Using a network-based cortical parcellation (Yeo et al., 2011) to derive timeseries for 17 unique networks, we found that all three sub-networks comprising the default network (each of which exhibited distinct timecourses) responded abnormally in the autism group, an effect that was reliable across both halves of the video (all $p < 0.01$ and Cohen's d effect sizes=0.44-0.62). In all cases, reduced inter-subject synchronization was observed in the autism group. These findings add to the growing body of work demonstrating abnormalities in the default network in autism, but highlight the relative specificity of default network dysfunction in autism during unconstrained viewing of social interactions.

E39

A MAP FOR SOCIAL NAVIGATION IN THE HUMAN BRAIN Rita Tavares[1], Christian Williams[1], Yael Grossman[1], Avi Mendelsohn[1], Daniela Schiller[1]; [1]Icahn School of Medicine at Mount Sinai, NY — Where do I stand? On a given social encounter we can become more or less intimate with others and gain or lose power over them. Over time, we learn to position ourselves within

a social structure by using others as reference points. How does the human brain encode these social coordinates? We hypothesized that the neural mechanisms underlying navigation in physical space are also employed to navigate social space and that these neural correlates could be found in the hippocampus. To test this hypothesis, we devised a naturalistic paradigm of social encounters, built on the principles of role-playing games. During the task, participants interact with several characters while undergoing functional MRI. Each interaction is translated to numerical values representing power and intimacy. These social coordinates are then used to draw a vector between each of those characters and the participant's point of view. The angle and distance of the vector are employed as predictors for BOLD signal analysis. Our vector model consistently correlated with activation of the hippocampus. This suggests both that we can extract the neural correlates of social navigation using a geometrical model, and that encoding of spatial and social navigation might happen in overlapping areas of the brain.

E40

CONGRUITY OF VALENCED APPEARANCE-BEHAVIOR CUES IMPACTS MEDIAL PREFRONTAL ACTIVITY Brittany Cassidy[1], Angela Gutchess[1]; [1]Brandeis University — Previous work has revealed several brain regions, notably medial prefrontal cortex (mPFC), are recruited while forming impressions from others' behaviors. The interplay of appearance- and behavior-based cues for impression formation has been understudied because much of the previous work utilizes face-behavior pairs in which faces are equated across conditions on several characteristics (e.g., trustworthiness). This allows for the possibility that the congruity of facial characteristics and behaviors could impact the engagement of neural regions, including mPFC. We investigated this possibility using fMRI. Eighteen young adults viewed trustworthy- and untrustworthy-looking faces alone for two seconds, and then the face was paired with a positive, negative, or neutral behavior for four seconds. Participants then indicated their likelihood of approaching each individual. We calculated the strength of responses toward the face-behavior pairs based on the mean approach likelihood for each participant. Both congruent (e.g., trustworthy face/positive behavior) and incongruent (e.g., trustworthy face/negative behavior) face-behavior pairs were judged more extremely than appearance-based (e.g., trustworthy face with neutral behavior) pairs. mPFC engagement complemented this finding, with increased activity for congruent and incongruent face-behavior pairs compared to appearance-based ones. Behaviorally, congruent pairs were judged more extremely than incongruent ones for untrustworthy- but not trustworthy-looking faces. mPFC activity reflected this interaction, which was driven by enhanced activity when participants viewed negative versus positive behaviors. This suggests that the presentation of valenced social material influences mPFC activity during impression formation, and further highlights the salience of negative information when viewing congruent and incongruent appearance- and behavior-based social cues.

E41

GRAY MATTER VOLUME IN THE AMYGDALA IS ASSOCIATED WITH FACIAL ASSESSMENTS OF TRUSTWORTHINESS Lily Preer[1], Mareen Weber[1], Olga Tkachenko[1], Shreya Divatia[1], Lauren A. Demers[1], Elizabeth Olson[1], William D.S. Killgore[1]; [1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Harvard Medical School — Structural abnormalities in the amygdala may interfere with processing of perceptions of threat. Evidence has shown that amygdala damage is associated with impaired recognition of fearful faces and decreased accuracy in determinations of facial trustworthiness. Some evidence suggests that greater amygdala volume is related to increased anxiety and fearfulness. The present study tested the hypothesis that amygdala volume would be inversely correlated with accuracy in assessing trustworthiness in faces. nnFifty-seven healthy individuals ages 18-45 (M=30.2, SD=30.2) completed a computerized facial assessment of trustworthiness task. In this task, participants were presented with a series of 100 pairs of computer-generated facial expressions varying along a continuum of rated trustworthiness and selected which face in the pair was more trustworthy. Participants also underwent structural magnetic resonance imaging at 3.0 Tesla. Voxel-based morphometric random effects multiple regression whole-brain analyses were used to assess whether gray matter volume was related to trustworthiness accuracy (p<.001, non-stationary cluster extent corrected, cluster threshold k e" 87). Reduced gray matter volume in the left amygdala was related to better performance on the trustworthiness task (89 voxels, T=4.33, MNI coordinates: x=-14, y=2, z=-24). nnFindings support prior research on the role of amygdala structure in facial determinations of trustworthiness, but expand on this by showing that smaller gray matter volume is related to greater accuracy in determining trustworthiness. We speculate that larger gray matter volume in the amygdala may increase emotional interference, reducing the accuracy of determinations of trustworthiness.

EXECUTIVE PROCESSES: Development & aging

E42

THE ACUTE EFFECTS OF EXERCISE ON LARGE-SCALE NETWORKS OF THE HUMAN AGING BRAIN: INSIGHTS INTO THE PROTECTIVE ROLE OF EXERCISE Timothy B. Weng[1], Gary L. Pierce[1], Warren Darling[1], Vincent Magnotta[1], Michelle W. Voss[1]; [1]The University of Iowa — Regular exercise protects against age-related declines in the brain and cognitive function. However, the mechanisms by which exercise improves brain function in aged humans remains poorly understood. Investigating the acute effects of exercise may reveal insights about the parameters that determine accumulated outcomes of long-term exercise interventions. By employing a novel acute exercise paradigm with functional magnetic resonance imaging (fMRI) in a group of healthy younger (N=12) and older (N=8) adults, this study sought to examine the acute effects of exercise on large-scale functional brain networks acquired during a resting state. We hypothesized that moderate-intensity exercise would increase functional synchrony of two networks that are disrupted with normal aging, the Default-Mode Network (DMN) and the Fronto-Executive Network (FEN). For each participant, resting-state fMRI data were collected before and after 30 minutes of both moderate and very light intensity cycling. Exercise sessions were counter-balanced for order of intensity. Results indicate that baseline age-related differences in functional synchrony of the DMN and the FEN were attenuated by a single bout of moderate-intensity exercise. After exercise, functional synchrony in these networks increased disproportionately more in older than in younger adults (all p<0.05). These results are the first documentation of acute exercise effects on functional brain networks in humans and are consistent with animal studies that demonstrate immediate effects of exercise on the brain. Follow-up studies will further characterize the mechanisms by which exercise induces acute changes in functional synchrony in older adults and whether they predict long-term changes in the same individuals.

E43

INTRINSIC CONNECTIVITY IN ADOLESCENTS AND ADULTS PREDICTS DIFFERENCES IN IMPULSIVITY AND RISK-TAKING Samantha Abram[1], Krista Wisner[1], Rachael Grazioplene[1], Colin DeYoung[1], Angus MacDonald, III[1]; [1]University of Minnesota, Twin Cities — Discrete neural networks, or intrinsic connectivity networks (ICNs), are theorized to reflect the inherent functional architecture of the brain at rest. Additionally, ICNs have been shown to correspond with task-related neural activity, with recent findings suggesting that the strength of certain cognitive and affective ICNs may predict performance on decision-making measures. Within-network strength and between-network efficiency has been to shown to improve from adolescence into adulthood. This study examines the development of decision-making neural networks from adolescence into adulthood, first comparing connectivity strength in adolescents and adults of relevant ICNs, and then applying these findings to assess group differences in impulsive decision-making. 70 adolescents (ages 15-19) and 300 adults (ages 20-40) completed a resting-state scan and BIS/BAS scales, which measure the behavioral approach and inhibition systems. Group-level Independent Component Analysis was performed on resting-state data to extract 60 ICNs. Dice coefficients were used to compare ICNs across samples, producing a correlation heat map matrix with 18% of correlations above 0.70, 53% above 0.50, and 97% above 0.30. The reproducibility of ICNs across samples provides grounds for probing the utility and function of specific ICNs, specifically those related to decision-making processes. These findings support the presence of a consistent set of networks across developmental stages.

This project will also examine adolescent versus adult differences in connectivity strength of decision-making ICNs, and how these discrepancies relate to performance on measures of risk-taking.

E44

EXPLORING THE RELATIONSHIP BETWEEN SMALL VESSEL DISEASE AND VASCULAR COGNITIVE IMPAIRMENT USING FUNCTIONAL NEUROIMAGING: A SYSTEMATIC REVIEW Ayan Dey[1,3], Vessela Stamenova[3], Gary Turner[1,2], Sandra Black[1,3,4], Brian Levine[1,3]; [1]University of Toronto, [2]York University, [3]Rotman Research Institute at Baycrest Hospital, [4]LC Campbell Cognitive Neurology Research Unit at Sunnybrook Hospital — Cerebral small vessel disease (SVD) is a pathological condition of the brain's microvasculature which increases with age and is exacerbated by vascular risk factors. It is identified by findings of white matter lesions and subcortical infarcts on magnetic resonance imaging (MRI). SVD is the prime contributor to subcortical vascular cognitive impairment (scVCI) which is typically characterized by executive and behavioural dysfunction; its presentation however is often insidious with an unclear relation between neuroimaging findings and cognitive decline contributing to dementia. Findings from conventional MRI show that individuals with nearly identical WML burden present with a wide variation in cognitive performance ranging from asymptomatic to dementia. This suggests that other factors that determine symptom expression exist and may be revealed through investigation of SVD effects on functional brain activity. Here we present a systematic review of all studies to date (n=38) that have explored the relationship between SVD and cognitive impairment using functional neuroimaging. Converging hemodynamic and electrophysiological evidence from functional neuroimaging studies complement structural imaging in supporting the hypothesis that impairments observed in patients with scVCI result from disruption of frontosubcortical circuits and ischemic damage to cholinergic tracts. Moreover we present a model relating behavioural disturbances observed in scVCI to decoupling of the frontoparietal control network and the default mode network. Future investigations should use the aforementioned markers as surrogate indicators of neural network change associated with recovery and rehabilitation. Such investigations should employ a multimodal approach, use targeted neuropsychological measures of cognition and take advantage of multivariate statistical analysis.

E45

EXERCISE IN OLDER ADULTS IMPROVES EXECUTIVE FUNCTION, NOT MEMORY Ilana B. Clark[1], Jennifer J. Heisz[1]; [1]McMaster University — Worldwide, countries are bracing for a rapid increase in the aging population and the consequent surge in neurodegenerative diseases, such as Alzheimer's disease and other dementias. Alzheimer's disease is the most common form of dementia, causing severe memory loss and interfering with daily life. There is urgent need for interventions to mitigate age-related cognitive decline. Evidence points to the cognitive benefits of physical exercise and a strong link between exercise and executive function. However, less is known on how exercise affects memory. We examined the relationship between physical fitness and memory processing in physically active older adults of varying levels of physical fitness. We predicted their maximal oxygen consumption (VO2max) using a Step Test or 6-minute walk, and assessed their cognitive performance on a range of tasks including tests of memory (delayed match-to-sample, face-name learning), processing speed (simple reaction time), and executive function (Stroop, Go-No-Go, Intentional forgetting). We observed a positive relationship between physical fitness and performance on executive function and processing speed tasks. However, level of physical fitness was unrelated to memory performance. This demonstrates that physical fitness in older adults promotes executive function, but not memory, suggesting that benefits on brain function are selective. It is possible that exercise-induced neurophysiological changes may target specific brain structures that support executive function, while there may be other mechanisms supportive of memory that are not directly related to physical fitness. Future research is needed to understand how exercise can improve memory when explaining the link between physical activity and Alzheimer's disease.

E46

CHANGES IN RESPONSE BIAS: EVIDENCE FROM OLDER ADULTS AND PATIENTS WITH ALZHEIMER'S DISEASE Sean Flannery[1,2], Rebecca G. Deason[1,2,3], Prabhakar S. Mithal[1], Erin P. Hussey[1,4], Eileen T. Crehan[1], Brandon A. Ally[1,3], Andrew E. Budson[1]; [1]VA Boston Healthcare System;, [2]Boston University School of Medicine, [3]Texas State University, [4]Vanderbilt University — Patients with Alzheimer's disease (AD) typically show a liberal response bias (greater tendency to response "old") on memory tests. This tendency may be due, in part, to their inability to successfully monitor their responses and implement criterion changes. In the current study, we manipulated the underlying ratio of old and new items in a recognition memory test to determine whether patients with mild AD could shift their response bias appropriately. During 3 sessions, healthy controls and AD patients studied words and then were tested with varying percentages of old items (50%, 30%, 70%). Additionally, we wanted to determine whether healthy controls and AD patients were able to successfully monitor their patterns of responses. To assess this insight, we asked participants how many old/new items they had seen at the halfway point and at the end of each recognition test phase. The results show that when the underlying ratio of old and new items was varied, both older controls and AD patients manipulated their response bias accordingly. All participants showed a more conservative response bias in the 30% condition and a more liberal bias in the 70% condition although this shift was more pronounced for healthy controls. When asked to provide information about the number of old/new items, healthy controls reported seeing significantly more new items than old items whereas AD patients showed the opposite pattern. These findings provide evidence that despite their tendency towards a liberal response bias, patients with mild AD do retain some insight into their response patterns.

E47

RELATIONSHIP OF HEMOGLOBIN A1C WITH COGNITIVE FUNCTIONING OVER TIME WITH NON-DIABETIC ADULTS Katherine Kane[1], Laura Grande[1,2], William Milberg[1,3], Regina McGlinchey[1,3], Elizabeth Leritz[1,3]; [1]Boston VA Healthcare System, [2]Boston University School of Medicine, [3]Harvard Medical School — Elevated hemoglobin A1c (HA1c) is a prevalent cardiovascular risk factor and is also a known risk factor for cognitive decline. However, little is known how HA1c levels affect cognition longitudinally in non-diabetic, neurologically healthy, mid-to-late life adults with mild to moderate cerebrovascular risk. The sample included 63 community-dwelling adults (M age = 68.21 years (range = 43-85), M education = 14.81 years, 65.1% Female), with an average follow-up of 3.37 years. Participants diagnosed with diabetes at Time 1 were excluded. HA1c levels were collected at Time 1 (T1) and Time 2 (T2) and the change was calculated as (T2-T1/T1). Using Mayo Clinic standards, 54% had normal HA1c levels, 41.3% were pre-diabetic, and 4.8% had high HA1c levels. All participants underwent a comprehensive neuropsychological test battery from which composite scores were calculated for the broad domains of memory and executive function. Mean HA1c levels at T1 were 5.67 and at T2 were 5.81. HA1c levels were associated with executive function at T1 ($r = -.32$, $p < .05$) and T2 ($r = -.33$, $p < .05$). After controlling for age, the change in HA1c between T1 and T2 explained 20.7% of the variance in executive function at T2, suggesting that as HA1c levels increase over time, executive function worsens. Overall, these data suggest that increased dysregulation of glucose levels over time negatively impacts executive function. One implication of these data is that even mild to moderate elevations in HA1c levels can affect executive functioning over an almost four-year period.

EXECUTIVE PROCESSES: Monitoring & inhibitory control

E48

BEHAVIORAL PREDICTORS OF THE NEURAL INCONGRUENCY EFFECTS IN THE SIMON TASK Brandee Feola[1], Sharona M. Atkins[3], Michael F. Bunting[2,4], Michael R. Dougherty[2,3,4], Donald J. Bolger[1,3,4]; [1]Department of Human Development & Quantitative Methodology, University of Maryland, [2]Department of Psychology, University of Maryland, [3]Neuroscience &

Cognitive Science Program, University of Maryland, [4]Center for Advanced Study of Language, University of Maryland — The current study examined the behavioral predictors of the neural activation during the Simon Task. Participants completed a battery of cognitive tasks including the Simon Task, Raven's Progressive Matrices, and the Attentional Network Test (ANT). Neural activation during the Simon Task was collected using functional Magnetic Resonance Imaging (fMRI). The Simon Task (Simon & Small, 1969) requires the individuals to respond in the direction the arrow while ignoring the location of the arrow. The Simon effect suggests individuals are slower when the location of the arrow and the direction of the arrow are conflicting. The Raven's Progressive Matrices (Raven, 1936) is a pattern completion task used as a proxy for the Intelligent Quotient (IQ). The ANT (Fan et al., 2003) is an assessment of the alertness, orienting, and executive components of attention. To examine the predictors of the Simon Task, activation during conflict trials was examined in relation to performance on the Raven's Progressive Matrices and the ANT. Results suggest neural activation during the conflict trials of the Simon Task depends on the individual's IQ. More specifically, there was a negative relationship between performance on the Raven's Progressive Matrices and activation in the network involved in conflict resolution including in the caudate, insula, and cerebellum. When controlling for IQ, neural activation during the conflict trials of the Simon Task in frontal-medial and caudate areas were negatively related to the executive component of the ANT. The results suggest IQ impacts the neural networks supporting conflict resolution.

E49

BEHAVIORAL AND NEURAL SUBSTRATES OF SELF-CONTROL

Theresa Teslovich[1], Alisa Powers[1], Chelsea Helion[1], Catherine S. Insel[2], Jennifer A. Silvers[2], Kevin N. Ochsner[2], Walter Mischel[2], B.J. Casey[1]; [1]Sackler Institute for Developmental Psychobiology, Weill Cornell Medical College, [2]Columbia University — The ability to resist temptation for the sake of larger, delayed gains (i.e., delay of gratification) is a critical component of self-control. Longitudinal studies have linked those who choose to wait for the larger, delayed reward (high-delayers) with higher academic achievement, lower body mass index and less substance abuse than low-delayers. Frontostriatal circuitry has been implicated in self-control in adults, but the neural substrates of self-control in children remains unclear given significant changes in frontostriatal circuitry during this period. The current study tested 20 children, aged 6-12 years on the delay of gratification task and on a go/no-go imaging task that included appetitive and neutral stimuli. Behaviorally, no difference was observed between high (N=10) and low (N=10) delay groups in overall false alarm rate. However, low-delayers were faster than high-delayers, particularly when detecting appetitive cues. These behavioral findings were paired with enhanced recruitment of dorsolateral prefrontal cortex and the anterior cingulate in high-delayers relative to low-delayers when correctly suppressing a response. These preliminary results are consistent with our recent 40-year longitudinal follow-up study and suggest that self-control, as measured by the delay of gratification task, may be associated more with sensitivity to appetitive cues in the environment rather than simply due to impulsivity. Together, these studies may help inform which core components of delay of gratification could be targeted with novel interventions (e.g., top down control strategies or diminishing salience of appetitive cues) to achieve maximal change in behavior, and potentially when during childhood to target these components.

E50

ANTICIPATING CONFLICT: NEURAL CORRELATES OF A BAYESIAN BELIEF AND ITS MOTOR CONSEQUENCE

Sien Hu[1], Jaime Ide[1], Sheng Zhang[1], Angela Yu[2], Chiang-shan Li[1]; [1]Yale University, [2]University of California, San Diego — Many imaging studies described the neural bases of behavioral adaptation. However, the relationship between the neural bases of top-down control and subsequent responses is not clear. The current study addressed this gap of research. One-hundred-and-sixty-one participants performed a stop signal task during functional magnetic resonance imaging (fMRI). We used a Bayesian probabilistic model to quantify the expectation of conflict based on recent exposure to conflict. We computed the expected likelihood of the stop signal, or p(Stop), for each trial, and used the correlation between p(Stop) and reaction time (RT) as an index for sequential effect for each individual participant. We then used p(Stop) and RT as parametric modulators in two general linear models for fMRI signals of go trials, each aligned to the fixation onset or go signal onset. Across participants, positive modulations of p(Stop) and RT revealed overlapping but also distinct activations. The pre-supplementary motor area (pre-SMA) and right inferior parietal lobule (IPL) responded positively to p(Stop) modulation - the anticipation of conflict, and bilateral insula responded positively to RT modulation. Importantly, the single trial amplitude of go trials significantly and negatively correlated between pre-SMA/IPL and bilateral insula for participants who showed, but not those who did not, a significant sequential effect. Furthermore, Granger causality analysis showed a directional influence from pre-SMA/IPL to insula differentially in the two groups. These results thus identified and established a causal relationship between the neural activities in association with conflict anticipation and with prolonged RT as a result of such anticipation.

E51

CARDIORESPIRATORY FITNESS AND CONTEXT PROCESSING IN PREADOLESCENT CHILDREN

Lauren Raine[1], Brian Saliba[1], Mark Scudder[1], Arthur Kramer[2], Charles Hillman[1]; [1]University of Illinois at Urbana- Champaign, Il, USA, [2]The Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana- Champaign, Il, USA — There is a growing trend of inactivity among children, which may not only result in poorer physical health, but also poorer cognitive health. Previous research has shown that lower aerobic fitness relates to decreased cognitive function for tasks requiring perception, memory, and action. PURPOSE: To investigate the relationship between aerobic fitness and proactive and reactive cognitive control using a continuous performance task (CPT). Proactive control relies on anticipation and prevention of interference prior to the occurrence of a cognitively demanding event, whereas reactive control relies on the detection and resolution of interference after initiation of the cognitive event. METHODS: Forty-eight 9-10 year old children (n=24 higher fit; HF and n=24 lower fit; LF) performed an AX-CPT requiring them to respond to target cue-probe pairs (AX) or non-target pairs (AY, BX, BY) under two different trial duration conditions (a long [5000 ms] and a short [1200 ms] delay between the cue and probe), which modulated working memory demands. RESULTS: Across trials, HF children had greater accuracy than LF children. For target trials, the long duration resulted in lower accuracy than the short duration. For non-target trials, an interaction of duration and trial type was observed, indicating that the long duration resulted in decreased BX and BY accuracy relative to the short duration. Further, AY trials had significantly greater accuracy during the long duration compared to short duration. CONCLUSIONS: These data suggest that fitness may modulate cognitive control strategies during tasks requiring context updating and maintenance, key components of working memory.

E52

INDIVIDUAL DIFFERENCES IN "HOT" AND "COOL" PRESCHOOL EXECUTIVE FUNCTION: THE BENEFIT OF FEEDBACK

Ashley St. John[1], Srishti Nayak[1], Stacey Doan[1], Amanda Tarullo[1]; [1]Boston University — Executive function (EF) refers to higher order cognitive and self-regulatory processes (e.g. inhibiting an impulse) and is critical to academic and socioemotional functioning (Carlson, 2005). We assessed whether having a reward at stake ("hot" EF) helped or hindered preschool children's EF performance. We also examined predictors of individual differences of both "cool" (purely cognitive) and hot versions of a rule-switching task (Dimensional Card Change Sort; DCCS). 25 children aged 4.0-4.5 completed two versions of the DCCS, sorting objects by shape (pre-switch) then by color (post-switch). In the cool version there was no feedback and in the hot version they received or lost stickers based on their response. From the NIH Toolbox, children completed the Flanker (inhibitory control and attention) and Child List Sort (working memory) and the mothers completed the DCCS and Flanker. Children had higher accuracy post-switch on the hot DCCS than the cold DCCS ($t=-3.21$, $p<.01$), showing that children benefited from feedback. Most children were at ceiling for hot post-switch accuracy. Maternal DCCS and Flanker were highly correlated ($r=.69$, $p<.001$) and were combined. Child Flanker ($\hat{I}^2=.661$, $p<.01$) and maternal EF ($\hat{I}^2=.353$, $p=.099$) explained 45.5% of the variance in child cold DCCS post-switch accuracy ($R2=.455$, $F(2,12)=6.849$, $p=.01$). Conversely, only child cold DCCS accuracy predicted hot DCCS accuracy ($R2=.271$, $F(1,13)=6.201$, $p<.05$). Results show that preschool children consistently benefit from feedback on the hot DCCS. Performance on the cool DCCS (without feedback) is more variable and is predicted by maternal EF and children's Flanker scores, highlighting the importance of inhibitory control.

E53

DEEP BRAIN STIMULATION FOR TRAUMATIC BRAIN INJURY: CHANGES IN COGNITION AND FUNCTION ASSOCIATED WITH CHANGES IN RELATIVE BRAIN ACTIVITY Dylan M. Nielson[1], Per B. Sederberg[1], W. Jerry Mysiw[1], Michael V. Knopp[1], Jennifer Bogner[1], John D. Corrigan[1], Ali R. Rezai[1]; [1]The Ohio State University — Over 1.7 million Americans sustain a traumatic brain injury (TBI) per year. Approximately 20% of these individuals sustain a moderate to severe TBI, commonly resulting in lifelong disability. Deep brain stimulation (DBS) has shown promising results for a number of psychiatric and neurological disorders such as obsessive compulsive disorder and movement disorders. Here we report findings from an open label trial of DBS treatment in 4 subjects with severe disability who sustained a TBI more than 10 years prior. We demonstrate a relationship between changes in function and cognition following DBS and changes in relative brain metabolic activity. Following surgery and stimulation titration, participants received stimulation alone for 6 weeks, followed by 6 weeks of stimulation combined with rehabilitation therapy, and a 9 month follow up period. Brain positron emission tomography (PET) scans with 18F-fluorodeoxyglucose and a battery of cognitive and functional measures were collected over the course of the study. Statistical analysis was conducted with linear mixed effects regression to account for subject-level variance in the relationship between repeated PET measures and behavioral assessment. Performance on measures of function and cognition correlated with relative brain activity across subjects in several frontal regions, many of which also had significant decreases in relative pet activity over the course of the study. Combined, this indicates that the effects of DBS on cognition and adaptive function in TBI may be related to a decrease in relative activity in frontal regions.

EXECUTIVE PROCESSES: Working memory

E54

INVESTIGATING NEURAL ACTIVITY IN VISUAL WORKING MEMORY: EVIDENCE FOR AN AGE-RELATED DELAY IN EFFICIENT FILTERING Tina Schwarzkopp[1], Ulrich Mayr[2], Kerstin Jost[1]; [1]RWTH Aachen University, [2]University of Oregon — The capacity of working memory (WM) varies across individuals and declines with age. Recent research addresses the issue of the functional reason behind the reduction of capacity. Jost, Bryck, Vogel and Mayr (2011) replicated earlier findings suggesting that the ability to prevent irrelevant information from being stored is the factor behind the individual differences within an age group. However, this factor did not seem to be responsible for the age-related decline. The time courses of filtering in event-related potentials revealed that older adults do not have a general impairment in efficient filtering, but instead start to filter out irrelevant information later. In their study target items were selected on the basis of color. The aim of the present study was to examine whether with an easier selection criterion age effects still appear in terms of delayed filtering. Young and old adults performed a change-detection task with filtering demands, where they had to filter out irrelevant information on the basis of location. The contralateral delay activity served as an online measure of how much irrelevant information was actually stored in visual WM and additionally reflected the time course of filtering. We found differences in filtering between younger and older adults in form of a delay in efficient filtering in older adults, even when target selection is easy. In conclusion, we suggest that the delay in filtering in older adults is a critical factor of age effects in visual WM, regardless of the difficulty in selecting targets among distracters.

E55

DISTRIBUTED CODING OF RULES FOR WORKING MEMORY MANIPULATION IN FRONTOPARIETAL CORTEX Chris Dodds[1], Celia Morgan[1,2]; [1]University of Exeter, UK, [2]University College London, UK — Neuroimaging studies have consistently demonstrated that frontoparietal cortex is activated more strongly during the manipulation, relative to the simple maintenance of information in working memory (WM). However, it is unclear precisely what information is represented in these regions during task performance. In the present study, we tested the hypothesis that the currently implemented rule is encoded in the distributed pattern of activation across frontal and parietal regions activated during WM manipulation. Twenty healthy volunteers performed a WM task in the MRI scanner requiring, on each trial, maintenance of a string of four letters over a short delay, reordering of the letter string according to one of two rules, and a subsequent forced choice decision to a probe. Subjects were scanned over ten blocks in an event-related design in which rule order was randomised within blocks. Multivoxel pattern analysis was carried out using an N-minus-one (leave-one-block-out) cross-validation procedure, implemented in the Princeton MVPA toolbox. Results showed that the identity of the currently implemented rule could be decoded from the voxelwise pattern of activation across left frontal and parietal regions that were activated during WM manipulation. Normalisation of voxel responses to each condition within ROIs ensured that rule coding could not be accounted for by univariate differences. These results show that encoding of task rules in distributed patterns of neuronal responses across frontoparietal cortex extends to situations in which the rules apply to the manipulation of information held in WM.

E56

AN ATTENTIONAL SET-SHIFTING TASK FOR HUMANS AND OTHER ANIMALS WITH SIMPLE BAYESIAN INFERENCE E. Alexander Chase[1], David S. Tait[1], Eric M. Bowman[1], Verity J. Brown[1]; [1]University of St Andrews — Attentional set-shifting tasks are reliable and valid measures of executive control and flexibility, and they are available for multiple species including humans, monkeys, rats, mice, and fish. With species-appropriate methods, set-shifting offers an elegant method for translational research. Typically, set-shifting tasks present subjects with a choice between two complex stimuli where only one aspect, such as colour, predicts reward while other aspects, like size and shape, are irrelevant. By presenting a series of novel discriminations where the same aspect predicts reward, we can encourage the formation of "attentional set". Then, by presenting a discrimination that relies on a previously irrelevant stimulus dimension, we can measure the shifting of attention. Impairments in set-shifting are common to many human disorders, but it is often difficult to determine their precise cognitive mechanisms: the task easily identifies subjects who struggle to focus or shift, but not what is distracting them. Increasing the sensitivity of set-shifting tasks may improve diagnosis and treatment research by elucidating the psychological and neurological bases of different impairments. We have developed a new attentional set-shifting task that uses Bayesian inference to estimate the likelihood of various strategies subjects may employ during each stage. Healthy adult participants learn this task readily; typically completing every stage in less than ten minutes. Trials to criterion performance is similar to previously published data from other tasks, but individual performance can now be analysed on a trial-by-trial basis to reveal how and why errors occur.

E57

MODELING THE NEURAL REPRESENTATION OF NORMATIVE WORKING MEMORY ABILITY THROUGH FUNCTIONAL NEUROIMAGING AND CLINICAL NEUROPSYCHOLOGY Tonisha Kearney-Ramos[1], Jennifer S Fausett[1], Jennifer L Gess[1], Ashley Reno[2], Jennifer Peraza[3], Clint Kilts[1], G Andrew James[1]; [1]University of Arkansas for Medical Sciences, [2]University of Virginia School of Medicine, [3]University of New Mexico School of Medicine — Objective: The central role of working memory (WM) in cognition has led to research exploring WM dysfunction in psychiatric and neurologic disorders. The n-back task is arguably the most widely-used paradigm for studying the neural basis of WM, yet its neuropsychometric properties have received little empirical investigation. We merge clinical neuropsychology and fMRI to explore the construct validity of a verbal variant of the n-back task (LNB) and to identify the task-evoked networks involved in WM, thus characterizing the neural correlates of normative WM function. Methods: LNB construct validity was investigated using bootstrapped correlations between LNB performance and neuropsychological measures of WM to establish convergent validity, and measures of divergent cognitive constructs (i.e. attention) to determine discriminant validity. Independent component analysis (ICA) identified brain networks active during the LNB in 35 healthy participants. General Linear Modeling was used to correlate each component activity timecourse with task condi-

tions to determine WM-specific recruitment. Results: Correlations revealed convergence between LNB and WM-related tasks (bootstrapped $|\rho| \geq 0.39$) and divergence from non-WM tasks (bootstrapped $|\rho| \leq 0.33$). ICA identified 35 networks, with 18 demonstrating task-specific engagement. Of these, the bilateral frontoparietal, bilateral dorsolateral prefrontal cortices, bilateral superior parietal lobules including precuneus, and frontoinsular networks were preferentially recruited by 2-back compared to 0-back control or rest conditions, indicating WM involvement. Conclusion: These results support the use of the LNB as a measure of WM and confirm its use in probing network-level neural correlates of normative WM processing, and in the future, characterizing individual differences in WM brain-behavior relationships.

E58

SUPRAMODAL ALPHA- AND BETA-BAND SIGNATURES OF NUMEROSITY INFORMATION IN HUMAN WORKING MEMORY

Bernhard Spitzer[1], Sebastian Fleck[1], Felix Blankenburg[1,2]; [1]Dahlem Institute for Neuroimaging of Emotion, Freie Universität Berlin, Habelschwerdter Allee 45, 14195 Berlin, Germany, [2]Center for Adaptive Rationality, Max Planck Institute for Human Development, Lentzeallee 94, 14195 Berlin, Germany — "Numerosity" can be assessed by analogue estimation, similar to a continuous magnitude, or by discrete quantification of the individual items in a set. While the extent to which these two processes rely on common neural mechanisms remains debated, recent studies of sensory working memory (WM) have identified an oscillatory signature of continuous magnitude information, in terms of quantitative modulations of prefrontal upper beta activity (20-30 Hz). Here, we examined how such parametric oscillatory WM activity may also reflect the abstract assessment of discrete items' numerosity. We recorded EEG while participants (n=24) processed the number of stimulus pulses presented either visually, auditory, or tactile, under else identical experimental conditions. Behavioral response profiles showed varying degrees of analogue estimation and of discretized quantification in the different modalities. During sustained processing in WM, the amplitude of posterior alpha oscillations (8-13 Hz) reflected the increased memory load associated with maintaining larger sets of discrete items. In contrast, earlier numerosity-dependent modulations of right-prefrontal upper beta specifically reflected the extent to which numerosity was assessed by analogue estimation, both between and within presentation modalities. Together, the analogue approximation - but not the discretized representation - of numerosity information exhibited a parametric oscillatory signature akin to a continuous sensory magnitude. The results indicate dissociable oscillatory mechanisms of abstract numerosity integration, at a supramodal processing stage in human WM.

E59

THE RELATIONSHIP BETWEEN IMPLICIT SEQUENCE LEARNING, SPEECH IN NOISE PERCEPTION, AND WORKING MEMORY

Alexandria Muise-Hennessey[1], Sean McWhinney[1], Aaron J. Newman[1]; [1]Dalhousie University — Sequential memory plays an important role in spoken language processing. The ability to implicitly learn sequences is correlated with sentence perception in degraded listening conditions (Conway, C. M., Bauernschmidt, A., Huang, S. S., & Pisoni, D. B. (2010). Cognition, 114, 356–71). We investigated whether the relationship between implicit sequential pattern learning (as in a Markovian finite-state artificial grammar) and sentence perception in noise (AzBio) are mediated by cognitive functions such as memory, attention, and executive function. Replicating previous work, we found that implicit sequence learning performance was correlated with speech perception in noise. As well, operation span (a working memory measure) was strongly correlated with speech-in-noise perception but not with implicit sequence learning, suggesting that the relationship between sequence learning and speech-in-noise perception is not mediated by working memory. Additional studies are underway to characterize the relationship between speech-in-noise perception and implicit sequence learning as a function of the signal-to-noise ratio of the speech.

E60

SWITCHING BETWEEN FILTER SETTINGS REDUCES THE EFFICIENT UTILIZATION OF VISUAL WORKING MEMORY

Kerstin Jost[1], Ulrich Mayr[2]; [1]RWTH Aachen University, Germany, [2]University of Oregon — The capacity limitation of working memory requires that only relevant material gains access to the workspace while irrelevant material is prevented from being stored. Thus, the ability to filter out irrelevant information seems to be an important factor of how efficiently the limited storage space is used. While there has been some work suggesting that individual and developmental differences affect both filtering ability and working-memory capacity, we know much less about context factors. Here, we examine to what degree the need to flexibly change filter settings affects filtering efficiency. Participants were presented with visual objects in two different colors and a cue presented in advance indicated which objects had to be stored. The contralateral delay activity of the EEG measured in the retention interval was used to assess filtering efficiency. The data showed that when filter settings switched and, hence, need to be adjusted, more irrelevant material passes the gate to working memory. This switching-induced filtering deficit suggests that attentional control processes determine how efficiently the limited workspace can be used. Furthermore, these results indicate that in switching situations, conflict can affect not only response-selection demands, but also the content of working memory.

LANGUAGE: Development & aging

E61

SHEDDING NEW LIGHT ON READING IN SPANISH-ENGLISH AND ENGLISH-FRENCH BILINGUAL SCHOOL CHILDREN: AN FNIRS INVESTIGATION.

Kaja Jasinska[1], Melody Berens[2], Ioulia Kovelman[3], Laura-Ann Petitto[4]; [1]Haskins Laboratories, [2]U.S. Department of Defense, [3]University of Michigan, [4]Gallaudet University — How does a bilingual child's two languages impact the brain's neural circuitry for reading? Can we observe a "neural signature" (Kovelman, Baker, & Petitto, 2008) in the brains of bilingual children as they read, especially when each language in the bilingual pair has a different relationship between its sound patterning and the printed text? We tested the hypothesis that specific linguistic features of each language's sound to letter patterning predictably recruit specific neural regions that support reading. Bilinguals whose "other" languages differed were studied (English-Spanish, English-French) to determine whether the orthography of Spanish or French differentially impact reading in English. Spanish is "shallow," exhibiting regular sound-to-letter print correspondence. French is also shallow, but has more irregular sound-to-letter print correspondence. English is "deep," with both regular and irregular correspondence. METHOD. 24 children (7 English-Spanish bilinguals, 6 English-French bilinguals, 11 English monolingual controls; ages 6-10) read aloud words that exploited shallow-deep orthographic differences (regular, irregular, nonsense words) while undergoing functional Near Infrared Spectroscopy (fNIRS) neuroimaging (quiet, tolerates movement, permits natural reading aloud). RESULTS. Monolingual and English-French bilingual children showed greater left inferior frontal gyrus (LIFG) recruitment for irregular versus regular words. English-Spanish bilingual children showed greater left superior temporal gyrus (STG) recruitment for regular versus irregular words. CONCLUSIONS: Group differences in the neural recruitment for reading in English were predicted from the shallow-deep orthographic patterning in a bilingual's other language. The findings shed new light on how language experience can change reading and the brain in the bilingual child.

E62

ANATOMICAL CORRELATES OF SOCIAL EVALUATIVE LANGUAGE IN CHILDREN WITH WILLIAMS SYNDROME

Jessica Phuong[1], Pamela Moses[1], Judy Reilly[1], Timothy T. Brown[2], Matthew Erhart[2], Eric Halgren[2], Ursula Bellugi[3]; [1]San Diego State University, [2]University of California San Diego, [3]Salk Institute — Williams Syndrome (WS) is a genetic disorder that results in intellectual disability, delayed language development, and enhanced sociability. Previous studies examining linguistic performance in children with WS found deficits in morphosyntax compared to typically developing (TD) children. However, children with WS used greater proportions of social evaluative language, including affective states, intensifiers, sound effects, accentuated prosody, queries to the listener, and audience hookers than did TD children. Abnormalities in structural brain development have also been found in children with WS. Yet, the relationship between gray matter structure and social evaluative language is unknown. In the current study, 6 children with WS (9 to 14 years) and 16 TD children (7 to 13 years) were

asked to respond to structured interview questions about their family and activities. Interviews were scored for rate of morphosyntax, and proportion of social evaluative language use. Correlations between language measures and MRI-based measures of cortical thickness and surface area were examined. Results showed that children with WS performed more poorly on morphosyntax measures compared to TD children, while use of their social evaluative language was comparable. In children with WS, social evaluative language correlated with cortical regions previously implicated in components of social behavior in WS, while this was not the case in TD children. Further, these regions did not correlate with morphosyntax in children with WS. These findings suggest that anatomical correlates of the structural aspects of language are distinct from the use of language for social purposes in children with WS.

E63

FRONTAL ASLANT FIBER TRACT IN THE DEVELOPING BRAIN: A DIFFUSION TENSOR IMAGING (DTI) STUDY. Iris Broce[1], Gonzalo Iribarne[1], Dustin Moraczewski[1], Mark Sheffield[1], Byron Bernal[2], Nolan Altman[2], Anthony Steven Dick[1]; [1]Florida International University, [2]Miami Children's Hospital — The specific goal of the study is to characterize a potentially important fiber pathway associated with the production of language in the developing brain. This fiber tract is called the frontal aslant tract (FAT) and has been suggested to make connections between the superior frontal gyrus (SFG), posterior supplementary motor area (SMA), pre-SMA, and inferior frontal gyrus (IFG; Thiebaut De Schotten et. al., 2012). Diffusion-weighted images were collected in 20 children (10 females; age range = 5-8 years, M age = 6.7 years, SD = 1.04 years). We manually identified the FAT using a two regions of interest (ROI) approach (Catani et al., 2012). The diffusion tensor in each voxel was determined using a weighted least-square method. The following metrics were computed: fractional anisotropy (FA) and apparent diffusion coefficient (ADC). Our preliminary results suggest that the FAT can be reliably identified in the preschool and early school age brain. The mean FA was slightly higher in the left FAT (.61) compared with the right FAT (.57). However, the reliability of the left-right differences will need to be assessed in the whole sample. The mean ADC value was 0.52 x 10(-3) mm(2)/s in the left FAT and 0.54 x 10(-3) mm(2)/s in the right. These results provide evidence for connections between the SMA/pre-SMA and IFG, even in children. They also have important implications for the cortical organization of the "motor stream" of language and speech processing, suggesting that the FAT may potentially play an important role in speech production.

E64

WORD FORM PROCESSING IN 3-, 6- AND 9-MONTH-OLD INFANTS Claudia Teickner[1], Angelika Becker[1], Ulrike Schild[2], Claudia Friedrich[2]; [1]University of Hamburg, [2]University of Tübingen — There is evidence for co-activation of detailed and less detailed word form representations in adult speech recognition. Here we investigated the development of those representational systems in the first year of life. We recorded event-related potentials (ERPs) while infants listened to single syllables (primes) followed by complete German words (targets). Common disyllabic words, frequently used in caregiver-infant interactions, were chosen from an early words screening inventory (German version of the McArthur Communicative Development Inventories). We tested 30 infants from German speaking parents at the age of three, six and nine months. We presented them with primes and targets in three different conditions. In an identity condition, primes match the onsets of the target words (e.g., ma - Mama). In a variation condition, primes deviate from targets in their initial place of articulation (PLACE; e.g., na - Mama). In a control condition, phonemes of primes and targets differ completely (e.g., vo - Mama). ERPs suggest that three-month-olds notice minimal prime-target variation. This might reflect either that word form representations have not been established yet, or that the very first representations are detailed for PLACE. Six-month-olds do not differentiate between the identity condition and the control condition, suggesting dominance of representations that are not detailed for PLACE. Nine-months-olds show evidence for both detailed and less detailed representations. Our results point to a serial development of detailed and less detailed representational systems.

E65

THE ROLE OF THE PUTAMEN AND PREMOTOR CORTEX IN BILINGUAL SPEECH PRODUCTION Jonathan A. Berken[1,2], Jen-Kai Chen[1], Vincent L. Gracco[2], Shari Baum[2], Kate E. Watkins[3], Denise Klein[1,2]; [1]Montreal Neurological Institute, [2]McGill University, [3]University of Oxford — It has been shown that the structure of the bilingual brain is shaped by language-learning experience. Here, we use voxel-based morphometry (VBM) to investigate anatomical brain differences between French-English simultaneous bilinguals, who acquired both languages from birth, and French-English sequential bilinguals, who learned their second language (L2) after the age of 5 years. Prior to scanning, speech samples were obtained in French and English and analyzed for proficiency. Simultaneous and sequential bilinguals were highly proficient in both languages, although sequential bilinguals had a less native-like accent in their L2 than in their first language. In a comparison of simultaneous and sequential bilinguals, simultaneous bilinguals showed greater grey matter density (GMD) bilaterally in the dorsolateral prefrontal and insular cortex, and in the left putamen. In contrast, sequential bilinguals demonstrated greater GMD bilaterally in the premotor cortex. Whole-brain regression analysis of the sequential bilinguals revealed a positive correlation between the degree of native-like accent in L2 and GMD in the left putamen and left premotor cortex. That is, the more native-like the accent in sequential bilinguals, the greater the GMD was in the left putamen and left premotor cortex. Our findings suggest that early vs. late bilingualism has different structural effects in brain regions that subserve speech production.

E66

ELECTROPHYSIOLOGICAL RESPONSE TO REPEATED SPEECH STIMULI IN 9 MONTH OLDS AT RISK FOR AUTISM SPECTRUM DISORDERS Anne Seery[1], Helen Tager-Flusberg[1], Charles Nelson[2,3]; [1]Boston University, [2]Harvard Medical School, [3]Boston Children's Hospital — Autism spectrum disorder (ASD) involves social/communicative impairments in addition to restricted or stereotyped interests and behaviors. Individuals with ASD often exhibit language impairment, potentially partially stemming from both atypical processing of linguistic stimuli and atypical attention to social stimuli. Behavioral symptoms of ASD do not manifest until after 12 months of age; however, atypical patterns of sensory processing, allocation of attention, and social interest are present earlier during the first year. Here, we focused on how infants at high risk for ASD (HRA) process linguistic stimuli (specifically, stimulus repetition) and how that relates to their later language ability. Two groups of 9-month-old infants were examined: HRA (n=40; each had an older sibling with ASD; estimated 20% recurrence), and low risk controls (LRC; n=45). We recorded high-density EEG while infants listened to consonant-vowel stimuli presented using an oddball paradigm. We examined the P150 in response to repetitions of the standard stimulus and to presentation of a deviant. While there was no difference between groups in their response to the deviant, HRA infants had larger amplitude P150 to the repeated standards over frontal electrodes than LRC infants ($F(1,83)=4.17$, $p=.044$) and showed less of a difference between the standards and deviant ($F(1,83)=5.07$, $p=.027$). Interestingly, these atypical patterns were related to better expressive language ability in toddlerhood in the HRA group (correlation coefficients between .35 and .57; $p's<.05$). We discuss the possibility that this may be related to heterogeneity within the HRA group in their attention patterns towards socially relevant linguistic stimuli.

LANGUAGE: Lexicon

E67

ERP EVIDENCE FOR THE BIDIRECTIONAL MAPPING CONSISTENCY BETWEEN ORTHOGRAPHY AND PHONOLOGY IN CHINESE CHARACTER RECOGNITION Wei-Fan Chen[1], Pei-Chun Chao[2], Yu-Lin Tzeng[2], Ya-Ning Chang[1], Chun-Hsien Hsu[1], Chia-Ying Lee[1,2]; [1]Institute of Linguistics, Academia Sinica, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taiwan — The bi-modal interactive-activation model (BIAM) assumes that, both visual and spoken word recognitions would be influenced by the bi-directional mapping consistencies between orthography (O) and phonology (P) (P-to-O and O-to-P consistency). However, in

studies of English and French, the P-O consistency was robust in spoken word recognition, but less reliable in reading tasks. In Chinese, a greater impact of orthographic effect during spoken word recognition is expected due to the pervasive homophony in Chinese. Indeed, our previous ERP studies have demonstrated two types of orthographic effects (homophone density and P-to-O consistency) in Chinese spoken word recognition. This study aims to examine these two types of orthographic effects in visual modality, with the orthogonal manipulation of Chinese O-to-P consistency (high versus low phonetic consistency). The ERPs data showed that two types of orthographic effects in reading Chinese. Characters with high homophone density elicited greater negativity from 300 to 400msec than those with low homophone density did. In addition, characters with low P-to-O consistency elicited greater negativity from 300 to 600msec than those with high P-to-O consistency did. Most important, these two types of orthographic effects were mainly found in character with low phonetic consistency. These findings support the bi-directional interaction between the phonology and orthography in reading Chinese.

E68

SPATIOTEMPORAL PATTERNS OF NEURAL ACTIVITY UNDERLYING MORPHOLOGICAL PROCESSING IN A MINIMALLY INFLECTED LANGUAGE: AN ELECTRO- AND MAGNETO-ENCEPHALOGRAPHIC STUDY IN MANDARIN

Yun-Hsuan Huang[1,2], Elisabeth Fonteneau[1,2], Caroline M. Whiting[1,2], Qing Cai[3], William D. Marslen-Wilson[1,2]; [1]University of Cambridge, [2]MRC Cognition and Brain Sciences Unit, Cambridge, U.K., [3]East China Normal University, China — Combinatorial structures involving morphological inflection are a salient property of human languages. Evidence from English, Arabic, Polish and Russian locates the core neural mechanism supporting such structures in linked left perisylvian regions (left inferior frontal gyrus (LIFG) and temporal regions). This study investigates whether the processing of inflections in Mandarin, a language in which inflections are scarcely used, engages similar neural substrates. Native speakers listened to bimorphemic word types differing in their morphological properties, as determined by the second morpheme: compounds (hu xi"o breathe"), derived words (jing hua"to purify"), and aspectually inflected verbs (chang zhe "singing"). Combined electro- and magneto-encephalographic recording and Representational Similarity Analysis searchlight analyses (Su et al., 2012) were used to capture the fine-grained spatio-temporal information pattern of the transient neural activity during morphological computation for each word type. Measuring from second morpheme onset, compound and inflected words elicited an early short burst in right frontal and temporal areas around 150 msec and bilateral temporal activity from 300 - 500 msec, with no patterns specific to derived forms. Critically, linked patterns in LIFG (BA 44, 45) and left anterior temporal regions from 220 - 400 msec were only seen for inflected words. Despite the apparently minor role of inflectional morphemes in Mandarin, left perisylvian activity can still be observed, similar to the distinctive spatio-temporal pattern seen for more richly inflected languages. These parallels across typologically distant language families suggest a potentially universal role for the LIFG in interpreting the grammatical information conveyed by inflectional morphemes.

E69

HEMISPHERIC PROCESSING DIFFERENCES IN MASKED REPETITION PRIMING

Trevor A. Brothers[1,2], Tamara Y. Swaab[1,2], Matthew J. Traxler[1,2]; [1]UC Davis, [2]Center for Mind and Brain — While it is clear that the left hemisphere plays an important role in language comprehension, it is less certain to what extent the early stages of visual word processing are uniquely left-lateralized. In this study, participants read words presented to the left or right visual hemifield as event-related potentials (ERPs) were recorded from the scalp. Each word was preceded by a congruent or incongruent masked repetition prime, which could be presented in either the same or opposite hemifield. In both the crossed and uncrossed priming conditions, we observed robust repetition priming on the N250 and N400, similar to masked ERP priming effects seen for centrally presented words. Critically, these priming effects were observed only for left-hemisphere primes. When prime words were presented to the right hemisphere (left visual-hemifield), there was no effect of prime congruency. This same hemispheric asymmetry was observed using both short (20ms) and long (100ms) prime-target inter-stimulus intervals. These results provide evidence for a functional lateralization of early orthographic processing, and suggest a unique role for the left hemisphere in rapidly extracting form-invariant, visual representations without conscious awareness. Implications for the temporal dynamics of visual word processing will be discussed.

E70

NEUROCORRELATES OF THE ORTHOGRAPHIC LEXICON AND BUFFER IN CHINESE WRITING

Hsiang-Yu Chen[1,2], Sinead H.Y. Chen[1,2], Daisy L. Hung[1,2], Ovid J.L. Tzeng[2,3], Denise H. Wu[1,2]; [1]Institute of Cognitive Neuroscience, National Central University, Taiwan, [2]Laboratories for Cognitive Neuroscience, National Yang-Ming University, Taiwan, [3]Academia Sinica, Taiwan — Previous literature on writing has demonstrated a double dissociation of the underlying functional and neuronal mechanisms between the orthographic lexicon and the graphemic buffer in alphabetic languages. Specifically, the frequency of to-be-writtten stimuli correlated with the processing of the orthographic lexicon situated in the left fusiform gyrus and left inferior frontal junction, while the letter length of the to-be-written stimuli correlated with the processing of the graphemic buffer situated in the left superior frontal sulcus and left superior parietal lobule. In the present study, we aimed to identify the neural correlates of the orthographic lexicon and buffer in wrting Chinese characters via functional magnetic resonance imaging (fMRI). Twenty participants were required to perform a mental writing task and a recognition task on Chinese characters whose frequency and stroke numbers were manipulated. It was found that characters with low frequency were associated with higher activation in the left fusiform gyrus than characters with high frequency across the mental writing and character recognition tasks, which suggested this region to be the locus of the orthographic lexicon that represents the knowledge of character forms. It was also found that character stroke numbers correlated with the activation in the left middle frontal gyrus and left angular gyrus only in the mental writing task, which suggested this region to be the locus of the orthographic buffer that represents the knowledge of stroke sequences in written production. These results revealed the functional and anatomical dissociation between the orthographic lexicon and buffer in writing Chinese characters.

E71

MULTIVARIATE ANALYSIS OF EARLY ORTHOGRAPHIC PROCESSING IN VISUAL WORD RECOGNITION

Samarth Varma[1], Caroline Whiting[1,2], Isma Zulfiqar[1], William Marslen-Wilson[1,2]; [1]University of Cambridge, [2]MRC Cognition & Brain Sciences Unit, Cambridge — It has been hypothesized that reading, a fairly recent activity in human evolution, recycles visual object recognition processes such as identification of lines, contours and shapes which combine to detect letters, bigrams, morphemes and words. Neuroimaging studies and lesion data provide evidence for a posterior-to-anterior hierarchy of occipitotemporal neurons that are sensitive to such increasingly complex visual word fragments. In this study, we employ a Searchlight-based multivariate pattern analysis method called Representational Similarity Analysis (RSA) with combined magneto- and electroencephalography (MEG-EEG) to pick apart early stages of orthographic processing. RSA relies on comparing spatiotemporal response patterns, revealing not just the information content in space, but also its flow across the brain in time. We analysed a set of visually presented words and used Searchlight RSA to test models of early orthographic processing (length, bigram/trigram frequency). In agreement with previous studies, RSA successfully delineates regions in the ventral stream that are sensitive to such visual word form properties, showing bilateral occipital regions involved in processing of length, and left posterior fusiform gyrus involved in processing of orthographic structure. Additionally, we are also able delineate the timing during which these processes emerge, beginning at 100 ms in primary visual cortex. In particular, these results suggest the existence of abstract representations of letters and bigrams, consistent with the hypothesis that functionally specialized neurons are organized hierarchically in the order of their increasing receptive fields.

E72

TRACKING THE NEURAL DYNAMICS OF MORPHOLOGICAL PROCESSING USING COMBINED MEG-EEG: A MULTIVARIATE APPROACH

Caroline M. Whiting[1,2], Samarth Varma[1], William D. Marslen-Wilson[1,2]; [1]University of Cambridge, [2]MRC Cognition and Brain Sciences Unit — Behavioural and neuroimaging evidence has revealed a stage of automatic

segmentation in the recognition of morphologically complex words (e.g. decomposing "farmer" into {farm} + {-er}). This raises key questions about the spatiotemporal properties of the processes that map visual inputs onto lexical form and meaning, measured here by combined magnetoencephalography (MEG) and electroencephalography (EEG). We address these issues using multivariate pattern analysis to investigate how regions within the language network code for different properties of visual words (orthographic, morphological, lexical). In this study, we focus on the representational content of frontal and temporal regions to determine directly the spatiotemporal distribution of neural response patterns that reflect sensitivity to morphological structure (stem plus suffix). Multivariate analyses were performed in source space using representational similarity analysis (RSA) in bilateral fronto-temporal regions, examining the information carried by patterns of neural activity in a given region across time. The stimulus sets contrasted words containing a potential inflectional or derivational suffix (e.g. "jumped", "farmer", "corner") with simple words containing no internal structure (e.g. "giraffe"). Results showed that responses within left middle and superior temporal and left inferior frontal regions distinguished between words containing morphological structure and morphologically simple words over time-frames ranging from 250 to 500 ms from stimulus onset. Critically, these responses were not modulated by word meaning. These findings using a novel multivariate MEG-EEG approach support claims for early, automatic morphological processing, revealing spatiotemporal response patterns that are selective for morphologically complex visual forms in left hemisphere fronto-temporal regions.

E73

THETA AND BETA OSCILLATIONS AS SIGNATURES OF NOVEL WORD CONSOLIDATION Iske Bakker[1,2], Atsuko Takashima[1,2], Gabriele Janzen[1,2], Janet van Hell[2,3], James M McQueen[1,2,4]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, The Netherlands, [2]Behavioural Science Institute, Radboud University Nijmegen, The Netherlands, [3]Pennsylvania State University, [4]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands — This study was designed to shed more light on the cognitive functions associated with specific frequency bands in language and memory, by investigating oscillatory activity in response to newly acquired words. In particular, we aimed to identify oscillatory signatures of lexicalisation, that is, integration of novel words into the mental lexicon. On two consecutive days, participants memorised two sets of 30 novel and 30 existing words with definitions. EEG responses to novel and existing words learned on day 1 (remote) or day 2 (recent), and to untrained words, were measured during a semantic decision task. In the theta band, untrained novel words elicited weaker synchronisation than existing words. This difference was smaller for recent novel words, and absent for remote novel words. Desynchronisation in the lower beta band was stronger for existing than novel words in the untrained and recent conditions, but identical for remote novel and existing words. In the higher beta band however, a difference between novel and existing words emerged only in the untrained condition, whereas neither remote nor recent novel words differed from existing words. These results support the Complementary Learning Systems account (McClelland et al., 1995; Davis & Gaskell, 2009), which claims that off-line consolidation of novel memory representations underlies lexicalisation. We conclude that this gradual consolidation process is reflected most clearly in the theta and lower beta bands. Theta synchronisation and lower beta desynchronisation appear to play a role in retrieval of lexicalised memories, whereas upper beta reflects episodic memory processes.

LANGUAGE: Other

E74

MAKING SENSE OF THE SENSELESS: ABNORMAL BRAIN CONNECTIVITY IN PATIENTS WITH SCHIZOPHRENIA DURING SENTENCE PROCESSING Kirsten Weber[1,2,3], Ellen Lau[4], Candida Ustine[1,3], Arim Choi Perrachione[3], Nate Delaney-Busch[3], Gina Kuperberg[1,2,3]; [1]Massachusetts General Hospital, [2]Harvard Medical School, [3]Tufts University, [4]University of Maryland — Patients with schizophrenia show impairments in combining semantic and syntactic information to build and use context during sentence comprehension; rather, processing can be inappropriately driven by simple lexico-semantic relationships between individual words (Kuperberg, 2010). We also know from previous studies that frontal-temporal connectivity is altered in schizophrenia during simple lexico-semantic tasks (Friston and Frith, 1995; Li et al., 2010). In this study, we ask whether abnormal neural communication across components of the language network in schizophrenia is associated with an imbalance between semantic-syntactic unification and lexico-semantic processing. During fMRI scanning, 18 patients with schizophrenia and 20 demographically-matched controls read either sentences or random lists of words. A seed for the functional connectivity analysis was defined in left posterior temporal gyrus. We computed generalized psychophysiological interactions (gPPI, McLaren et al., 2012) from this seed for the sentences as well as the word lists. In reading sentences (versus baseline), patients with schizophrenia, relative to controls, showed significantly reduced connectivity from the seed to areas in the left inferior frontal gyrus. In reading word lists (directly contrasted with sentences), however, patients, relative to controls, actually showed enhanced connectivity with right temporal regions. These findings suggest that abnormal functional connectivity across the language network may underlie the impairments in building overall coherence in schizophrenia.

E75

RORSCHACH ASSESSMENT IN APHASIA PATIENTS Terri Dilmore[1], Sarah Wallace[1], Alex Kranjec[1]; [1]Duquesne University — The Rorschach is a widely used projective test designed to assess individual personality and emotional organization. Less is known about its neuropsychological value, particularly in populations with speech and language impairments. Beyond personality assessment, several features of the Rorschach suggest that it may be useful for investigating questions of interest to language researchers. Traditionally, treating and assessing aphasia has required patients to match a closed set of concrete words to pictures. In contrast, the Rorschach is open-ended and uses ambiguous visual stimuli, yet the frequency of verbal responses to particular inkblots is still well normed. While we are interested in investigating the value of the Rorschach as a platform for individuals with aphasia to describe their current mental state, the present study also explores relations between language, perception, and emotional organization. We used published Rorschach norms and individual language assessment data to interpret the responses of 3 aphasic patients. Across participants, a mean of 20 responses over 10 blots was provided. For two of the participants, results suggest that card turning, which was significantly higher in comparison to norms, may have aided their attempts to assign meaning to the blots. Across all participants, relating the blot to a personal experience appeared to guide responding. Detailed analyses using the Rorschach Performance Assessment System suggest differences in responding between aphasic and normed healthy adults, and between individual aphasic participants with distinct comprehension and production impairments.

E76

INTERHEMISPHERIC COMMUNICATION INFLUENCES READING BEHAVIOR Lise Van der Haegen[1], Qing Cai[1,2], Michael Stevens[1], Marc Brysbaert[1]; [1]Ghent University, Ghent, Belgium, [2]East China Normal University, Shanghai, China — We can read words at an amazing speed, with the left hemisphere taking the burden of the processing in most readers (i.e. over 95% of right-handers and about 75% of left-handers). Yet, it is a long-standing question whether word reading in central vision is possible without information transfer between the left and the right hemisphere (LH/RH). To investigate this, we first recruited a sample of healthy left-handers with LH or RH language dominance by means of an fMRI silent word generation (speech) and lexical decision (reading) task. Then, both groups were compared on (1) word naming latencies while fixating at all possible letter positions and (2) eye movement data during text reading. The results revealed that individuals with LH speech dominance named centrally presented words on average 3.64 ms more slowly per letter fixated more towards the word end. In contrast, RH dominants did not show an effect of fixation position. In text reading, the eyes of LH dominants landed more to the left than the eyes of RH dominants, making more information directly available to the dominant hemisphere because of the contralateral projection of visual information. These data show that the traditional view of bilateral cortical representations in central vision is incorrect. In contrast, interhemispheric communication is needed in central vision and eye move-

ments are adjusted to optimize information uptake. The findings are in line with the increase of white matter in the splenium of the corpus callosum when people learn to read.

E77

EFFECTS OF PRACTICE ON TONAL DISCRIMINATION FOR CHINESE AS A SECOND LANGUAGE LEARNER -- AN EXAMPLE OF MAGNETIC MISMATCH FIELD Rose Ru-Whui Lee[1,2], Kevin Chun-Hsien Hsu[2], Chung-I Erica Su[2], Sheng-Kai Lin[2], Denise Hsien Wu[3], Ovid Jyh-Lang Tzeng[2]; [1]National Taiwan Normal University, Taiwan, [2]Academia Sinica, Taiwan, [3]National Central University, Taiwan — This investigation examined the tonal discrimination ability for beginning CSL (Chinese as a second language) learners after 3 times practices of multimedia digital instruction via the magnetic correspondent of mismatch negativity (MMNm). The MMNm are originally elicited in auditory cortex of brain by response to any discriminable change in some repetitive aspect of the ongoing auditory stimulation , including tonal discrimination, in the absence of attention. We adopted the multi-deviant oddball paradigm and used the syllable "yi" pronounced in the low-dipping tone (T3) as the standard. The deviant stimuli were the same syllable pronounced in either the high-level tone (T1) or the high-rising tone (T2). Additionally, the MMNm activity between acoustically dissimilar contrast (T3/T1) and acoustically similar contrast (T3/T2) were measured in the course of pre-test and post-test. In the results, T3/T1 contrast generally elicited larger MMNm with shorter latency than the T3/T2 contrast did. The planned comparisons also indicated that the left hemisphere MMNm of T3/T1 contrast, but not T3/T2 contrast, was significantly increased in the post-test. The result shows the learning effect on sensitivity for tonal discrimination in left hemisphere, which is in consistence with the lateralization of left hemisphere for language processing mechanism. It suggests that even after a little amount of practices in general (not tone-specific instruction), tonal discrimination ability could be improved due to accommodation by learner's internal and automatic mechanism of language processing.

E78

OMITTED STIMULUS POTENTIAL IN JAPANESE-ENGLISH BILINGUALS: AN ERP STUDY Michelle Ma[1], Yuriko Oshima-Takane[1], Lara Pierce[1], Hiroko Nakano[2], Fred Genesee[1]; [1]McGill University, [2]Saint Mary's College of California — Previous studies in our lab have revealed that the presentation of null objects in English sentences (grammatically illegal) elicits an event-related potential (ERP) component, known as the omitted stimulus potential (OSP), in adult English monolinguals. However, an OSP is not elicited when Japanese monolinguals listen to Japanese null objects, as the omission of object arguments is permitted in Japanese. The present study capitalized on this to investigate whether Japanese-English bilinguals show transfer of grammatical null objects in Japanese when processing English ungrammatical null object sentences. Fifteen adult Japanese-dominant Japanese-English bilinguals underwent two sessions of EEG recording, one session in Japanese and one in English. Participants heard a series of context sentences (e.g., "the apples on the tree are ripe now"), followed by response sentences containing a transitive verb and either a correct pronoun (e.g., "we should pick them") or a null object (e.g., "we should pick Ø"). EEG responses were analyzed to determine whether bilinguals were sensitive to violations of English ungrammatical sentences with omitted objects. Results showed that bilinguals' ERP waveforms in both English and Japanese sessions were similar to those of Japanese monolinguals. Specifically, no OSP component was observed, indicating transfer of Japanese null objects to English. However, grammatical judgement ratings in a separate behavioural task were similar to the ratings by respective monolinguals. These findings suggest that although Japanese-dominant bilinguals make native-like judgements about the ungrammaticality of English null object sentences, their dominant language, Japanese, is the language of implicit processing of English ungrammatical null object sentences.

E79

SELECTIVE BRAIN-TO-BRAIN COUPLING AT A NATURALISTIC "COCKTAIL PARTY" SCENE Bohan Dai[1], Guang Shi[1], Jing Jiang[1], Chunming Lu[1]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University,Beijing 100875,China — Human listeners can easily separate out a speaker of interest from other speakers in a noisy, crowded environment. Moreover, the neural activity of a listener can selectively tract the temporal structure of the attended speech stream, resulting in tuning into a single voice. This effect raised an interesting question about how the neural activity of a listener relate to that of the attended speaker who produces the speech stream in such a "Cocktail Party" scene. This question was investigated in this study by using fNIRS-based hypercanning on twelve adult participant groups (3 persons per group) in an ecologically realistic spoken communication context. Neural coupling of brain activity in the left hemisphere between persons were computed by using WTC method. The results showed that the neural coupling between the listener and the attended speaker was significantly increased compared to that between the listener and the unattended speaker in the temporoparietal junction (TPJ), no matter whether the attended speaker was a priori appointed or selected freely during the communication. Furthermore, this effect appeared in the face-to-face condition, but not in the back-to-back condition. Together these results suggested that in a "Cocktail Party" scene, the neural activity of the listener was also coupled to that of the speaker, and attention play a key role in modulating this neural coupling effect. Visual inputs can effectively facilitate this neural coupling effect, and probably further enhance communication quality.

E80

COARTICULATION IN LEXICAL ACCESS - AN ERP-STUDY Ulrike Schild[1], Claudia Teickner[2], Claudia K. Friedrich[1]; [1]University of Tuebingen, [2]University of Hamburg — It is a matter of debate how detailed lexical representations in speech recognition are. Here we investigate the use of regressive assimilation by means of ERPs (Event-Related Potentials) recorded in cross-modal word onset priming. Auditory primes with consonant-vowel (c-v) structure were followed by visual German target words. Primes were either the onsets of their following target words, e.g., ri- taken from RINNE (Engl., chute; matching condition), or the onsets of pseudowords with a different place of articulation of the consonant following the initial vowel, e.g., ri- taken from RIMME (variation condition). Note, that primes only differ in anticipatory coarticulation carried by the vowel (ri[n] and ri[m] respectively). Unrelated prime-target pairs were taken as controls. Lexical decision times for target words were fastest in the matching condition, intermediate in the variation condition and slowest in the control condition. ERPs for both the matching condition and the variation condition start to differ from the control condition at 200 ms, ERP differences between the matching condition and the variation condition were not evident before 300 ms. Thus, less detailed representations appear to be accessed faster than more detailed lexical representation. These results are evidence for coactivation of more and less detailed representations along the complex stream of speech recognition.

LANGUAGE: Syntax

E81

THE SYNTACTIC PROCESSING OF CATAPHORIC PRONOUNS IN DUTCH Leticia Pablos[1], Bobby Ruijgrok[1], Jenny Doetjes[1], Lisa L. Cheng[1]; [1]Leiden University — The processing of cataphoric pronouns has been shown to follow similar mechanisms as the processing of wh-dependencies in behavioural studies. The parser actively searches for an antecedent to interpret the pronoun within the sentence, except in cases where the pronoun must obey principle C of the binding theory (a name cannot be c-commanded by a nominative pronoun). The present study investigated the involved mechanism and ERP components generated in cataphoric pronouns processing in Dutch by manipulating the pronoun-antecedent gender match. The Gender Mismatch (GMM) effect predicts a processing slowdown at the antecedent when there is a gender discrepancy with the preceding pronoun, however that should only appear when the pronoun can be bound by it according to the active search paradigm. An EEG experiment was conducted on 24 native speakers of Dutch with 36 target sentences created in a latin square-design controlling the presence of a constraint (Principle-C/No-Constraint) and the pronoun-antecedent gender (Match/No-match). ERP analysis at the position of the potential antecedent show a central anterior negativity in a post-stimuli 200-600ms window in the No Constraint-mismatch condition with respect to the No constraint-match condition (3-way ANOVA interaction of within factors condition, hemisphere (left, Right, Central) and electrode position (Ante-

rior, Middle, Posterior); F(12,276)=2.05, p=0.045)). In contrast, Principle-C conditions yielded no significant ERP waveforms differences. Results support the active search for an antecedent whenever there is a pronoun that must be bound locally, while grammatical constraints such as Principle C are immediately respected.

E82

WHEN JAPANESE DO NOT SHOW OMITTED STIMULUS POTENTIALS Yuriko Oshima-Takane[1], Noriaki Kanayama[2], Hiroko Nakano[3], Kazuo Hiraki[4], Akira Akabane[4]; [1]McGill University, [2]Hiroshima University, [3]Saint Mary's College of California, [4]University of Tokyo — Previous research has shown that monolingual English adults showed Omitted Stimulus Potentials (OSPs) when they listened to sentences that lacked object arguments (e.g., "Our freezer stopped working today. Will the landlord replace Ø?"), but not when listening to sentences that contained pronominal objects (e.g., "Will the landlord replace it?"). The OSPs associated with the null object sentences were characterized by early onset and prolonged positivity (200 - 800 ms). The present study investigated whether OSPs elicited by the English monolinguals reflect the detection of the physical absence of expected stimuli, similar to P300, as well as the syntactic reanalysis, similar to P600. It was expected that Japanese monolinguals would show decreased or no OSP because, unlike English, Japanese is a null argument language in which object omission is grammatically acceptable and often occurs in everyday conversation when omitted arguments are recoverable from the context. Electroencephalogram (EEG) activity was recorded while nine Japanese monolinguals listened to 51 pairs of context sentences followed by a response sentence with pronominal or null objects. As expected, no OSPs were elicited by Japanese monolinguals when listening to the null object sentences. The follow-up experiment showed that Japanese monolinguals (N=9) showed OSPs when listening to sentences with ungrammatical omissions (e.g., "Will the landlord replace our Ø?"). The finding that Japanese showed OSPs only when listening to ungrammatical sentences suggest that the OSPs elicited by English monolinguals reflect the detection of omission as well as the subsequent syntactic reanalysis.

E83

SYNTACTIC PROCESSING IN BILINGUAL CHILDREN: EXAMINING THE OPTIONAL INFINITIVE STAGE WITH FUNCTIONAL NEAR INFRARED SPECTROSCOPY Erica Seifert[1], Maria M. Arredondo[1], Xiaosu Hu[1], Lourdes M. Delgado Reyes[2], Teresa Satterfield[1], Ioulia Kovelman[1]; [1]University of Michigan, Ann Arbor, [2]University of Iowa — Child language acquisition in languages like English is marked by an Optional Infinitive (OI) stage (ages 2-4) during which children use nonfinite and finite verb-forms interchangeably. For example, a preschooler might produce both "yesterday we bake a cake" (nonfinite) and "yesterday we baked a cake" (finite). These types of errors persist after age 4 in children with Specific Language Impairments, suggesting that research on the OI stage could provide insight on the neurogenetic basis of syntax acquisition. The present study explored if early and systematic bilingual exposure to Spanish and English affects children's processing of OI errors in English, behaviorally and in the brain. METHOD: 22 Spanish-English bilinguals and 27 age-matched English monolinguals participated (mean age = 10). During fNIRS brain imaging, the children completed a grammaticality judgment task composed of sentences with OI errors ("Yesterday he walk."), control errors ("He is walk."), and correct sentences ("He is walking."). Control errors represented errors that are not present in typical language development. RESULTS: Relative to monolinguals, bilinguals were faster yet more likely to accept OI error sentences are correct. All children showed greater left frontal lobe activation during the OI condition, while bilinguals also showed greater amplitude and extent of activation across all conditions. CONCLUSIONS: Bilingual language experience can modulate the neurodevelopmental course of syntactic processing, development of finiteness, and language organization in the young brain. The results carry implications for the study of developmental language impairments in bilingual and monolingual populations.

E84

AN EVENT-RELATED POTENTIAL EFFECT OF AUDITORY SEQUENTIAL LEARNING RELATED TO SYNTACTIC PROCESSING OF NATURAL LANGUAGE. Sonia Singh[1], Jerome Daltrozzo[2], Joanne Deocampo[3], Christopher M Conway[4]; [1]Georgia State University, Atlanta, Georgia, USA. — Sequential learning (SL) is a cognitive process enabling people to perceive and learn environmental patterns. Since language acquisition is dependent on learning temporal patterns of speech, SL is considered essential for language development and performance. Despite this, there is still insufficient neural evidence supporting a relationship between SL and language ability. We investigated this relationship using event-related potentials (ERPs) with a SL task in 9 adults (8 females, 18-27 years). Participants also completed a measure of syntactic processing of natural language: the Grammaticality Judgment subtest of the Comprehensive Assessment of Spoken Language (CASL). In the SL task, a non-verbal "predictor" preceded a "target", with varying probability. Results indicated that ERPs to the predictors were modulated by this probability. There was an increased amplitude of a P300/P600-like component to higher probability predictors, which demonstrated that SL had occurred. This P600 effect interacted with Grammaticality [300-400ms post-predictor onset: F(8,24)=3.59, p=.026, Î·p2=.545], thus suggesting that syntactic processing of one's native language is directly related to SL. Similarly, a recent ERP study of SL using visual instead of auditory stimuli (Daltrozzo, Deocampo, Trapani, Sims, & Conway, 2013. Statistical learning is correlated with language performance: An event-related potential study. Annual Meeting of the Psychonomic Society, Toronto, Ontario, Canada, November 14-17. Abstract) also reported a relationship between a P300/P600-like effect of SL and syntactic processing in natural language. Taken together, these findings further suggest a strong and systematic link between neural correlates of SL and those of syntactic processing of natural language.

E85

THE ROLE OF THE GENDER-TO-ENDING CONSISTENCY IN SPANISH SENTENCE PROCESSING Sendy Caffarra[1], Horacio Barber[2]; [1]BCBL, [2]University of La Laguna — When we have to explicitly retrieve a morpho-syntactic feature of a noun, such as grammatical gender, two possible routes can be used. A lexical route recovers gender as an abstract feature in the lexicon (e.g., "mesa", tableF), while the form-based route takes account of the strong correlations between the gender feature and a specific formal cue (e.g., the Spanish word ending "-a" represents a cue because it is strongly related with feminine gender). Evidence for the presence of these two routes has been found with isolated word presentation. However it is still unclear whether the two routes can be used during sentence reading and how these two routes work during the computation of agreement dependencies. This ERP study investigated the processing of gender agreement in nouns that could provide a gender-related ending (i.e., transparent nouns; e.g., "mesa", tableF) or not (i.e., opaque nouns; e.g., miel, honeyF). The gender agreement between an article and the noun was manipulated and the 240 word pairs were embedded in sentences. Thirty-two Spanish native speakers were required to performed a grammaticality judgement test. ERPs to the target noun showed that transparent nouns elicited greater fronto-central negativity between 200 and 500 ms, suggesting that the system uses the form-based route even in sentence reading. In addition, a LAN-P600 (350-500 ms; 500-800 ms) effect was observed for gender mismatches. Interestingly, this biphasic pattern did not differ for transparent and opaque nouns, indicating that agreement computation would rely on the lexical route, instead of the form-based route.

E86

DISTRIBUTION OF GRAMMATICAL FUNCTIONS ACROSS BIHEMISPHERIC AND LEFT PERISYLVIAN NETWORKS Mirjana Bozic[1,2], Weiyu Ye[1,2], William D Marslen-Wilson[1,2]; [1]University of Cambridge, [2]MRC Cognition and Brain Sciences Unit, Cambridge — Language comprehension engages functionally distinct large-scale networks in both hemispheres. A distributed bilateral network has been linked to the semantic and pragmatic interpretation of the spoken input, while a left hemisphere fronto-temporal network is strongly associated with complex syntax and inflectional morphology. Neuroimaging and neuropsychological evidence suggests however that the processing of syntactically simple utterances need only

involve bilateral temporal structures. This implies that the interpretation of grammatical cues to phrasal and clausal structure is not solely restricted to the LH perisylvian system, and that the bilateral system can support structurally simple grammatical computations. Defining structural simplicity as linear sequences generated by a Finite State Grammar (FSG), we contrasted three linear sequences of increasing complexity - (1) minimal two-word strings (They listen); (2) longer three-word strings (I go home); (3) strings with non-adjacent dependencies (We often walk) - with two types of strings expected to engage the LH system. These were (4) structurally non-linear sequences (Today I work) and (5) minimal strings that were inflectionally complex (You agreed). Both univariate and multivariate analyses showed results that departed from this framework, with only the minimal two-word phrases restricted to bilateral temporal regions. Conditions (2), (3), and (4) grouped together to activate left inferior frontal regions as well as bilateral temporal areas, similar to the inflectionally complex strings (5). These data confirm that the bihemispheric system can support basic forms of grammatical interpretation, and suggest that some redefinition is needed of what constitutes syntactic complexity.

E87

CORTICAL ENCODING OF THE HIERARCHICAL STRUCTURE OF SPOKEN LANGUAGE Nai Ding[1], Hang Zhang[1], Xing Tian[1], Lucia Melloni[1,2,3], David Poeppel[1]; [1]NYU, [2]Max-Planck Institute for Brain Research, [3]Columbia University — Language is hierarchically organized into syllables, words, phrases, and sentences. For spoken language, parsing a continuous speech stream into these hierarchical linguistic structures is a fundamental and challenging task. The boundaries between syllables generally have clear acoustic signatures; in contrast, determining the boundaries between words and phrases critically relies on a listener's linguistic knowledge. It is now well characterized that auditory cortical activity is entrained to the syllabic rhythm of speech. However, how larger linguistic structures, such as phrases, are encoded online remains elusive. We designed new phrasal speech materials in which the hierarchical linguistic structure of speech is dissociated from low level acoustic features and measured cortical activity using magnetoencephalography (MEG) from listeners listening to such materials. We demonstrate that cortical activity is hierarchically entrained to the rhythms of words, phrases, and sentences, unconfounded by the tracking of acoustic properties of speech. Furthermore, such hierarchical entrainment is demonstrated to be associated with the syntactic structure of speech rather than the predictability of each incoming word. In summary, when listening to a continuous speech stream, cortical activity is entrained not only to the acoustic features or the syllabic rhythm of speech but also to larger, abstract linguistic units such phrases.

LONG-TERM MEMORY: Episodic

E88

NEURAL SUBSTRATES OF NAP-DEPENDENT CONSOLIDATION OF DECLARATIVE MEMORY IN YOUNG ADULTS Bengi Baran[1], Janna Mantua[1], Rebecca M.C. Spencer[1]; [1]University of Massachusetts Amherst — Declarative memories are better recalled after an interval of sleep compared to wake, a difference thought to reflect sleep-dependent memory consolidation. While a large body of work shows that changes in memory performance are accompanied by quantifiable changes in the brain (i.e. consolidation related reorganization), less is known about the specific role of sleep physiology on functional activation in the declarative memory retrieval network. In the present study we used functional MRI and polysomnography to identify electrophysiological properties of a mid-day nap that relate to changes in retrieval related activation. Participants (n= 12) were trained on a word-pair learning task and recall was tested after a 5hr interval that included a daytime nap or restful wake (within subjects, conditions separated by one week, order counter-balanced). Participants performed better (i.e. decreased forgetting compared to baseline) when the intersession interval included a nap. The nap benefit score (intersession performance change following the nap minus the intersession performance change following wake) correlated positively with time spent in slow-wave sleep (r= .70, p= .01), and participants with greater sleep efficiency retained a greater memory for items after the delay (r= .66, p= .02). Functional activation associated with successful recall was contrasted between the nap and wake conditions. Following a nap, participants showed more activation in inferior frontal gyrus and insula, possibly due to better attentional allocation and better cue-dependent search during retrieval. Overall, these results suggest that an efficient nap rich in slow wave sleep enhances memory and facilitates attention allocation for successful recall.

E89

SOURCE MEMORY CONFIDENCE CO-VARIES WITH DIFFERENCES IN NEURAL REINSTATEMENT Emily K. Leiker[1], Jeffrey D. Johnson[1]; [1]University of Missouri — The phenomenological experience of retrieving qualitative information from episodic memory ("recollecting") is thought to be supported by hippocampally-mediated reinstatement of the neurocognitive processes activated during encoding. Several fMRI studies have provided evidence for this hypothesis by demonstrating stronger reinstatement when subjects report recollecting specific details compared to when recollection fails. However, the precise nature of the relationship between recollection and reinstatement remains largely unexplored, particularly in light of recent studies demonstrating that activity in some regions (e.g., inferior parietal cortex and hippocampus) co-varies with the amount or strength of information recollected. The current study addressed this issue by examining whether a behavioral measure of recollection quality - confidence ratings about source memory judgments - tracks the magnitude of neural reinstatement. Subjects (n = 19) were first shown a series of words in the context of one of three encoding tasks. A later memory test employed a two-step procedure in which subjects first made source memory judgments (designating the task previously completed for a word) and then rated their confidence about that judgment on a three-point scale. Pattern-classification analyses were used to index the degree to which task-related neural activity from encoding was reinstated during retrieval. The results indicated that, when source memory judgments were correct, the magnitude of reinstatement increased as a function of greater source confidence. These findings suggest that, not only does reinstatement appear to be involved in recollection, but judgments about the subjective experiences associated with retrieval may be directly supported by parametric changes in reinstatement.

E90

UNITIZATION OF PSEUDOWORDS: AN ERP INVESTIGATION OF THE ROLE OF SEMANTIC INFORMATION Ryan Hubbard[1], Brian Gonsalves[1]; [1]Department of Psychology & Beckman Institute, University of Illinois at Urbana-Champaign — According to dual-process theories of memory, recognition memory is dependent upon two distinct processes: familiarity (a sense of oldness) and recollection (retrieval of contextual information). In memory tasks that typically rely on recollection, such as associative memory, items can be recognized by familiarity alone if stimuli are "unitized", or mentally combined to form a single representation. However, it remains unclear as to what mechanism underlies this increase in familiarity-based recognition for unitized pairs. One proposal is that unitization may modulate the semantic relatedness between the two items. For example, "slope" is not semantically related to "bread"; however, following unitization, the relatedness of these two words might increase. If this is the case, we would expect that stimuli with little semantic information would lead to reduced unitization. To assess this claim, we performed two ERP experiments with pseudowords. In the first experiment, participants were shown either a pair of words or a pair of pseudowords, and were given either a perceptual unitization task or a non-unitization task. In the second experiment, participants were given either a pair of words or a pseudoword-word pair, and were given a conceptual unitization task or a non-unitization task. ERPs were recorded during a recognition test to assess any electrophysiological differences between conditions. ERP results show higher amplitude N400 responses to unitized pseudowords, while the opposite effect is seen for unitized words. While these results are preliminary, they suggest that neural measures of familiarity-based retrieval may differ depending on the semantic content of the information.

E91

THE INTERACTION OF UNITIZATION AND RELATIONAL ENCODING STRATEGIES ON MEDIAL TEMPORAL LOBE ACTIVATION DURING RETRIEVAL Hsiao-Wei Tu[1], Rachel Diana[1]; [1]Virginia Tech — In retrieval of typical episodic memories, context details must be recognized using recollection process whereas familiarity alone can support item recognition.

Unitization is a specialized encoding strategy that allows context details to be processed as item features and therefore increases the involvement of familiarity-based recognition in retrieval of these context details. Relational encoding stores items and contexts as independent units whereas unitization merges the item and context information into a single new representation. Our previous study (Tu & Diana, under review) showed that a mixture of unitized and non-unitized context details in the same episode reduced the contribution of familiarity to retrieval of any one detail. However, this result may have been influenced by the perceptual linking between the study word and its context (background color or font size). In the current study, we removed the visual cues for the context in order to ensure that encoding was based on the unitization manipulation: a scenario describing an event. That is, participants were only able to extract necessary contextual information from the scenarios provided at encoding. Receiver operating characteristic curves suggest that the two individual context details were processed independently under these conditions. We also collected neuroimaging data which show activation in the hippocampus and perirhinal cortex when both details were unitized, as compared to when one or more context details were not unitized.

E92

CHANGES IN FUNCTIONAL CONNECTIVITY WITHIN THE DEFAULT MODE NETWORK LINKED TO SUCCESSFUL ASSOCIATIVE ENCODING

Erin D. Horne[1], Marianne de Chastelaine[1], Danielle R. King[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 refer to lower levels of encoding-related activity for later remembered than later forgotten study items. In the present study, subjects (n=36) were scanned as they studied a series of word pairs. On a later test, they then discriminated between "intact" (same pairing as at study), "rearranged" (different pairing from study) and new pairs. Subsequent memory effects were identified by contrasting the neural activity elicited by the study pairs according to whether they were later correctly judged to be intact or incorrectly endorsed as rearranged. Consistent with numerous prior findings, negative effects were evident in posterior regions of the default mode network, including the posterior cingulate and right lateral parietal cortex. Psychophysiological interaction (PPI) analysis was used to identify where functional connectivity with these regions was modulated as a function of later memory performance. In several regions, connectivity was higher during the encoding of study pairs that went on to be correctly rather than incorrectly endorsed on the later memory test. The most prominent such regions were medial prefrontal cortex (mPFC) and right temporoparietal junction (TPJ), both of which were identified regardless of the location of the seed (posterior cingulate or right parietal cortex). Importantly, negative subsequent memory effects could not be identified in the mPFC, even at a very liberal threshold. Thus, successful versus unsuccessful associative encoding is associated with differential engagement of members of the default mode additional to those that manifest negative subsequent memory effects.

E93

VISUOSPATIAL MEMORY: AT ENCODING OR RETRIEVAL, IS THE RIGHT BRAIN CRITICAL FOR GLOBAL-TO-LOCAL PROCESSING?

Peii Chen[1,2], Ashley Hartman[1], Daniela Sacchetti[1], Randall Miller[3]; [1]Kessler Foundation, [2]Rutgers New Jersey Medical School, [3]Seton Hall University — Processing global configuration prior to local details (i.e., global-to-local processing) predicts an accurate recall of visuospatial information. While many have suggested that the right cerebral hemisphere underlies this hierarchical processing, the present study examined whether the right brain is critical for global-to-local processing at encoding or retrieval. This study assessed visuospatial memory in 44 healthy adults (age=64.5yr, SD=1.4) and 33 right-brain-damaged stroke survivors (age=64.6yr, SD=2.4; <90 days post stroke) who showed no signs of spatial neglect or depressive symptoms. All participants were asked to produce a copy of the Modified Taylor Complex Figure without knowledge of immediate and delayed recall (30 minutes) trials. Drawings were scored for accuracy (0-36) and configuration (0-10; indexing the degrees of global-to-local processing). After accounting for the presence of right-brain damage, age, and years of formal education, we replicated findings that a greater configuration score of the copy trial predicted greater accuracy of the delayed recall trial, $F(1,72)=6.02$, $p=0.017$. Configuration of the delayed recall trial showed a similar effect on recall accuracy, $F(1,72)=7.77$, $p=0.007$. We also addressed our research question: After controlling for age and education, we found that the presence of right-brain damage did not predict the configuration score of the copy trial, $F(1,73)=1.49$, $p=0.225$, but did predict poorer configuration of the delayed recall trial, $F(1,73)=5.30$, $p=0.024$. Therefore, the right hemisphere may be critical for global processing at retrieving, rather than encoding, visuospatial information. However, lesion-behavior mapping analysis failed to yield a specific brain region critical for such function.

E94

ELECTROPHYSIOLOGICAL CORRELATES OF INDUCED LIBERAL VERSUS CONSERVATIVE DECISION STATES IN RECOGNITION MEMORY

Justin Kantner[1,2], Jean M. Vettel[1], Benjamin O. Turner[2], Misty L. Schubert[2], James C. Elliott[2], Barry Giesbrecht[2], Michael B. Miller[2]; [1]U.S. Army Research Laboratory, [2]University of California, Santa Barbara — Most theories of recognition memory assume that people reach recognition decisions by establishing a criterion beyond which there is sufficient memory evidence to call an item "old" and up to which an item will be called "new." The criterion can be neutral, or individuals can be biased to respond "old" (a liberal bias) or "new" (a conservative bias). Research with patient populations and recent neuroimaging work are consistent with the idea that maintaining a conservative decision criterion requires greater frontally mediated control over test responses than maintaining a liberal criterion. We hypothesize that when an individual is compelled to adopt a conservative recognition bias, s/he must engage cognitive control processes that suppress prepotent "old" judgments and support cautious responding. However, the relationship between cognitive control and a conservative decision state is an open question. Meanwhile, while research has identified ERP components that track the placement of the decision criterion, the cortical oscillations that underlie decision bias in recognition are (to our knowledge) largely unexplored. We collected EEG recordings while manipulating participants' decision states via a "security patrol" recognition paradigm in which old-new discrimination was minimal and shifts between strongly liberal and strongly conservative states were necessary to avoid critical misses (letting dangerous people go free) or false alarms (harming innocent people), respectively. We present EEG correlates of a conservative recognition response state and consider the extent to which these overlap with patterns of neural oscillations observed in cognitive control tasks.

E95

AN ELECTROPHYSIOLOGICAL STUDY OF INDIVIDUAL DIFFERENCES IN RECOGNITION MEMORY.

Anjali Thapar[1], Grace Ewing[1], Daniel Montgomery[2], Saachi Malhotra[1], Jacoba Johnson[1], Amanda Glassner[1]; [1]Bryn Mawr College, [2]Haverford College — The use of event-related potentials (ERPs) to study brain activity associated with encoding and retrieval processes in recognition memory is well established. However, only a handful of studies have explored individual differences in neural activity associated with encoding and retrieval processes, and the majority of this research has focused on age-related changes in episodic memory. The present study examined individual differences in the old/new effect in young adult participants characterized as high vs. low medial temporal lobe participants based on a neuropsychological battery consisting of measures tapping immediate and delayed recall of verbal and visual memory. The old/new effect is commonly characterized by enhanced positive deflections in response to study (old) words as compared to new words. Participants studied a list of words and performed an item recognition memory test while wearing a Neuroscan 40 channel EEG cap and EEG data was recorded continuously throughout the memory task. Analysis of the behavioral data confirmed that the high- and low-MTL groups differed in performance on the recognition memory task. Analysis of the ERP data replicated the old/new effect found in the literature in both the high- and low-MTL groups but the magnitude of the ERP form was reliably different for the high- and low-MTL groups. The results of the study indicate that young adult participants can be reliably differentiated into high- and low-MTL groups and that individual differences in MTL functioning is associated with reliable differences in performance and neuronal activity on a yes/no recognition memory test.

E96

EPISODIC FUTURE THINKING IN SEMANTIC DEMENTIA: A COGNITIVE AND FMRI STUDY

Armelle Viard[1,2,3,4], Pascale Piolino[5,6], Serge Belliard[1,2,3,4,7], Vincent de La Sayette[1,2,3,4], Béatrice Desgranges[1,2,3,4], Francis Eustache[1,2,3,4]; [1]Inserm, U1077, Caen, France, [2]Université de Caen Basse-Normandie, UMR-S1077, Caen, France, [3]Ecole Pratique des Hautes Etudes, UMR-S1077, Caen, France, [4]Centre Hospitalier Universitaire, U1077, Caen, France, [5]Université Paris Descartes, Institut de Psychologie, Paris, France, [6]Inserm UMR S894, Centre de Psychiatrie et Neurosciences, Paris, France, [7]CHU Pontchaillou, Rennes, France — Semantic dementia (SD) is characterized by gradual loss of semantic memory. While episodic memory is preserved, behavioral studies show that future thinking is impaired in SD. Using fMRI, brain activity was measured in three female SD patients (EP: 77 years old, LL: 73, EG: 62), while they remembered personal past events or envisioned future events. Twelve healthy females served as controls (mean age 67.17 ± 5.22 years). Episodic quality and consciousness (Remember/Know) were checked at debriefing. Atrophy was assessed (VBM5) and subtraction analyses (SPM5; $p<0.05$ FWE corrected) were conducted to compare future to past thinking (F>P). EP evoked few episodic future events and presented atrophy in superior medial frontal gyrus (mPFC) which was less activated for F>P. LL presented atrophy in left anterior hippocampus and hyperactivated its right counterpart for F>P. Hyperactivation of superior mPFC during past remembering coincided with better "remember" responses for past compared to future thinking. EG hyperactivated lateral temporal cortex for F>P, a region important for semantic processing, coinciding with poorer episodic quality of future compared to past events. Altogether, patients' future projections were different depending on the severity and localization of their neocortical atrophy. Superior mPFC has a role in information integration, self-reference and autonoetic consciousness, essential for future thinking. Its atrophy may explain EP's difficulty to pre-experience episodic future events. For LL, right anterior hippocampal hyperactivation for future thinking served to compensate for its left counterpart atrophy. Integrity of both regions in EG permitted future projection, although episodic quality was poorer than past remembering.

E97

CROSS-DOMAIN CONTROL IN EPISODIC AND SEMANTIC MEMORY: EVIDENCE FROM A NOVEL SIMULTANEOUS EEG-FMRI PARADIGM

Ravi D. Mill[1], Akira R. O'Connor[1]; [1]School of Psychology and Neuroscience, University of St Andrews, St Mary's College, South Street, St Andrews, Fife, KY16 9JP, Scotland, UK. — Recent functional neuroimaging research has highlighted the importance of cognitive control in the domain of memory evaluation, yet neural substrates which differentially support control- and memory-specific processes have not been dissociated. A related question with direct relevance to theories of cognitive control is whether control is signalled in analogous fashion across different processing domains (e.g. episodic and non-episodic memory). We hence employed a simultaneous EEG-fMRI paradigm involving two decision-making tasks that were equated for underlying controlled processing, but which differed in the processing domain being evaluated: the semantic (pleasant/unpleasant?) and episodic (old/new?) memory tasks. In both tasks, participants had to decide if the status of to-be-judged words matched the status of separately presented cue screens. 'Mismatch' trials were hypothesised to heighten cognitive control relative to 'match' trials, and this manipulation was combined with block-wise variation of cue-word ordering to enable a comprehensive examination of the neural substrates of cross-domain control. We found cross-domain mismatch control activations localised to parietal and prefrontal cortices, which were heightened when cues preceded the appearance of words (Cue-First condition) and attenuated when words preceded the appearance of cues (Word-First condition). These findings reveal the neural substrates of cross-domain control, and highlight that these are sensitive to the format of the task in which control is recruited.

E98

THE BENEFIT OF TESTING: AN EVENT-RELATED POTENTIAL (ERP) STUDY

Cheng-hua Bai[1], Emma K. Bridger[1], Axel Mecklinger[1]; [1]Saarland University, Germany — The enhanced memory performance for items that are tested as compared to being re-studied (the testing effect) is a frequently reported memory phenomenon. However, few studies have explored the neural correlates of this effect at the time point when testing takes place. In this study, we utilized the ERP correlates of successful memory encoding to address this issue, hypothesizing that if the benefit of testing is due to retrieval-related processes at test then subsequent memory effects should resemble the ERP correlates of retrieval-based processing in their temporal and spatial characteristics. Participants were asked to learn Swahili-German word pairs before items were presented in either a Test or a Re-study condition. Memory performance was assessed immediately and one-day later with a cued recall task. Successfully recalling items at test increased the likelihood that items were remembered over time compared to items which were only re-studied. An ERP subsequent memory contrast (later remembered vs. later forgotten tested items), which reflects the engagement of processes that ensure items are recallable the next day were topographically comparable with the ERP correlate of immediate recollection (immediately remembered vs. immediately forgotten tested items). This result shows that the processes which allow items to be more memorable over time share qualitatively similar neural correlates as the processes which were related to successful retrieval at test. This finding suggests that testing is more beneficial than re-studying on memory performance over time because of its engagement of retrieval processes, i.e. the re-encoding of actively retrieved memory representations.

E99

CONFIGURAL MEMORY REPRESENTATIONS: AN EVENT-RELATED FMRI STUDY OF STRUCTURAL AND NON-STRUCTURAL LEARNING

Samuel C Berens[1], Chris M Bird[1]; [1]University Of Sussex — The medial temporal lobes (MTL) are critical for memory but the precise roles of structures within the MTL are not known. Based on lesion studies in rodents, Aggleton, Sanderson and Pearce (2007) proposed that the hippocampus underpins representations of the temporal and spatial arrangement of items (e.g. A is rewarded if presented to the left of B). This has been termed "structural learning". Recent evidence suggests that the perirhinal cortex is important for representing conjunctions of item features (e.g. A is rewarded when presented with B). We used event-related fMRI to investigate the brain regions involved in structural and non-structural configural learning. 23 right-handed participants engaged in a virtual reality trial-and-error learning task involving spatial-structural and non-structural trials. State-space modelling was used to compute trial-by-trial estimates of acquisition rate and trace-strength for each stimulus type. These parameters were regressed against BOLD activity to identify regions involved in memory encoding and retrieval respectively. As predicted, during periods of retrieval, hippocampal activity increased as a function of trace-strength for structural trials. In contrast, activity in the parahippocampal cortex correlated with trace-strength for non-structural trials. During periods of encoding, activity in Broca's area was associated with the acquisition of structural representations whereas activity in the left middle temporal gyrus was associated with the acquisition of non-structural representations. These findings provide support for the functional segregation of MTL areas in the learning of structural and non-structural configurations and they suggest that separate regions may be utilised when processing such information at encoding.

E100

FUNCTIONAL NEAR INFRARED SPECTROSCOPY REVEALS PREFRONTAL INVOLVEMENT IN ASSOCIATIVE RECOGNITION

James D. Schaeffer[1], Amarnath S. Yennu[1], Kellen C. Gandy[1], Fenghua Tian[1], Hanli Liu[1], Heekyeong Park[1]; [1]University of Texas at Arlington — Previous functional magnetic resonance imaging (fMRI) studies have shown that neural activity in the prefrontal cortex is involved in associative memory. Here we investigated associative recognition with functional near infrared spectroscopy (fNIRS) using an item-item associative memory paradigm. Participants studied a list of word pairs and made judgments of whether one item in the pair fit into the other. During retrieval, participants were presented with intact word pairs (studied words in the same pair), rearranged word pairs (studied words, but paired differently), and new word pairs. Participants made memory judgments toward test word pairs by responding"intact," "rearranged," or "new." For word pairs to which participants made accurate associative memory judgments (i.e. intact pairs correctly judged as "intact"), increases in oxygenated hemoglobin were observed in the dorsolateral prefrontal cortex (Brodmann's areas 46/9), when compared to inac-

curate associative memory judgments (i.e. intact pairs incorrectly judged as "rearranged"). These findings corroborate previous fMRI findings that have demonstrated lateral prefrontal cortical involvement in associative memory. Therefore, the results of this study provide converging evidence for the importance of the dorsolateral prefrontal cortex in retrieval of item-item associations. Further, this study demonstrates that fNIRS can be a viable neuroimaging tool for investigating cortical involvement in human episodic memory as an easily accessible yet economical neuroimaging tool.

E101

BETTER TAKE A NAP! NAPPING BENEFITS RECOGNITION MEMORY Sara Studte[1], Emma Bridger[1], Axel Mecklinger[1]; [1]Saarland University, Saarbruecken — An increasing number of studies have shown that sleep improves memory performance and that even short daytime naps can lead to memory benefits. Sleep-specific parameters which can be measured with EEG such as sleep spindles are thought to support memory consolidation. Using event-related potentials (ERPs) we explored the role of nap sleep for associative memory (AM) and item memory (IM). Subjects studied single words and word-pairs before performing an IM- and AM-test (pre-test). One group (n=22) was next allowed to nap (~90 minutes) while the other watched DVDs (control; n=19). Both groups then performed a final IM- and AM-test (post-test). IM performance decreased for both groups from pre- to post-test. Consistent with the view that nap sleep is particularly beneficial for hippocampus-dependent AM, performance dropped from pre- to post-test in the control group but remained at the pre-test level for the nap group. Both groups showed the expected ERP correlates of familiarity and recollection at pre- and post-test. Unexpectedly, these ERP effects were not modulated by nap sleep. However, spindle density correlated with pre-test AM performance ($r=0.45$, $p<0.05$) and also with the ERP correlate of recollection in the AM pre-test ($r=0.44$, $p<0.05$). These findings imply that successful learning and retrieval before nap sleep modulate memory consolidation of associated information (as reflected in enhanced spindle activity) during sleep. This, in turn, may help boost post-sleep performance.

E102

PARIETAL STIMULATION WITH TDCS LEADS TO ENHANCED MONITORING OF ITEM AND SOURCE MEMORY Denise Pergolizzi[2], Elizabeth F. Chua[2]; [1]The Graduate Center, CUNY, New York, NY, [2]Brooklyn College, CUNY, Brooklyn, NY — This study sought to clarify direct contribution of the lateral posterior parietal cortex (PPC) on item and source recognition using transcranial direct current stimulation (tDCS). The lateral PPC has been implicated in contributing to objective accuracy during item recognition in neuroimaging studies, but only subjective memory, such as confidence in source memory, in neuropsychological studies. In the current study we sought to observe what patterns of recognition memory could be altered using tDCS of the PPC during item versus source recognition. Thirty-six participants were randomly presented with a total of 50 words to be judged "living" (animacy judgment) or "bigger than a shoebox" (size judgment). Participants received 20 minutes of active (2 mA; n=18) or sham (n=18) tDCS using a bilateral CP3/CP4 montage during a recognition test. During item recognition, active stimulation participants had increased discriminability ($d'= 2.33$) compared to sham ($d'= 1.90$) between items correctly judged "old" and falsely judged "old", ($p<.03$) and a more conservative criterion ($C= 0.29$) compared to sham stimulated participants ($C= -0.07$, $p<.03$). This effect was revealed to be driven by a significant decrease in false alarms for active (9%) compared to sham (20%) participants ($p<.02$). During source recognition, sham stimulated participants revealed a criterion shift toward "bigger" judgments (0.18), while active stimulated showed no significant bias toward living or bigger judgments, revealing a more conservative criterion (-0.09, $p<.01$). These findings suggest the lateral PPC may be necessary in establishing criterial judgments for recognition decisions.

E103

"NEURAL WORDS" AS A SUBSTRATE FOR BOTH FLASH MEMORY AND THE EVOLUTION OF LANGUAGE Donald O'Malley[1]; [1]Northeastern University — Daily memory records (DMRs) are composed primarily of sub-linguistic items which have deep evolutionary roots. While focused attention is needed to memorize phone numbers or word lists, DMRs are written by an effortless, one-trial, "flash" process. The writing of these vast stores (which encode thousands of items: Brady et al., 2008; Gioioso and O'Malley, 2009), parallels the hippocampal encoding of navigational memories (Buzsaki and Moser, 2013), yet entails the epochal and chronological linking of preexisting neocortical representations. Neuronal gamma rhythms that bring world items into conscious experience might precede the writing of all DMR items / declarative memories. Parsimony suggests that gamma-band inputs activate autoassociative networks to form momentary epochs, which then become chained via a hippocampal sequencing algorithm, possibly by activating silent synapses (O'Malley, 2011, Neuroinformatics). Object recognition circuits are a potential substrate for the flash memory process, but we suggest the existence of more compact representations operating in neocortex ("eural words") along the lines of representations proposed to exist in hippocampus (McClelland et al., 1995). While linguistic words are our most compact symbols, words, phrases and sentences are but a tiny part of our DMRs (Ganz and O'Malley, 2011). Indeed, animals knew the objects, structures and physics of their world long before language existed and could combine these items in syntactical ways: they could store logical constructs and use such information at later times. We therefore propose that "neural words" not only underlie DMRs but also served as forerunners of the fully-arbitrary symbol manipulation system that is language.

LONG-TERM MEMORY: Other

E104

NEUROPHYSIOLOGICAL INDICES OF MANDARIN LEXICAL TONE PROCESSING: EFFECT OF MEMORY AND LANGUAGE EXPERIENCE Yan Yu[1], Valerie L. Shafer[2], Elyse Sussman[3], Margaret Kamows-ki-Shakibai[4], Jungmoon Hyun[2]; [1]William Paterson University of New Jersey, [2]City University of NY, the Graduate Center, [3]Albert Einstein College of Medicine, [4]Marymount Manhattan College — Language experience enhances discrimination of speech contrasts at a behavioral, perceptual level, as well as at a pre-attentive level, as indexed by event-related potential (ERP) mismatch negativity (MMN) responses. The enhanced sensitivity could be the result of changes in acoustic resolution and/or long-term memory representations of the relevant information in auditory cortex. We used a short (ca. 600 ms) versus long (ca. 2600 ms) interstimulus interval in a passive, oddball discrimination task to examine these possibilities. Mandarin and English listeners listened to bisyllabic nonword tokens that differed in lexical tone categories using a multiple oddball paradigm. The results revealed that reduced MMN amplitude in the English group under the long ISI condition only. In addition, Mandarin listeners showed a larger late negativity (LN) discriminative response than the English listeners for tone contrasts in the long ISI condition. Lack of robust MMN and LN to tone contrasts in English listeners under the long ISI condition suggests that that language experience modulates neural representation of lexical tones, largely at the phonemic level. They also suggest that the acoustic correlates of tone are fairly robust and easily discriminated at short ISIs regardless of language background. At longer ISIs beyond 2.5 s language-specific experience is necessary for robust discrimination. Results from repeated ANOVAs, linear mixed model, and principal component analysis will be compared and discussed.

E105

THE IMPLICIT REINSTATEMENT OF EMOTIONAL INFORMATION BIASES SOCIAL DECISIONS: AN FMRI STUDY Erik A. Wing[1], Brandon Levy[1], Ilana T. Z. Dew[1], Roberto Cabeza[1]; [1]Duke University — While the influence of emotion on explicit memory has been well studied, previously encoded emotional information may also have an implicit effect on current decisions and actions. A central question concerning implicit emotional influences on behavior is the nature of neural processes that support reinstatement of previously experienced affective content. In the present study, we used functional neuroimaging to examine the link between implicit reinstatement of emotional information and its effect on social decisions. Participants initially viewed faces with either angry or happy expressions, and subsequently made social judgments (e.g., would you want this person as a boss?) about the neutral version of those same faces, along with new faces. A final explicit memory test indicated that participants could not remember the original emotional expression of faces when provided with the neutral version. Nonetheless, social decisions showed an effect of previ-

ous expression: social ratings were more positive for previously happy vs. angry faces. Consistent with past research, neuroimaging analyses revealed repetition effects during the decision phase, with reduced activity in fusiform gyrus for previously-presented vs. new faces. Additionally, multivariate analysis of distributed activity in ventral occipitotemporal brain regions showed that within the set of repeated faces, cortical patterns differed as a function of the previous emotional expression (angry vs. happy), mirroring a similar dissociation found at encoding. These results suggest that emotional information may bias subsequent decisions by subtly altering online representations, and provide new parallels to work exploring retrieved representations at an explicit level.

E106

EXPERIENCE MODIFIES THE CONJUNCTIVE NEURAL REPRESENTATIONS NECESSARY FOR COMPLEX OBJECT PERCEPTION

Jonathan Erez[1], Rhodri Cusack[2,3], Felicia Zhang[1], Morgan D. Barense[1,4]; [1]University of Toronto, [2]University of Western Ontario, [3]The Brain and Mind Institute, London, ON, Canada, [4]Rotman Research Institute, Toronto, ON, Canada — Critical to perceiving an object is the ability to bind its constituent features into a cohesive representation. We have recently shown that the perirhinal cortex, a region long-believed to contribute exclusively to a dedicated memory system, coded conjunctive representations of novel complex objects, over and above their constituent features. One outstanding question is how the representations of such complex objects change with experience. To address this question, we trained participants on a visual search task with a set of objects that comprised either one (e.g., A, B, or C), two (e.g., AB, AC, BC), or three features (e.g., ABC). Following 6 training sessions, participants were scanned while performing a 1-back task with the trained objects and a set of novel objects. We then conducted a correlational multi-voxel pattern analysis (MVPA) to examine the degree to which the neural representation coded the conjunctions of features, over and above the features themselves and whether any differences existed between the conjunctive representations of familiar versus novel objects. Results revealed that anterior regions of the ventral visual stream, including the PRC, demonstrated complex conjunctive coding. In addition, we found that extensive training with the objects shifted these conjunctive representations to more posterior ventral visual stream regions. These results support the recent representational-hierarchical view of object perception and memory. Moreover, these findings suggest that experience shapes the representation of the conjunctions of features comprising complex objects, such that they are unitized and processed by more posterior ventral visual stream regions.

E107

DECREASED FUNCTIONAL CONNECTIVITY BETWEEN THE HIPPOCAMPUS AND PREFRONTAL CORTEX IS ASSOCIATED WITH LIFELONG HISTORY OF GETTING LOST

Giuseppe Iaria[1], Aiden E.G.F. Arnold[1], Clayton F. Burles[1], Irene Liu[1], Edward Slone[1], Sarah Barclay[2], Torben N Bech-Hansen[2], Richard M Levy[3]; [1]NeuroLab, Department of Psychology and Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta, Canada, [2]Department of Medical Genetics, University of Calgary, Calgary, Alberta, Canada, [3]Faculty of Environmental Design, University of Calgary, Calgary, Alberta, Canada — The lifelong history of getting lost in familiar surroundings despite any brain injury or neurological condition is known as Developmental Topographical Disorientation (DTD). To date, the neural correlates of this newly discovered cognitive disorder are unknown. Given the well-known role of the hippocampus in spatial navigation and the selectivity of DTD to this specific domain, we hypothesized that the inability to orient in DTD is related to ineffective functional connectivity between the hippocampus and other brain regions critical for spatial orientation. Here, we tested this by asking a group of individuals with DTD and a group of control subjects to undergo a resting-state functional MRI (rsfMRI) scan. In addition, both groups performed a task-based fMRI study while forming a cognitive map of a virtual environment. Finally, we performed Voxel Based Morphometry to exclude structural differences between DTD and control groups. The results study showed a decreased functional connectivity between the right hippocampus and the prefrontal cortex (PFC) in individuals with DTD. The fMRI study revealed decreased signal change in DTD individuals within the insular cortex, and the temporal and parahippocampal gyri in the right hemisphere while forming a cognitive map. No structural differences were revealed between groups. These findings provide the first group based neural evidence of DTD and suggest that ineffective functional connectivity between hippocampus and PFC may affect the monitoring and processing of spatial information while moving within an environment, resulting in the selective inability to form cognitive maps that are critical for orienting in the environment.

E108

STABILITY IN HIPPOCAMPAL REPRESENTATION OF FACES DURING ENCODING RELATES TO RACE EFFECTS IN MEMORY

Thackery I. Brown[1], Melina R. Uncapher[1], Karen F. LaRocque[1], Anthony D. Wagner[1]; [1]Stanford University — People are better at remembering faces from their own race than other races - a phenomenon that has significant implications in courtroom settings. To examine the representational basis for this racial bias in face memory, 23 healthy young participants (7 African American (AA) and 16 European American (EA)) underwent functional magnetic resonance imaging while studying pictures of novel AA and EA faces. Using representational similarity analyses, we examined the relationship between neural pattern similarity for faces at encoding and subsequent memory. Separate representational similarity measures were computed for faces of the participant's own race (in-group) and the other race (out-group) within the fusiform gyrus and the hippocampus - regions important for face processing and memory. Analyses of data from the fusiform gyrus revealed that, for both in-group and out-group faces, the stability of the representation of a face across repeated encoding trials predicted later memory, such that subsequently remembered faces had greater stability across exposures. Critically, in the hippocampus, stability did not differ based on subsequent memory for in-group faces, but was significantly greater for remembered than forgotten out-group faces. These results suggest that a mechanistic account of racial bias in face memory may involve hippocampal processes, such that the robustness of face representation during encoding in the hippocampus is important specifically for recognizing individuals of another race.

E109

ENCODING-RELATED BRAIN ACTIVITY IN PATIENTS WITH ACCELERATED FORGETTING

Kathryn Atherton[1], Anna Christina Nobre[1], Nicola Filippini[1], Adam Zeman[2], Christopher Butler[1]; [1]University of Oxford, [2]University of Exeter — Patients with transient epileptic amnesia (TEA, a sub-type of medial temporal lobe epilepsy) commonly complain of accelerated long-term forgetting (ALF), despite performing within the normal range on standard neuropsychological tests and having clinically normal structural brain imaging. These patients typically exhibit normal learning and initial retention, but forget rapidly over subsequent days and weeks. ALF is presumed to reflect a deficit in hippocampus-dependent memory consolidation. However, it remains possible that these patients suffer from a subtle encoding abnormality. In this fMRI study, we presented 160 novel naturalistic visual stimuli to a group of patients with TEA, who complained of ALF, and a group of controls. There were two subsequent recognition tests: one immediately after the scan and one four days later. These patients actually demonstrated abnormally poor performance on the first test (within 45 minutes of encoding). They produced more false alarms than the controls on both tests. In the left hippocampus, the patients showed a greater activity difference between subsequently remembered and forgotten items than that seen in the controls. This effect was driven by a group difference in the activity associated with subsequently forgotten items: these items were associated with less activity, and a smaller proportion of active voxels, in the left hippocampus in the patients than the controls. These group differences in encoding-related brain activity were significant only for delayed test performance and not for early test performance. These results demonstrate that there are brain activity abnormalities at the stage of encoding in patients with ALF.

E110

BINOCULAR RIVALRY OF NATURAL OBJECTS: A TOOL TO STUDY THE INFLUENCES OF PRIOR EXPERIENCE ON OBJECT AWARENESS

Delphine Oudiette[1], John C. Plass[1], Emmanuel Guzman-Martinez[1], Satoru Suzuki[1], Marcia Grabowecky[1], Ken A. Paller[1]; [1]Northwestern University — Binocular rivalry occurs when two dissimilar stimuli are presented, one to each eye; conscious perception then spontaneously alternates between the two. Probabilistic-inference accounts predict that stimuli with a higher

prior probability should dominate in binocular rivalry. However, it has been challenging to study the effects of prior experience on visual competition at the level of object representation due to the difficulty of creating a large set of distinctive but dominance-balanced pairs of real-world objects. We created 28 pairs of images of objects matched for shape, size, orientation, and major contours (e.g. cigar vs. pen). To equalize low-level visual features, we converted each image to grey-scale and matched contrast and luminance independently for each pair. Nine participants observed the pairs through a stereoscope in 30-s trials. Stimuli were tinted equiluminant red or green (counterbalancing eye and color), and participants indicated by keypress which percept they saw dominantly (red or green). For each pair, we computed the mean dominance duration of the two percepts. All 28 pairs triggered surprisingly crisp rivalry with minimal piecemeal/blended perception (9% on average). Furthermore, in 15 pairs the durations of the two percepts were statistically equivalent (difference in dominance duration ranging from 0.5 to 8%). Using these 15 pairs, it is now possible to examine how prior experience influences inter-object binocular rivalry. These procedures open the door for determining the extent to which factors such as passive exposure, familiarity, and strategic attentional deployment subsequently influence stages of visual object processing that lead to awareness.

E111

SAME STRATEGY - DIFFERENT STRUCTURE: HIPPOCAMPAL AND CAUDATE VOLUME ARE DIFFERENTLY ASSOCIATED WITH NAVIGATION STRATEGY IN MEN AND WOMEN

Kristin Nordin[1], Jonas Persson[1], Eva Stening[1], Agneta Herlitz[2], Arvid Morell[1], Lars-Olof Wahlund[2], Johan Wikström[1], Hedvig Söderlund[1]; [1]Uppsala University, Sweden, [2]Karolinska Institutet, Solna Sweden — Spatial navigation performance depends on strategy, favoring hippocampus-mediated allocentric strategies employing cognitive maps over response-oriented egocentric strategies mediated by the caudate nucleus. This distinction is reflected in neural activation but also in grey matter volume. Men overall outperform women on spatial memory tasks, and frequently display allocentric-associated right hippocampal activity during navigation - however, whether strategy relates similarly to volume in men and women is unclear. Therefore, we examined sex-differences related to strategy in grey matter volume of the hippocampus and caudate nucleus. Young adults (m39/w40) performed a spatial memory task involving recalling starting position in a virtual maze, rated their strategy, and were scanned with structural MRI. Men performed better than women, and allocentric men better than egocentric men. Women performed equally across strategies. Allocentric strategy was positively related to volume in the right hippocampus in both men and women, while egocentric strategy was related to volume in bilateral caudate nucleus: positively in women and negatively in men. Comparing strategies within each sex, allocentric men had greater right hippocampal volume than egocentric men who displayed greater left hippocampal volume. In women, strategy was not reflected in lateralization but in systems; allocentric women had bigger bilateral hippocampi while egocentric women had bigger bilateral caudate nuclei. Furthermore, men could be successfully classified as allocentric or egocentric based on whole-brain volume using multivoxel pattern analysis, women could not. Strategy-use is hence indeed reflected in brain volume, but men and women using the same strategy do not automatically share the same neural structure.

E112

BOOSTING VOCABULARY LEARNING BY CUEING DURING SLEEP

Thomas Schreiner[1], Björn Rasch[2,3]; [1]University of Zurich, Institute of Psychology, Zurich, Switzerland, [2]Zurich Center for Interdisciplinary Sleep Research (ZiS), Zurich, Switzerland, [3]University of Fribourg, Department of Psychology, Fribourg, Switzerland — Experimentally reactivating memories during sleep by re-exposure to associated memory cues (e.g., odors or sounds) improves memory formation during sleep and enhances later recall. Here we tested whether cued reactivation during NonREM sleep can improve vocabulary learning. We cued prior learned Dutch words either during NonREM sleep or during active or passive waking. As we expected, re-exposure to Dutch words during sleep improved later memory for the German translation of the cued words as compared to uncued words. Cueing did not improve memory in both wake conditions. Furthermore, the benefits of cueing during sleep on memory occurred without any "costs", as recall of uncued words in the main sleep group was identical to memory performance of sleeping control participants who did not receive any cues during sleep. Finally, high-density EEG recordings revealed that successful cueing during NonREM sleep is associated with a pronounced frontal negativity in event related potentials and increased oscillatory theta power. Our results indicate that cued reactivation of foreign words during sleep enhances vocabulary learning, suggesting that cueing during sleep might prove to be an efficient tool to facilitate vocabulary learning also in an educational setting.

LONG-TERM MEMORY: Skill learning

E113

PREDICTING INDIVIDUAL DIFFERENCES IN COGNITIVE GAINS FROM VIDEOGAME TRAINING USING MACHINE LEARNING ANALYSES OF FMRI FUNCTIONAL CONNECTIVITY PATTERNS

Aki Nikolaidis[1], Nicco Reggente[2], Drew Goatz[3], Kathryn Hurley[3], Andrew Westphal[2], Arthur F. Kramer[1]; [1]University of Illinois, Urbana Champaign, Beckman Institute, [2]University of California, Los Angeles, Psychology Department, [3]University of Illinois, Bioengineering Department — One of the important questions in cognitive training, and learning and memory more broadly, is how pre-existing individual differences in brain connectivity influence the effect of training. In this study, we use the fMRI functional connectivity of multiple networks, including the frontal-parietal and motor networks, to predict individual differences in learning over the course of 30 hours of cognitive training with the Space Fortress videogame. We used various metrics of functional connectivity and graph theory-derived parameters from 45 young adult participants as features to train adaptive multivariate regression models. Using a leave-one-participant-out cross-validation procedure, we find that we can predict a significant percentage of the variance in learning performance (defined as pre-post differences in Space Fortress score). By analyzing the performance of different regression models, we find that distinct brain networks contain different types of information regarding individual differences in learning rate. Furthermore, using both support vector regression and ridge regression we demonstrate how different feature and model parameters have important effects on model performance, and we consider how these parameters may have limited previous research using such techniques. We discuss implications of our results for cognitive training, as well as the continued use of machine learning and graph theoretical analyses in cognitive neuroscience.

E114

USING EEG TO IDENTIFY NEURAL SIGNATURES OF IMPLICIT SEQUENCE LEARNING

Kelsey R. Thompson[1], Laura Batterink[1], Ken A. Paller[1], Paul J. Reber[1]; [1]Northwestern University — Implicit learning reflects a reshaping of neural circuits through extensive practice and occurs largely outside of conscious awareness. The Serial Interception Sequence Learning (SISL) task provides a relatively process-pure measure of implicit motor sequence learning. The task produces little to no explicit recognition of the trained sequence in participants. During the task, participants watch a rapid progression of moving cues and attempt to make precisely timed 4-alternative-forced-choice responses. The cues include a covertly embedded repeating sequence. Participants exhibit improved performance during the repeating sequence compared to novel sequences. Using fMRI, we found reductions in activity during performance of an implicitly learned sequence (Gobel, Parrish, & Reber, 2011). However, the temporal dynamics of neural activity associated with performing a well-practiced sequence have not been previously identified. Using a modified version of the SISL task, participants were trained on a motor sequence and subsequently tested on their sequence knowledge while their EEG was recorded. Brain potentials time-locked to cues were analyzed to reveal distinct responses to the four individual cues. Differences in the ERPs to the same cues within trained and untrained sequences were observed in occipital scalp channels, providing a detailed picture of the neural dynamics supporting implicit learning. The findings indicate that implicit sequence learning produces changes in the way cues comprising a trained sequence are visually processed, which then increases fluidity in response planning and execution.

E115

A COMPUTATIONAL MODEL FOR DOPAMINE FIRING AND CONDITIONING USING A REPRESENTATION OF FUTURE TIME

Inderdeep Singh[1], Marc Howard[1]; [1]Boston University — It has been proposed that conditioning should not be described as learning of an atomic association, but as learning the temporal relationships between the CS and the US. Moreover, it has been proposed that conditioning is time-scale invariant. We start with a mechanistic model that constructs a scale-invariant representations of future events. When a CS is presented, the representation of future events changes abruptly to indicate the future arrival of the US. The future occurrence of the US is immediately signaled---this mechanism does not require chaining of intermediate states nor does it require the prediction error signal to march back in time. We use the dynamic changes in net prediction to describe the dopamine cell response across the temporal interval in multiple reinforcement learning paradigms. At the behavioral level, the same model also provide a mechanistic model of several classic conditioning paradigms as well as generating scale-invariant conditioning.

E116

EEG ALPHA DESYNCHRONIZATION IS RELATED TO IMPLICIT LEARNING IN THE TRIPLETS LEARNING TASK.

Guangsheng Liang[1], Seth A. Kiser[1], Rebecca L. Fuller[1], Katy M. O'Neil[1], Darlene V. Howard[2], James H. Howard Jr[1,2,3]; [1]The Catholic University of America, Department of Psychology, [2]Georgetown University, Department of Psychology, [3]Georgetown University, Department of Neurology — Implicit sequence learning involves learning the likely order of events making it possible to process future events more effectively. For example, in the Triplets Learning Task (TLT) subjects observe two "cues" and respond to a third "target" by keypress on each of a series of trials. Unbeknownst to them, the first cue predicts the target on 80% of the trials (high frequency targets) and another location on 20% of the trials (low frequency targets). Learning is reflected in faster and more accurate responding to high than low frequency targets. In a previous study using electroencephalography (EEG) we demonstrated that the event-related potential N400 component had greater amplitude for low compared to high probability targets and that this difference changed with practice. Here we investigated whether spectral power in the EEG alpha frequency band (7-13 Hz) is also related to target processing in the TLT. Fourteen college-age students completed three, 500-trial sessions of the TLT while we recorded EEG. Time/frequency analysis of the EEG revealed a decrease in alpha power (alpha desynchronization) in task-relevant electrodes coincident with target onset. This occurred early in learning and increased in duration with practice. Additionally, alpha desynchronization was longer for high than low frequency targets. These results are consistent with previous research using simultaneous EEG and MRI to show that alpha desynchronization is associated with default mode network (DMN) deactivation. This suggests that alpha desynchronization in the present study may reflect a shift from DMN to task-relevant networks in the TLT.

E117

THE RESTING BRAIN PREPARES MOTOR MEMORIES FOR SUBSEQUENT CONSOLIDATION BY SLEEP

Dara Manoach[1,2], Michael Gregory[3], Yigal Agam[1,2], Chindhuri Selvadurai[1], Amanda Nagy[4], Matthew Tucker[3], Edwin Robertson[3], Robert Stickgold[3]; [1]Massachusetts General Hospital/ Harvard Medical School, [2]Athinoula A. Martinos Center for biomedical imaging, [3]Beth Israel Deaconess Medical Center/ Harvard Medical School, [4]Harvard College — There is ongoing debate concerning the function of resting-state brain activity. Prior work demonstrates that memory encoding enhances subsequent resting-state functional connectivity within task-relevant networks and that these changes predict better recognition. Here, we used functional connectivity MRI (fcMRI) to examine whether task-induced changes in resting-state connectivity predict later consolidation by sleep. In two separate sessions, resting-state scans were acquired before and after participants performed a motor task. In one session participants trained on the motor sequence task (MST), a well-established probe of sleep-dependent memory consolidation, and were tested the next day, after a night of sleep. In the other session they performed a motor control task (MCT) that involved only minimal learning. In an accompanying behavioral control study, participants trained on the MST and were tested after either a night of sleep or an equivalent interval of daytime wake. Both fcMRI and sleep control participants showed significant improvement of MST performance, while the wake control participants did not. In the fcMRI participants, increased connectivity in bilateral motor cortex following MST training predicted this next-day improvement. This increased connectivity did not appear to reflect initial learning since it did not correlate with learning during training and was not greater after MST training than MCT performance. Instead, we hypothesize that this increased connectivity processed the new memories for sleep-dependent consolidation. Our findings demonstrate that physiological processes immediately after learning predict subsequent sleep-dependent enhancement of performance and suggest that the resting brain prepares memories of recent experiences for later consolidation during sleep.

NEUROANATOMY

E118

DISENTANGLING DISORDERS OF CONSCIOUSNESS: INSIGHTS FROM DTI AND MVPA

Zhong A. Zheng[1], Nicco Reggente[1], Evan S. Lutkenhoff[1], Adrian Owen[2], Martin M. Monti[1]; [1]University of California, Los Angeles, [2]University of Western Ontario — The stratification of individuals surviving severe brain injury in Minimally Conscious State (MCS) and Vegetative State (VS) patients is, currently, entirely based on behavioral criteria. This approach is problematic for at least two reasons: (i) behavioral assessments are known to be susceptible to sizeable misdiagnosis (~40%); (ii) this stratification of patients is entirely blind to the underlying pathology. To address both issues, we employed diffusion probabilistic tractography to assess projections from thalamic nuclei in 8 MCS plus (+) patients, who exhibit high-level behavioral responses, 8 MCS minus (-) patients, who only show low-level responses, and 8 VS patients. Evaluation of thalamo-cortical connectivity revealed more connections from the lateral-group nuclei to prefrontal, motor, and sensory regions in MCS+, as compared to VS. Additionally, tractography maps from thalamic nuclei were used as patterns in a logistic regression classification scheme. Using the ventral lateral nucleus' whole-brain tractography maps as patterns, a leave-two-patients-out cross-validation correctly classified 6/8 VS patients and 7/8 MCS+ patients. This classification relied mostly on increased thalamo-frontal connections in MCS+ patients, as compared to VS. These results suggest that DTI combined with machine learning classification may facilitate the diagnostic distinction between VS and subcategories of MCS by uncovering the neural markers and pathological changes underlying disorders of consciousness.

E119

STABILITY OF THE SULCAL PATTERN OF THE ANTERIOR CINGULATE CORTEX FROM CHILDHOOD TO ADULTHOOD: A LARGE SCALE LONGITUDINAL MRI STUDY

Cloélia Tissier[1,2,3], Grégoire Borst[1,2], Marion Plaze[3], Clara Fischer[4], Jean-François Mangin[4], Marie-Odile Krebs[3], Nitin Gogtay[5], Jay Giedd[5], Olivier Houdé[1,2,6], Amin Raznahan[5], Arnaud Cachia[1,2,3]; [1]Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [2]CNRS U3521, Laboratory for the Psychology of Child Development and Education, Sorbonne, Paris, France, [3]Center of Psychiatry and Neurosciences, INSERM U894, Paris, France, [4]Computer-Assisted Neuroimaging Laboratory, Neurospin, I2BM, CEA, France, [5]Child Psychiatry Branch, National Institute of Mental Health, Bethesda, MD, USA., [6]Institut Universitaire de France, France — Brain imaging have provided compelling evidence that differences in cognitive abilities are correlated to quantitative differences in the brain anatomy (e.g. cortical ribbon thickness or the cortical surface area). These correlations reveal the dynamic interplay between brain maturation and learning/training on cognitive development but provide no information on the early constraints imposed by the structure of the brain on cognitive development. Recent works suggest that the sulcal pattern, a qualitative feature of the cortex anatomy determined in utero, provide such information. However, a strong assumption is that the sulcal pattern is a stable qualitative feature of the cortex anatomy not affected by maturation and learning occurring after birth. To provide evidence for this assumption, we studied the sulcal pattern of 75 healthy subjects at the NIMH from childhood to adulthood (263 MRIs; age range: 7.88-32.8 y.o.). Analyses were focused on the anterior cingulate cortex which can present two distinct sulcal patterns: a "single" type, with only the cingulate sulcus, or a "double parallel" type, with an

additional paracingulate sulcus (PCS). The ACC sulcal pattern type was classified from visual inspections of the three-dimensional, mesh-based reconstructions of the cortical folds. We found that the ACC sulcal patterns remained exactly the same between the baseline and the latest scan for all subjects (kappa=1). Our findings provide the first evidence that the sulcal pattern of the ACC is stable over the course of brain development, and therefore constitute a good candidate to investigate the early neurodevelopmental constraints on normal and pathological cognitive abilities.

E120

NEUROANATOMICAL AND COGNITIVE CORRELATES OF HIGH DRINKING LEVELS IN VETERANS DIAGNOSED WITH ALCOHOLISM AND PTSD Arkadiy Maksimovskiy[1,4], Regina E. McGlinchey[1,2], Catherine B. Fortier[1,2], David Salat[1,3], William Milberg[1,2], Marlene Oscar-Berman[4,5]; [1]Geriatric Research Education and Clinical Center (GRECC) and the Translational Research Center for TBI and Stress-Related Disorders (TRACTS), VA Boston Healthcare System, [2]Harvard Medical School, [3]A. A. Martinos Center for Biomedical Imaging, [4]Boston University School of Medicine, [5]VA Boston Healthcare System — Alcoholism frequently occurs in returning U.S. Veterans and is often comorbid with Post Traumatic Stress Disorder (PTSD). This study investigated the relationship between white matter abnormalities and neuropsychological performance in Operation Enduring Freedom and/or Operation Iraqi Freedom (OEF/OIF) alcoholic Veterans. Our two primary aims were: (1) to examine the relationship of alcoholism to brain structure and function, while controlling for the potential effects of comorbid PTSD, and (2) to examine whether the effects of drinking are moderated by the quantity of lifetime alcohol consumption. Our sample consisted of 71 deployed OEF/OIF Veterans stratified into four groups: alcoholics without PTSD, alcoholics with PTSD, participants with PTSD without comorbid alcoholism, and control participants without alcoholism or PTSD. Participants were given an exensive neuropsychological and psychiatric assessment battery, as well as Magnetic Resonance Diffusion Tensor Imaging (DT-MRI) scans. Results showed that disruption of executive functioning, and abnormal fractional anisotropy (FA; a measure of axonal integrity) within the frontal subcortical and dorsolateral frontal-parietal regions, occurred independently of the effects of PTSD. Furthermore, these cognitive and neuronal alterations were unique to the most severe subgroup of alcoholics who consumed the greatest amount of alcohol over the course of their lifetime, as compared to the rest of the sample. Axonal integrity within this subgroup, in regions underlying the frontal subcortical area, was shown to be decreased independently of cognitive changes. Integrity of axons underlying the dorsolateral frontal-parietal region, however, was increased. We hypothesized that the latter finding may be a compensatory mechanism for executive dysfunction.

E121

HEALTHY ELDERS CARRYING THE APOLIPOPROTEIN-E E ALLELE EXHIBIT GREATER BRAIN ATROPHY OVER 5 YEARS THAN NON-CARRIERS Katherine E. Reiter[1], Kristy A. Nielson[1,2], Sally Durgerian[2], John L. Woodard[3], Michael Seidenberg[4], J. Carson Smith[5], Christina M. Figueroa[1], Kathleen E. Hazlett[1], Christina Kay[4], Cassandra D. Kandah[4], Michael A. Sugarman[3], Andria L. Norman[3], Stephen M. Rao[6]; [1]Marquette University, [2]Medical College of Wisconsin, [3]Wayne State University, [4]Rosalind Franklin University, [5]University of Maryland, [6]Cleveland Clinic — Few studies have investigated long-term longitudinal changes in brain structure or cognitive function in healthy elders at risk for Alzheimer's disease (AD). The goal of the current project was to examine long-term changes in brain volume, using MRI, as a function of Apolipoprotein-E ε allele inheritance. Sixty-seven elders were examined with MRI and neuropsychological testing at baseline and 5 years later. Regional grey matter volumes (in percent intracranial volume) were computed by Freesurfer (v. 5.1, http://surfer.nmr.mgh.harvard.edu) for both timepoints and subtracted to change scores. Principal components analysis on regional change scores revealed 6 components. Two components significantly differed between gene groups (demographics covaried): a bilateral hippocampal component and a general, bilateral medial and dorsal cortical component (e.g., cingulate, precuneus, superior parietal, pre/post central, caudal middle frontal, paracentral, lingual gyri) showed greater 5-yr atrophy in ε carriers. Although all participants were cognitively intact at baseline, regression showed the combination of Îµ4, baseline Mini-Mental State Exam, and baseline Rey Auditory Verbal Learning Task learning performance (Trials 1-5) significantly predicted medial-dorsal volume change over 5 years. Hippocampal volume change was predicted only by ε. Thus, long-term longitudinal measures revealed that large-scale volume reductions occur in those who carry the Apolipoprotein-E ε allele, especially in medial and dorsal brain regions, some of which are commonly associated with the Default Mode Network. These reductions significantly exceed those exhibited by comparable non-carrier elders. More, lower-normal cognitive screening and learning scores are predictive of greater future global atrophy, suggesting that such individuals might benefit from early interventions.

E122

BRAIN SURFACE CURVATURE-BASED BIOMARKERS FOR DEVELOPMENTAL DYSLEXIA Danielle D. Sliva[1], Nora M. Raschle[12], Jennifer Zuk[1], Sara A. Smith[1], Bryce Becker[1], Barbara Peysakhovich[1], P. Ellen Grant[12], Nadine Gaab[12], Rudolph Pienaar[12]; [1]Boston Children's Hospital, [2]Harvard Medical School — Magnetic resonance imaging studies have reported structural differences in language-related brain regions in children and adults with developmental dyslexia (DD), as well as children with a familial risk for DD, using measures such as gray matter volume, cortical thickness and cortical surface area. Variation in cortical surface folding is implicit within all of these measures, yet can be better characterized by using surface curvature-based measures. In this study, variations in cortical surface-based curvature measures were examined in adults with (aDD+) and without (aDD-) a diagnosis of DD, children with (cDD+) and without (cDD-) a diagnosis of DD, and pre-reading children with (FHD+) and without (FHD-) a familial risk for DD. We describe changes in cortical surface curvature between groups to explore whether curvature measures can be used as a more sensitive biomarker for DD than prevailing structural measures. Cortical surface reconstructions were generated using FreeSurfer, and curvature functions were computed at each vertex. A distribution of values was then obtained for each subject, for each curvature function, across: (1) regions defined as the cortical lobes; and (2) regions defined at the intersection between lobar regions. Finally, a cluster-based analysis was performed to compare distributions across groups. Statistically significant differences were observed across a varying range of curvature measures between aDD+ and aDD-, cDD+ and cDD-, and FHD+ and FHD- groups in several regions of interest. These results suggest that cortical surface folding may provide a sensitive biomarker for DD over a broad range of ages and levels of reading development.

PERCEPTION & ACTION: Audition

E123

ATTENTION MODULATES EVENT-RELATED POTENTIAL INDICES OF THE PRECEDENCE EFFECT Benjamin H. Zobel[1], Richard L. Freyman[1], Lisa D. Sanders[1]; [1]University of Massachusetts Amherst — When presented with two identical sounds from different locations separated by a short onset asynchrony, listeners report hearing a single source at the location of the lead sound, a phenomenon called the precedence effect (Wallach et al., 1949; Haas, 1951). When the onset asynchrony is above echo threshold, listeners report hearing the lead and lag sounds as separate sources with distinct locations. Event-related potential (ERP) studies have shown that perception of separate sound sources is accompanied by an object-related negativity (ORN) 100-250 ms after onset and a late posterior positivity (LP) 300-500 ms after onset (Sanders et al., 2008; Sanders et al., 2011). The current study tested whether these ERP effects are modulated by attention. Clicks were presented in lead/lag pairs at and around listeners' echo thresholds while in separate blocks they 1) attended to the sounds and reported if they heard the lag sound as a separate source, and 2) performed a difficult 2-back visual task. Replicating previous results, when attention was directed to the sounds, an ORN and LP were observed for click pairs 1 ms above compared to 1 ms below echo threshold. In contrast, when attention was directed away from the sounds to the visual task, neither the ORN nor the LP was evident. Instead, click pairs 1 ms above echo threshold elicited an anterior positivity 250-450 ms after onset. These results indicate that attention modulates early perceptual processes in the precedence effect and may be critical for auditory object formation under these conditions.

E124

THE RELATIONSHIP BETWEEN AUDITORY SENSORY GATING AND HIGHER-LEVEL COGNITIVE FUNCTION

Monica Hill[1], Carly Yadon[2]; [1]Drexel University, [2]Missouri State University — Sensory gating refers to the brain's ability to regulate responsiveness to incoming sensory stimuli. This mechanism represents an important step in information processing because irrelevant stimuli are filtered out, allowing the brain to allot greater resources to relevant sensory material. Impaired sensory gating is prevalent in many clinical disorders (e.g., schizophrenia). However, poor gating is also common in otherwise healthy individuals. There is a dearth of studies conducted solely on this population; consequently, the effects of impaired sensory gating on healthy individuals are not well understood. Because cognitive fragmentation may occur with poor sensory gating, we hypothesized that participants with poor sensory gating would perform more poorly on an executive function battery. Behavioral data were collected using the Delis-Kaplan Executive Function System (D-KEFS) and scalp-derived electrophysiological data were recorded (Cz) during a paired-tone event-related potential paradigm. Results are reported from 43 university students who met inclusion criteria. As expected, our sample exhibited the typical sensory gating response (P50 component amplitude of second tone was less than amplitude of first tone), $t(42) = 9.15$, $p < .001$. Participants with better P50 gating received higher overall executive function scores, $r(41) = -.316$, $p = .039$, and exhibited more efficient problem-solving behaviors, $r(41) = -.400$, $p = .008$. These results suggest that sensory gating and executive function may be related. Understanding how sensory gating is related to cognitive function in healthy individuals will allow for greater understanding of how it may relate to psychopathology.

E125

RESTING STATE FUNCTIONAL NETWORKS IN TONE-DEAFNESS

Mary Kathryn Abel[1,2], H. Charles Li[2,3], Gottfried Schlaug[2,3], Psyche Loui[4]; [1]Harvard College, [2]Beth Israel Deaconess Medical Center, [3]Harvard Medical School, [4]Wesleyan University — Although music perception and production is ubiquitous across cultures and from a young age, a subset of the population cannot perceive and produce fine-grained differences in musical pitch. This disorder is commonly referred to as tone-deafness (TD), also known as congenital amusia. The affected brain network includes superior temporal gyrus (STG), middle temporal gyrus (MTG), and inferior frontal (IFG) regions, connected via the arcuate fasciculus, a white matter tract. Here we ask what intrinsic functional neural substrates might be underlying the auditory-motor system and its possible disruptions in tone-deafness. Twenty subjects (10 TD) underwent resting state functional connectivity MRI. Rs-fcMRI data showed decreased functional connectivity between the IFG and STG in TD subjects, as well as decreased functional connectivity between the right and left STG/STS. Interestingly, TD subjects showed increased functional connectivity between the frontal and the occipital lobe, suggesting visual compensatory mechanisms for this auditory deficit. In addition, graph theory analyses on pairwise functional correlations obtained from atlas-based parcellations of the rs-fcMRI data showed that TD subjects had decreased degrees, clustering, strength, and local efficiency of functional correlations across the whole brain. Taken together, results suggest that tone-deafness results from intrinsic regional disruption of network connectivity with additional effects in other brain regions, accompanied by possible compensatory mechanisms in the visual modality.

E126

EVIDENCE FOR GRADED REPRESENTATION OF VOICE ONSET TIME IN AUDITORY CORTEX

Nathaniel D. Anderson[1], Joseph C. Toscano[1], Monica Fabiani[1], Gabriele Gratton[1], Susan M. Garnsey[1]; [1]Beckman Institute, University of Illinois at Urbana-Champaign — We investigated how speech sounds are coded in auditory cortex using the event-related optical signal (EROS), a non-invasive neuroimaging method that allows neural activity to be observed with high spatial and temporal resolution (Gratton & Fabiani, 2001). A classic problem in speech perception concerns how listeners transform continuous acoustic cues (e.g., differences in voice onset time [VOT]) into discrete linguistic categories (e.g., phonemes like /b/ and /p/). Listeners' behavioral responses are non-linear, with acoustic differences near phoneme boundaries showing larger effects on categorization. This has been taken as evidence that speech is perceived categorically. However, previous ERP work has shown that early stages of perception are continuous: auditory N1 amplitude changes linearly with VOT, showing no effect of phoneme categories (Toscano, McMurray, Dennhardt, and Luck, 2010). The current study sought to localize this effect to determine whether it represents the way listeners code speech sounds in auditory cortex. Subjects heard stimuli varying in VOT between the words "beach" and "peach". EROS responses were measured using a montage of 40 near-infrared sources and 24 detectors attached to the scalp. Neural activity was measured by changes in the phase delay of light scattered back to the scalp surface. A significant linear trend across the VOT continuum was found in posterior STG around 96-120 ms post-stimulus onset. These results provide an online non-invasive demonstration that acoustic features in speech are coded continuously in auditory cortical areas.

E127

FUNCTIONAL ORGANIZATION OF THE HUMAN AUDITORY FIELDS: ACTIVATION OF AUDITORY CORTEX IN A PATIENT WITH AUDITORY AGNOSIA FROM TRAUMA TO THE INFERIOR COLLICULUS

Oren Poliva[1], Patricia EG Bestelmeyer[2], Michelle Hall[3], Janet Bultitude[4], Robert D Rafal[5]; [1]Bangor University — An fMRI investigation mapped the auditory fields that were selectively activated, or unresponsive to sounds, in a young woman with auditory agnosia due to a lesion to the inferior colliculus. The patient was unable to recognize speech or environmental sounds (or reliably distinguish them from each other) but discrimination was greatly facilitated by context. Auditory temporal resolution was severely compromised. Discrimination of words differing in voice onset time was more impaired than for words differing in place of articulation. Words presented to the right ear were extinguished with dichotic presentation; and auditory stimuli in the right hemifield were mis-localised to the left. Correlation of selective fMRI field activations with her symptoms suggested that 1) her auditory perceptual deficit is primarily due to bilateral unresponsiveness to sounds of the anterior STG and STS (auditory ventral streams); 2) her partially spared leftward-localization, audio-visual integration and phonemic perception are due to intact processing in the right posterior STG (right auditory dorsal stream); 3) the separation into ventral and dorsal streams occurs earlier than often hypothesized, already at the primary auditory cortex, with area hR projecting to the anterior STG, and hA1 to the middle-posterior STG; 4) voicing is processed in the ventral stream. We further conclude that auditory agnosia patients are capable of segregating sounds into auditory objects (i.e. syllables) but are impaired at perceiving the details of each auditory object (i.e. phonemes). Auditory agnosia patients are also capable of acoustic imagination and, therefore, have intact inner language.

E128

NEGATIVE AUDITORY CONDITIONING IN DROSOPHILA MELANOGASTER

Adrianna Krul[1], Jessyka Venchkoski[1], Alexa Gammo[1], Alexa Decker[1], Julian Keenan[1]; [1]Montclair State University — In previous studies, adult Drosophila melanogaster have been conditioned employing classical Pavlovian methods such that a positive UCS (e.g., sugar) elicits a positive CR (e.g., proboscis-extension reflex) following repeated paring with an auditory stimuli (CS+). The purpose of this research experiment was to study the abilities of third-instar Drosophila melanogaster to associatively learn with auditory stimuli. Five different hertz levels (0, 50, 100, 250, and 500) were used as the conditioned stimuli, while caffeine served as the negative, gustatory, unconditioned stimulus (UCS-). The auditory tone was placed over the half the petri dish containing caffeine, while the other half had only agar. Data was obtained by recording the placement of the larvae on an agar petri dish at timed intervals following five conditioning trials. Primary analysis of the data shows two trends. 1.) The average location of the larvae on the petri dish was farther away from the tone at 100 and 250Hz, which are known to be in the auditory detection range of melanogaster, This result indicates that the larvae were successfully conditioned at 100 and 250Hz 2.) The average movement of the larvae in the petri dish was towards the tone as time progressed. This second trend may indicate that with the 3 minute test trial, melanogaster discover that there is no longer a UCS- and CS- relationship. These data support the hypothesis (and our previous finding using UCS+ and CS+) that Drosophila melanogaster have the ability to be classically conditioned to an auditory stimulus.

E129

THE ROLE OF THE INTRAPARIETAL SULCUS IN SYSTEMATIC RHYTHMIC TRANSFORMATIONS Mary Elizabeth Sutherland[1,2,3], Robert J. Zatorre[1,2,3], Sonja A. Kotz[4,5]; [1]Montreal Neurological Institute, McGill University. Montreal, [2]BRAMS International Laboratory for Brain, Music and Sound Research. Montreal, [3]CRBLM Centre for Research on Brain, Language and Music. Montreal, [4]Max Plank Institute for Cognitive and Human Brain Sciences, [5]School of Psychological Sciences, University of Manchester — This functional magnetic resonance imaging study deals with the problem of constancy, our ability to recognize objects as the same even under different transformations, in the musical domain. Specifically, we are interested in how people can recognize a rhythm as the same even when it is played at different speeds. This skill of systematically transforming auditory stimuli has previously been investigated in the realm of melodic transposition and melodic reversal. These studies have shown both functional and structural changes in the intraparietal sulcus, a region known to be involved systematic transformations in other modalities such as mental rotation. Therefore, we hypothesized that the systematic transformation of purely rhythmic stimuli would also recruit the intraparietal sulcus. In order to investigate this hypothesis, we developed a rhythm transformation task. The behavioral results showed that the different tempo condition was more difficult than the same tempo condition ($p < .001$). These differences were reflected in the functional imaging data, which showed that recognizing a rhythm as the same or different when it was played at a different tempo led to an increased BOLD response in bilateral intraparietal sulcus and superior temporal gyrus. Additionally, we found an increased response in dorsolateral prefrontal cortex, an area involved in working memory. Taken together, our results expand the role of the IPS in systematic auditory transformations to the rhythmic domain, adding to the evidence that this area is responsible for the systematic transformation of perceptual information across different reference frames regardless of modality or of stimulus features.

PERCEPTION & ACTION: Multisensory

E130

MULTIMODAL CORTICAL MECHANISMS IN SOUND PROCESSING Garrett Cardon[1], Anu Sharma[1]; [1]University of Colorado at Boulder — Hearing occurs via both air conduction and bone conduction. That is, sound travels to the cochlea both through the air and skin and bone, via sound waves or vibration, respectively. Having arrived at the cochlea, air-conducted and bone-conducted stimuli are transduced into neural impulses that are processed by the brain as sound. Thus, it is plausible that, in addition to auditory processing, the somatosensory system is also involved in sound perception. The aim of this project was to test the hypothesis that the somatosensory cortex is involved in sound processing. In this study, we examined the cortical sources of activity underlying air- vs. bone-conducted signals. Using 128 channel high-density EEG, we evaluated cortical responses to a 250 Hz tone presented via loudspeakers and a clinically used bone oscillator. Independent components analysis (ICA) and current density reconstruction (i.e., sLORETA) revealed activation from both the auditory and somatosensory cortical systems in sound processing, though activity from the auditory cortex dominated the response. These data provide evidence of highly synchronous cooperation between the auditory and somatosensory systems during sound processing. Our results may have implications for clinical processes and research regarding cross-modal interaction between these two cortical systems in patients with hearing loss. Supported by NIH-NIDCD F31 DC013218-01A1 to G.C and NIH-NIDCD R01DC0625 to A.S.

E131

MULTISENSORY LEARNING AND INTERATION IN A FIRST-PERSON FISHMAN GAME Yile Sun[1], Barbara Shinn-Cunningham[2], David Somers[2], Robert Sekuler[1]; [1]Brandeis University, [2]Boston University — Integration of Information from multiple modalities shapes human cognition, but the limiting factors and mechanisms are poorly understood. We have examined multisensory integration in a first-person video game in which players encountered rapidly-swimming fish belonging to two different species, and made speeded categorization of each fish's species. In three experiments, fish from the two species were visually identical, but differed in rate at which they oscillate in size. Each fish could be accompanied by a broadband sound that was amplitude modulated at either 1) the same frequency (and in synchrony with) the fish's size oscillation, or 2) the frequency that would have matched the visual oscillation of a fish of the other species. This made a fish's temporal auditory and visual modulations either congruent or incongruent. To increase chances that audio-visual modulations might be perceptually integrated, we chose frequencies (6 and 8HZ) similar to speech's auditory and visual modulations: syllable rate (auditory modulation) and the rate at which the mouth opens and closes (visual modulation). Throughout, players were instructed to categorize fish solely on the visual dimension. Two experiments included control conditions in which each fish was accompanied by no sound or by a broadband sound not temporally modulated. Congruent audio-visual modulation produced responses faster and more accurate than did incongruent audio-visual modulation. Moreover, control condition's responses were indistinguishable from ones with incongruent audio-visual modulations. Our results demonstrate that temporally-correlated congruent information from multiple modalities can facilitate perceptual-based decisions.

E132

INTERACTIONS IN LOWER-LEVEL CORTICAL AREAS CAN EXPLAIN AUDIO-VISUAL ILLUSIONS: A NEUROCOMPUTATIONAL STUDY Cristiano Cuppini[1], Elisa Magosso[1], Nadia Bolognini[2,3], Giuseppe Vallar[2,3], Mauro Ursino[1]; [1]University of Bologna, [2]University of Milano-Bicocca, [3]IRCCS Istituto Auxologico Italiano — The ability of the brain to integrate information from different sensory channels is fundamental to perceive the external world. Recent experimental findings suggest that multisensory interactions occur in lower-level cortical areas at early processing stages, contrary to the classical idea of independent sensory processing streams. The mechanisms underlying these early processes and the organization of the underlying circuitries are still a matter of debate. The aim of the present work is to investigate audiovisual interactions by means of a simple neural network consisting of two layers of visual and auditory neurons. We suggest that the spatial and temporal aspects of audio-visual illusions, such as the Shams illusion and the ventriloquism effect, can be explained within this simple framework, based on two main assumptions: auditory and visual neurons communicate via direct excitatory synapses; spatio-temporal receptive fields are different in the two modalities, auditory processing exhibiting a higher temporal resolution, visual processing a higher spatial acuity. With these assumptions, the model is able: i) to simulate the sound-induced flash fission illusion; ii) to account for other audio-visual illusions, such as the sound-induced flash fusion and the ventriloquism illusions; iii) to predict that visual and auditory stimuli are combined optimally in multisensory integration. In sum, the proposed model provides a unifying summary of spatio-temporal audio-visual interactions, able to account for a wide set of empirical findings, and to represent a framework for future experiments.

E133

INFANTS ARE SENSITIVE TO AUDIOVISUAL SPEECH ASYNCHRONY Kathleen Shaw[1], Lauren Powers[1], Heather Bortfeld[1]; [1]University of Connecticut — Speech perception is multimodal, with listeners receiving information from both the auditory and visual speech signals simultaneously. Researchers have suggested that audiovisual integration develops more slowly than unimodal, with children being less sensitive than adults to asynchronous audio and visual signals (Hillock et al., 2011). However, research with infants has relied on simple stimuli, such as single CV-syllables (Lewkowicz, 2010) when assessing audiovisual sensitivity. The current study provided a more ecologically-valid test by exposing infants to tri-syllabic words that were audiovisually synchronous or asynchronous. Twenty infants, 5-9-months of age, were presented with two counter-balanced video blocks, one synchronous and the other asynchronous. For synchronous blocks, audio and visual signals were simultaneous. In asynchronous blocks, the audio signal preceded the visual signal by 300ms. Infants were median-split into younger (M = 6.23 months) and older (M = 8.2 months) age groups. A 2 (age: younger, older) x 2 (word type: visible, less visible) x 2 (proportion of looking: synchronous, asynchronous) mixed-model ANOVA was conducted. There was a main effect of word and marginal interaction of age and synchrony, with both groups of infants preferring to look at visible articulations regardless of audiovisual synchrony ($p < .05$) and older infants looking longer to asynchronous presentations, $p = .054$. In

contrast to previous work, we suggest that sensitivity to audiovisual timing is driven by the causal relationships between articulators and the sounds produced. Future directions include assessing hemodynamic responses to asynchronous presentations to determine the neural correlates of audiovisual perception in infancy.

E134

IMPACT OF VISUAL MIRROR THERAPY ON PHANTOM LIMB PAIN FOLLOWING AMPUTATION: VISUAL RESPONSIVENESS IN SOMATOMOTOR CORTEX Annie Chan[1,2], Emily Bilger[2], Sarah Griffin[1], Viktoria Elkis[2], Sharon Weeks[2], Lindsay Hussey-Anderson[2], Katie Hughes[1], Mikias Wolde[1], Howard Gilmer[3], Paul Pasquina[1], Jack Tsao[1], Chris Baker[2]; [1]Walter Reed National Military Medical Center, [2]National Institute of Mental Health, [3]National Rehabilitation Hospital — Almost 90% of amputees experience phantom limb pain (PLP) in their missing limb. Visual input from mirror therapy has been widely reported to reduce PLP - amputees place a mirror between their missing and intact limbs, then simultaneously move both the intact and phantom limbs while viewing the reflected image of the intact limb in the mirror. Research suggests that deprivation of somatosensory input can lead to cortical reorganization in somatosensory cortex, and it has been proposed that PLP may be a consequence of such reorganization. We investigated the impact of visual input on PLP and cortical reorganization in amputees undergoing four weeks of mirror therapy. Eleven lower limb amputees and controls completed three fMRI scans at two-week intervals. After the first scan, amputees began daily mirror therapy (15-mins) and recorded daily pain experiences. During each scan, we measured activation elicited by visual presentation of hands and feet. We also measured somatomotor activation for the intact and amputated limb as well as adjacent body regions. We observed differences in visually-elicited activations that were modulated over the course of mirror therapy. Visual presentation of a foot (but not hand) corresponding to the amputated limb produced stronger activation of somatomotor cortex than in controls, and the strength of this activation diminished following therapy. These results suggest that removal of somatosensory input due to limb amputation unmasks responses or inhibitory inputs in somatosensory regions, which may contribute to or be a marker for PLP, and that mirror therapy helps to reverse these changes.

E135

SPACE AND TIME IN THE PARIETAL CORTEX: FMRI EVIDENCE FOR A NEURAL ASYMMETRY Tom Gijssels[1,2], Shirley-Ann Rueschemeyer[3,4], Roberto Bottini[5], Daniel Casasanto[1]; [1]University of Chicago, USA, [2]Free University of Brussels, Belgium, [3]University of York, UK, [4]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Netherlands, [5]University of Milan-Bicocca, Italy — How are space and time related in the brain? This study contrasts two proposals that make different predictions about the interaction between spatial and temporal magnitudes. Whereas A Theory Of Magnitude (ATOM) implies that space and time are symmetrically related, Metaphor Theory predicts that they are asymmetrically related. Numerous behavioral experiments show asymmetric cross-dimensional interference between space and time in magnitude comparison or reproduction tasks. Here we investigated whether space and time modulate activity in the same neural structures in the inferior parietal cortex (IPC), and whether this activity is symmetric or asymmetric across domains. We used functional magnetic resonance imaging (fMRI) to measure participants' neural activity while they made spatial and temporal judgments on the same visual stimuli. The behavioral results replicated earlier observations of a space-time asymmetry: Temporal judgments were more strongly influenced by irrelevant spatial information than vice versa. The fMRI data indicated that encoding space and time drives the Blood Oxygen Level-Dependent (BOLD) signal in overlapping clusters in the IPC and that, consistent with Metaphor Theory, this activation was asymmetric: The BOLD signal in the shared region of IPC was higher during temporal encoding than during spatial encoding. We consider three possible interpretations of this neural asymmetry, based on three possible functions of IPC.

PERCEPTION & ACTION: Vision

E136

INFLUENCE OF VISUAL SPATIAL FREQUENCY CONTENT AND COLOR PROPERTIES ON PREFERENCE OF NATURAL AND URBAN SCENES Omid Kardan[1], Emre Demiralp[2], John Jonides[3], Marc Berman[1]; [1]The University of South Carolina, [2]Adobe Systems, Inc., [3]The University of Michigan — Previous research has shown that interacting with natural environments such as walking in a park or viewing nature images can have a beneficial effect on memory, attention and mood (Berman et al., 2008; 2012). However, there has been little research aimed to uncover the properties of natural environments that may lead to such benefits. In this study we explored the relationships between visual spatial frequency content and color properties of images from natural and urban scenes and related them with participants' preferences for those images. Variables related to spatial frequency and color content from a corpus of two hundred images with mixed natural and man-made content were measured. Regression analyses showed that more high-frequency content, fewer straight edges, more color saturation, and less hue predict greater liking. To further investigate the influence of semantic categories (nature vs. urban), we performed the same analysis for another set of images consisting of 50 high-natural and 50 high-urban scenes. Our results showed that more high-frequency content and color saturation predict more liking for the images in the urban category (replicating the previous results). However, more hue, and less high-frequency content predict greater preference in the images of nature scenes suggesting a shift of preference toward low frequency semantic content such as sky, mountains, and sea in this category. While preference does not necessarily equate to an environment leading to memory and attention benefits, this study provides a first-step in attempting to uncover the properties of natural environments that may lead to salubrious effects.

E137

MAPPING THE EMERGENCE OF CONJUNCTIVE OBJECT REPRESENTATIONS IN VISUAL CORTEX WITH FMRI Rosemary Cowell[1], John Serences[2]; [1]University of Massachusetts Amherst, [2]University of California San Diego — In the 'standard model' of object recognition, object representations are built up in stages from elemental building blocks: each successive stage in visual cortex represents conjunctions of the features represented at the previous stage. We tested this model with fMRI, by measuring BOLD activation in visual cortex elicited by hierarchically composed visual stimuli. Stimuli were constructed by defining binary visual features (e.g., low vs. high spatial frequency), combining those into simple conjunctions, and creating complex conjunctions by combining the simple conjunctions. We performed multi-voxel pattern analysis on BOLD activation patterns to assess conjunction information in each region of visual cortex. To do so, we measured the accuracy of classifying BOLD activation patterns at two levels: (1) the feature-level (2-way classification problems in which the class of a stimulus is defined by its value on a particular binary visual feature), and (2) the conjunction-level (a 16-way problem in which each of the 16 unique stimuli forms a class of its own). Next, we compared the measured conjunction-level accuracy with the conjunction-level accuracy that was predicted from the measured feature-level accuracies for the features comprising the conjunctions. If a brain region contains no information about conjunctions, the measured conjunction-level accuracy should be no greater than predicted by combining the individual feature accuracies. The measured conjunction-level classification accuracy exceeded the conjunction-level accuracy predicted from features by a greater amount in later cortical stations (e.g., V2) than in earlier stations (e.g., V1), implying an increase in 'conjunction knowledge' with progression along the ventral pathway.

E138

STIMULATING THE RIGHT FRONTAL EYE FIELD AT BETA FREQUENCIES: ELECTROPHYSIOLOGICAL CORRELATES AND IMPACT ON CONSCIOUS PERCEPTION. A PILOT TMS-EEG STUDY Marine Vernet[1], Romain Quentin[1], Lorena Chanes[1], Antoni Valero-Cabré[1]; [1]Centre de Recherche de l'Institut du Cerveau et la Moelle (CRICM), Paris, France, CNRS UMR 7225-INSERM UMRS 975-UPMC — Long considered noise, ongoing fluctuations of neural oscillations are now believed to be functionally rele-

vant. Rhythmic neurostimulation techniques such as transcranial magnetic stimulation (TMS) recently emerged as unique tools to explore such causal role of ongoing oscillations in visual cognition. We recently showed that uniform 30 Hz TMS bursts delivered pre-target onset to the right frontal eye field (FEF) increased conscious visual sensitivity. Using the same paradigm, the present study combines TMS with electroencephalography (EEG) to elucidate if: (1) uniform TMS bursts are indeed able to entrain beta oscillations; (2) their electrophysiological signature differs from that of non-uniform bursts with random frequencies; and (3) differences in baseline activity may influence the effects of neurostimulation. Healthy subjects performed a visual detection task with near threshold Gabor patches. Participants indicated if the target appeared left or right of a fixation cross, or was not perceived. Prior to target onset, uniform 30 Hz bursts of 4 pulses were delivered on the right FEF. The behavioral and EEG signature was compared to the one evoked by non-uniform bursts with random frequencies. Preliminary results suggest that uniform bursts increased visual performance and entrained beta oscillations via an increase of inter-trial coherence, suggesting a mechanism of phase alignment. In contrast, non-uniform bursts entrained oscillations in several frequency bands. Finally, the level of pre-target beta activity may be predictive of the ability of TMS bursts to enhance visual detection. Thus, TMS-EEG not only allows demonstrating the mechanism of TMS facilitation but also predicting its magnitude.

E139

PERCEPTUAL INFLUENCES ON BLOCK DESIGN TASK PERFORMANCE IN AUTISM Victoria M Doobay[1], Vanessa Bao[1], Domenico Tullo[1], Armando Bertone[1,2]; [1]McGill University, [2]Université de Montréal — Individuals with autism recurrently demonstrate faster and more accurate performance (cognitive peaks) on the Block Design Task (BDT) subtest of the Wechsler Intelligence Scale. Using a computerized version of the BDT, the current study assessed whether this characteristic peak originates from a perceptual (bottom-up) origin by manipulating the visual attributes defining the component blocks of the BDT. Secondly, this study assessed whether there is a relationship in performance difference between manual (traditional) and computerized measures of the BDT. Twenty participants with and without autism completed both traditional and computerized versions of the BDT. For the computerized version, participants were asked to match a centrally presented target design with one of 4 surrounding probes as quickly and accurately as possible, presented on a touch-sensitive screen. The visual attributes of the blocks were manipulated: traditional, red/white; luminance-defined, black/white; or texture-defined blocks. The perceptual coherence of blocks, was also manipulated, where low-coherence (LC) designs necessitated increased local analysis relative to high-coherence (HC) designs. Reaction times in the LC condition were significantly lower in the autism group (i.e., cognitive peak) for the black/white luminance condition only. Correlations between the manual and computerized BDT performance were negative, demonstrating that there is no relationship between performances on these two versions of the test. These results indicate that the characteristic, higher-level visuo-spatial performance in autism, as exemplified by cognitive peaks, may have a perceptual (bottom-up) rather than cognitive (top-down) origin. These results can inform clinical decisions regarding the perceptual and cognitive strengths in individuals with autism.

E140

EXPLORING THE REPRESENTATIONAL GEOMETRY OF OBJECT REPRESENTATION IN THE VENTRAL STREAM USING BRAIN-BEHAVIOR CORRELATIONS Michael Cohen[1], Talia Konkle[1], Ken Nakayama[1], George A Alvarez; [1]Department of Psychology, Harvard University — The visual processing stream contains regions that selectively respond to different objects, and the representational geometry within each region can be measured by the similarity of responses across different items. Here we asked if interference between objects in a perceptual task is predicted by the representational geometry across different regions of the visual system. Participants performed a visual search task with eight categories. We measured the time to find a target from one category among distractors from a different category, (e.g. one face among seven chairs), for all possible category pairings. These reaction times were used as an index of perceptual similarity, yielding an 8x8 behavioral similarity matrix. Six new participants underwent functional neuroimaging while viewing individual items from each category. We computed the correlation in responses for all category pairings, yielding an 8x8 neural similarity matrix for each region. We found a significant correlations between behavioral and neural similarity in ventral-temporal (r=0.62), lateral-temporal (r=0.48), and dorsal-parietal cortex (r=0.28), but not early visual cortex (r¬=-0.07). To explore the spatial locus, each region was divided into ten ROIs based on overall voxel activity. The correlations in these sub-regions remained high throughout ventral-temporal and lateral-temporal cortex (rs>0.39; Ps<0.05). This uniformity in the brain-behavior correlations across the ventral stream is surprising given the well-known differences in response selectivity, and suggests that different regions of this cortex may be emphasizing different aspects of a common perceptual feature space. Broadly, these results suggest that the representational geometry across high-level ventral visual cortex constrains object perception.

E141

SHARK OR MARINE ANIMAL? DETECTION AND RECOGNITION ACROSS CATEGORICAL LEVELS IN RSVP Carl Hagmann[1], Mary Potter[2]; [1]Massachusetts Institute of Technology, [2]Massachusetts Institute of Technology — Although pictured objects and scenes can be understood in a brief glimpse, there is a debate about whether the categorical level at which they are first encoded is the basic level proposed by Rosch (1976) or a superordinate level. Participants attempted to detect a target presented among six pictures using RSVP at 80, 53, 27, or 13 ms/picture. The target was specified by one of 28 superordinate names (e.g., marine animal) or by a corresponding basic-level name (e.g., shark). The name appeared either before or after the picture sequence, between groups. Detection (d') was significantly above chance in all conditions, including 13 ms. There was a main effect of presentation duration that did not interact with group or level. Detection in the name-before group was more accurate with the basic-level than the superordinate name, showing that specific advance information facilitated visual encoding. In the name-after group the two levels did not differ significantly, suggesting that encoding had occurred at the basic level during presentation. The results are consistent with the claim that the basic level is usually the entry level for object perception.

THINKING: Decision making

E142

NEURAL SYSTEMS INVOLVED IN RULE LEARNING AND SWITCHING Hillary Wehe[1], Zhiya Liu[2], Kurt Braunlich[1], Carol Seger[1]; [1]Colorado State University, Fort Collins, Colorado, [2]South China Normal University, Guangzhou, China — In this study we explore the cognitive processes of hypothesis testing, rule application, and rule switching in order to dissociate neural networks active in each. During fMRI scanning, participants categorized letter stimuli that could be sorted by eight individual features (e.g. color, size, font). Participants had to learn which feature to sort by through feedback. Once each rule had been learned, subjects were cued via either negative feedback or visual cues to shift to a new rule. Learning was divided into three phases: Shifting (orienting to the new task), Hypothesis Testing, and Rule Application (correct responding after the rule was learned). Conditions were compared using the General Linear Model (GLM); overall, frontoparietal networks and the basal ganglia were active during hypothesis testing, and ventral striatum during Shifting, Constrained principal component analysis (CPCA) identified three primary networks involved during the task. The first was most active during Shifting, and included large regions of the lateral frontal cortex and superior parietal lobe. This network may have been involved in switching to a hypothesis testing strategy and/or formulating a new hypothesis. The second extended across the entire Hypothesis testing phase, and decreased during Rule Application. It included regions of the inferior parietal lobe and medial parietal cortex. A third network included areas commonly associated with the default network, including medial parietal and medial frontal cortex and the angular gyrus. It increased in activity during Rule Application, consistent with participants being able to reduce their focus on the experimental task.

E143

ELECTROENCEPHALOGRAPHIC IDENTIFICATION OF NEUROCOGNITVE DEFICITS WITHIN CONCUSSED ATHLETES Chan Hee Lee[1], Jessican Peterson[1], Cheyenne Layman[1], Karch Connors[1], Jessica Bove[1], Joel Bish[1]; [1]Ursinus College — Concussions can be the result of blunt force or blow to the head. These often cause changes in the chemical balance within the brain which in turn affect the behavior and cognitive ability of affected individuals. The impairments differ in duration from a few hours, to weeks or even months and years. Sports related activity is currently the largest cause of concussions. This study used electroencephalography (EEG) as well as cognitive/behavioral testing, to identify potential differences between student athletes with a history of concussion(s) and student athletes without a history of concussion(s). During an EEG analysis, participants completed a series of tests intended to investigate impulse control abilities and basic memory capacities. Using event-related potentials and spectral analysis, the levels of brain bands (alpha, beta, theta, delta) over frontal and parietal electrode sites of the brain were evaluated. Significant lower levels of bands (theta, alpha, delta) within concussed athletes were observed. Concussed individuals also exhibit slower reaction times to each cognitive task. Additionally, significant correlations between the power of the synchronized activity over the frontal lobes and reduced cognitive efficiency were exhibited particularly in those tasks requiring impulse control and executive function. Previous research has shown theta and alpha bands have been correlated in understanding inhibition to elicited responses. Lower levels of theta bands may suggest a decreased inhibition to these responses. Concussed individuals produce similar delta waveforms to those that have a history of sleep deprivation and/or prolonged disturbed sleep also previously shown to be a symptom of concussions.

E144

DOPAMINE MODULATES EFFORT- AND STAKE-INCENTIVISED DECISION MAKING Trevor T-J Chong[1,2], Valerie Bonnelle[1], Sanjay Manohar[1], Kai-Riin Veromann[1], Kinan Muhammed[2], Masud Husain[1,2]; [1]Department of Experimental Psychology, University of Oxford, Oxford OX1 3UD, [2]Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford OX3 9DU — Humans adapt the degree of effort they are willing to expend according to the rewards they expect to receive. Data from animal studies suggest dopamine might be a key neurotransmitter involved in such incentivised decision-making. Here, we examined the role of dopamine in choice behaviour when participants are required to decide how much effort they are willing to exert for different magnitudes of reward. Parkinson's disease patients (n=20) were tested ON and OFF their usual dopaminergic medication. On each trial, they had to decide whether they would be willing to exert one of six pre-specified levels of effort (as measured by force exerted on a hand-held dynamometer) to obtain one of six pre-specified stakes that were offered. For each patient, we calculated both the effort level and stake magnitude at which they were willing to exert the pre-specified force on 50% of occasions (the Effort and Stake "ndifference Points"). Our key finding was that patients had higher Effort Indifference Points and lower Stake Indifference Points when ON their usual dopaminergic medications relative to OFF. These findings are not explained by differences in physical strength between the two sessions. The results indicate that dopamine increases the willingness of patients with Parkinson's Disease to invest a greater amount of effort for a given stake, and conversely lowers the stakes for which patients are willing to expend a given amount of effort. Overall, this demonstrates that dopamine can enhance motivation towards effortful actions and willingness to work for reward in humans.

E145

VENTROMEDIAL PREFRONTAL CORTEX IN AMBIVALENT ECONOMIC DECISION-MAKING Linda Yu[1], Sangil Lee[1], Joseph Kable[1]; [1]University of Pennsylvania — The ventromedial prefrontal cortex (vmPFC) has been implicated in calculation and comparison of the subjective value of choice options, and in decreased susceptibility to contextual influences. Patients with vmPFC damage show a slightly pronounced asymmetric dominance effect, a well-known contextual influence on preference. It has been hypothesized that the asymmetric dominance effect may be a rational response to incomplete (or unknown) preferences. This raises the possibility that the asymmetric dominance effect in vmPFC patients arise from incomplete preferences. To further test this idea, we developed a series of tasks to differentiate incompleteness from another form of ambivalence, indifference (regarding options as equal in value). We trained healthy controls on two sets of symbols that corresponded to monetary amounts in different fictional currencies. They then had to make a series of choices within symbols of the same currency (indifference), and across different currencies without knowing the exchange rate between them (incompleteness). When participants were presented with choices between equivalent amounts, they were more likely to allow the computer to make their decisions for them in the within-currency condition, but not in the across-currency condition. In addition, when they are presented with the choice between a lower and a higher amount option, they were more likely to select the latter in the within-currency condition compared to the between-currency condition. Ongoing work is exploring whether the choices of vmPFC patients are more similar to the pattern associated with incomplete or indifferent preferences.

E146

WHY THE NEXT BIG WIN WILL NOT HELP YOU STOP: ERP CORRELATES OF GAMBLING BEHAVIOR Kevin Alexander[1], Heather Bruett[1], Dolores Cutler[1], Andrew Leynes[1]; [1]The College of New Jersey — Event-related potentials (ERPs) were recorded during a simple gambling tasks in which subjects wagered small amounts of money ($.05 or $.25) on each trial. On a subset of trials, the outcome (gain or loss) was known before the wager, and on another subset of trials they were forced to bet either the high or low amount (no choice condition). All trials elicited an outcome related positive ERP (ORP) peaking at about 400 ms which was larger for gain relative to loss trials; thereby, replicating previous ERP studies (e.g., Kamarajan et al., 2009: BBS, 197, 62-76). Interestingly, this ERP was smallest when the outcome was known in advance and reduced on trials with force-choice betting. The gain vs. loss ERP difference was significant only for gambling trials. These differences suggest that the physiological response to gambling is driven by the uncertainty more than the actual outcome (gain vs. loss).

E147

FRAMING EFFECTS ON PREFERENCES IN APPETITIVE AND AVERSIVE CHOICE SCENARIOS Colleen Finnerty[1], Catherine Hanson[1], Stephen Jose Hanson[1]; [1]Rutgers University — Recent research has characterized decisions about tangible rewards such as money and food. However, little is known about behavioral or brain dynamics when decisions involve no tangible reward. In the present study, participants made hypothetical choices between appetitive and aversive options. In the appetitive task, 9 participants chose between pairs of options self-selected to be either high or low value (e.g. travel destinations, sports), under either positive or negative framing ("which do you like more/less"). In the aversive task, 15 participants chose between options they perceived to be either higher or lower in severity (e.g. illnesses, car accidents), again under positive and negative framing ("which would you rather have/avoid"). A separate group of 10 participants then underwent fMRI scanning while performing the appetitive framing task. As predicted, response time for negative/loss framed scenarios was significantly longer than for positive/gain framed scenarios in both the appetitive and aversive tasks. Neuroimaging analysis showed differential response between conditions during appetitive framing. There was greater activation in ventromedial prefrontal cortex (PFC) in negative framing and dorsolateral PFC during positive framing. Graph analysis was performed to quantify effective connectivity differences between conditions in areas including striatum, anterior cingulate, insula, and PFC. Differences were observed in the number, strength, and directions of connections in positive compared to negative framing. Taken together, these results suggest that framing has reliable effects on choices for preferences, regardless of valence, and even when those decisions occur without action-outcome contingencies.

E148

RISKY DECISION-MAKING IN TEENAGE GIRLS: THE INFLUENCE OF PUBERTAL HORMONES, REWARD MAGNITUDE, AND SOCIAL COMPARISON Zdena Op de Macks[1], Silvia Bunge[1], Lance Kriegsfeld[1], Andrew Kayser[2], Ron Dahl[1]; [1]University of California, Berkeley, [2]University of California, San Francisco — This study examines the role of pubertal devel-

opment, reward magnitude, and social comparison in adolescent risky decision-making and associated brain processes. In a revised version of the Jackpot task (Op de Macks et al., 2011), 64 healthy, female adolescents aged 11-13yrs chose to "play" the game or "pass" based on information about risk (low/high), reward magnitude (small/large), and type of feedback (social ranking/money). Decisions to "play" were influenced by risk and reward magnitude. Among girls in mid/late puberty, as defined by the Pubertal Development Scale, decisions were differently influenced by social and monetary feedback, whereas early pubertal girls made similar decisions in both contexts. Salivary gonadal hormone assessments revealed that girls with higher testosterone levels made more decisions to "play" in the high-risk, small-reward condition. Preliminary whole-brain analyses (n = 45) focusing on regions engaged more strongly for rewards vs. losses revealed ventral striatum across the social and monetary feedback conditions, orbitofrontal and dorsolateral prefrontal cortices (OFC, DLPFC) in the social ranking condition, and amygdala and ventrolateral PFC (VLPFC) in the monetary condition. Losses vs. rewards engaged VLPFC in the monetary condition, and lateral OFC and DLPFC in the social condition. While making risky decisions, risk-avoidant girls showed stronger activation in control-related regions (lateral PFC and anterior cingulate cortex), whereas risk-taking girls showed stronger activation in affective regions (striatum and medial PFC). These initial findings provide insights regarding the neural and hormonal underpinnings of social influences on risky decision-making in peri-pubertal girls.

THINKING: Reasoning

E149

WHERE SMART BRAINS ARE DIFFERENT: A META-ANALYSIS OF BRAIN IMAGING STUDIES ON INTELLIGENCE

Kirsten Hilger[1], Christian J. Fiebach[1,2,3], Ulrike Basten[1]; [1]Goethe University, Frankfurt am Main, Germany, [2]IDeA Center for Individual Development and Adaptive Education, Frankfurt am Main, Germany, [3]Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen, The Netherlands — Individual differences in general intelligence have been associated with differences in brain structure and function. Based on a review of both structural and functional brain imaging studies on intelligence, a popular theory - the Parieto-Frontal Integration Theory of Intelligence (P-FIT, Jung & Haier, 2007) - describes a network of frontal and parietal brain regions as the main neural basis of intelligence. Here, we put the P-FIT to an empirical test by conducting a voxel-based quantitative meta-analysis of 18 functional and 20 structural imaging studies published until 2013. The quantitative approach allows testing for spatial convergence of effects across studies and yields exact localizations for clusters of common foci in a standard brain space. We focused our analysis on studies that reported coordinates in standard brain space for an association between an established test of psychometric intelligence and either (a) brain activation during a cognitive task (functional meta-analysis) or (b) a measure of morphological brain attributes (structural meta-analysis). The functional meta-analysis resulted in seven clusters distributed across both hemispheres, located in lateral frontal, medial frontal, parietal, and occipito-temporal cortices. The structural meta-analysis resulted in two clusters in the left hemisphere, located in frontopolar and inferior occipital cortex. A pooled meta-analysis, considering both functional and structural foci, also yielded a set of fronto-parietal regions. In sum, this first quantitative meta-analysis of brain imaging studies on intelligence, using all currently available reports, confirms the importance of fronto-parietal networks in explaining inter-individual differences in intelligence that was postulated earlier in the P-FIT.

E150

DAMAGE TO THE VENTROMEDIAL PREFRONTAL CORTEX INCREASES LENIENCY OF PRISON SENTENCING TOWARDS INDIVIDUALS WHO COMMIT VIOLENT CRIMES

Kelsey Warner[1], Erik Asp[1], Daniel Tranel[1]; [1]University of Iowa — Studies using attitude measures have shown that patients with damage to the ventromedial prefrontal cortex (vmPFCs) present a "doubt deficit" that manifests as higher authoritarianism. Individuals high in authoritarianism submit easily to authorities and are often aggressive towards others in the name of authority. The Criminal Judgment Task was used as a behavioral measure of authoritarianism in vmPFCs. VmPFCs (n = 10), brain-damaged comparisons (BDC, n = 24), and normal healthy comparisons (NC, n = 31) were presented with fictitious criminal vignettes of putatively "real criminals" and details about their crimes. Individuals responded to each report by sentencing the criminal with a prison term. Since vmPFCs are unable to garner "doubting safeguards" revealed in patterns of higher authoritarianism, it was hypothesized that these individuals would be more punitive in their judgments towards criminals. Results revealed that vmPFCs were more lenient in their criminal judgments than BDCs and NCs. Further analysis indicated that this leniency was moderated by whether or not the crime had a victim. This suggests that vmPFCs fail to take the perspective of victims of violent crimes. The False Tagging Theory (FTT), a neuroanatomical model of belief and doubt, asserts that the prefrontal cortex is critical for doubting initially believed cognitive representations. According to the FTT model, vmPFCs fail to take the perspective of others due to an inability to adjust from their viewpoint towards that of another. These findings implicate the critical nature of the prefrontal cortex in the assignment of culpability to criminal actions.

E151

ABSTRACT ANALOGICAL REASONING IN HIGH-FUNCTIONING CHILDREN WITH AUTISM SPECTRUM DISORDERS

Natalie Gallagher[1], Benjamin Yerys[3], Lauren Kenworthy[2], Mosner Maya[3], Fearon Edward[1], Balhana Carlos[1], Green Adam[1]; [1]Department of Psychology, Georgetown University, [2]Center for Autism Spectrum Disorders, Children's National Medical Center, [3]Center for Autism Research, Children's Hospital of Philadelphia — Identifying abstract similarities between superficially different experiences enables children to form regularities (rules and expectations) that they can rely on to navigate their world. Children with autism spectrum disorders (ASD) often do not spontaneously recognize abstract similarities, focusing instead on surface-level features. This likely contributes to deficits in the development of appropriate schemas for navigating novel situations, including social interactions. Analogical reasoning is the central cognitive mechanism that enables typically developing children to understand abstract similarities between different situations. Intriguingly, studies of high-functioning children with ASD point to a relative cognitive strength in basic, non-abstract forms of analogical reasoning. If this analogical reasoning ability extends to abstract analogical reasoning, then it may provide a bridge between a cognitive strength and core ASD deficits. We explored this possibility by testing children with ASD and typically developing controls on explicitly instructed (i.e., non-spontaneous) abstract analogical reasoning with real-world pictorial images. The relative abstractness of the analogies was determined via a quantitative measure of semantic distance derived from latent semantic analysis. Children with ASD performed as well as typically developing children, including performance on abstract (semantically distant) analogical reasoning. Children with ASD, but not typically developing children, showed an effect of age on semantically distant analogical reasoning. Semantically distant analogical reasoning ability predicted social function as measured by the Social Responsiveness Scale. These data provide new indication that children with ASD are capable of identifying abstract similarities through analogical reasoning, and that this ability can be leveraged to improve social function.

Poster Session F

ATTENTION: Other

F1

NEURAL CORRELATES OF THE COST OF DISTRACTOR DISENGAGEMENT Benjamin Dorn[1], Jyoti Ramanathan[1], Jacob Bollinger[1], Adam Gazzaley[1]; [1]UCSF — Several studies have shown that distractions impede goal-relevant processing and behavior. Recent studies suggest that the impact that distracting stimuli have on performance is not mediated by the susceptibility for attentional capture, but rather the speed in which one recovers from capture; i.e., the disengagement from distraction. We studied the neural basis of this phenomenon using high-density EEG recordings simultaneous with a task in which peripheral visual distractors precede presentation of a target array. We find that distractors significantly engage visual processing prior to target presentation. Further, the extent of visual engagement by a distractor prior to the target predicts the negative impact on target discrimination performance. These results will be presented in the context of different latencies of pre-target distractor presentations.

F2

THE TEMPORO-PARIETAL JUNCTION NODE OF THE VENTRAL ATTENTION NETWORK IS BILATERAL AND SUBDIVIDED INTO ANTERIOR AND POSTERIOR PATCHES. Kathryn J. Devaney[1], Emily J. Levin[1], Maya L. Rosen[1], Samantha W. Michalka[1], Lingqiang Kong[1], David C. Somers[1]; [1]Boston University — The ventral attention network (VAN) functions as a "circuit-breaker" to facilitate stimulus-driven reorienting of attention. Previously, this network has been described as right-lateralized and comprised of the tempo-parietal junction (TPJ), the inferior frontal gyrus and the inferior frontal junction. Frequently, the VAN is localized with fMRI by comparing the BOLD response to stimuli in expected vs. unexpected locations. Here, we used a novel localizer task incorporating unexpected (oddball) images to quickly and reliably localize the VAN in individual subjects (n = 12). Our results indicate a bilateral TPJ with a posterior patch (pTPJ) in the dorsal superior temporal sulcus and an anterior patch (aTPJ) in the supramarginal gyrus. Although both anterior and posterior TPJ are responsive to oddball stimuli, they display distinct functional connectivity profiles. During the resting state, the pTPJ, but not the aTPJ, is temporally correlated with early visual areas. Both aTPJ and pTPJ are connected with medial nodes of the cognitive control network, and with each other. These results indicate functional specialization within what was previously believed to be a single node of the VAN, and suggest multiple follow-up questions to further elucidate our understanding of the human attention system.

F3

CHANGES IN P100 AMPLITUDES TO ALCOHOL IMAGES IN FRESHMAN FEMALES ARE MODERATED BY ETHNICITY AND ALCOHOL-RELATED ATTITUDES Kyle Thurin[1], Natalie Ceballos[1], Reiko Graham[1]; [1]Texas State University Department of Psychology — The transition from the home to the college environment increases exposure to alcohol, in turn increasing the risk for problem drinking. Relatively little is known about how this transition affects young women, Latinas in particular. We assessed changes in event-related potentials (ERP) to alcohol images in 42 freshman females using a 3-stimulus oddball paradigm. Freshman females (24 Non-Hispanic/Caucasian, 18 Hispanic/Latina, mean age = 18.0) completed 2 sessions approximately 6 months apart. In each session, participants completed self-report questionnaires and two versions of the task (counterbalanced): one where alcohol images were designated as target stimuli, another with non-alcohol images as targets. No changes in alcohol consumption and alcohol-related attitudes were observed over time. ERP analyses focused on the P100, a marker of exogenous visual attention and revealed an attenuation of P100 amplitudes over time. For Hispanics/Latinas, P100 amplitudes were higher for alcohol images at both Time 1 and Time 2, and P100 attenuation did not differ as a function of stimulus type. For Non-Hispanics/Caucasians, P100 amplitudes were equivalent for alcohol and non-alcohol images at Time 1 and attenuation over time was less for alcohol images. Exploratory correlations revealed that positive and negative attitudes towards alcohol were predictive of P100 amplitudes at Time 1, whereas only negative attitudes were predictive at Time 2. Results suggest that prior exposure to alcohol images, as long as 6 months prior to re-testing, results in attenuation of the P100. Furthermore, attitudes toward alcohol influence the salience and subsequent visual processing of alcohol-related stimuli.

F4

REFLEXIVE ORIENTING TO HAPPY AND DISGUSTED GAZING FACES AND TOBACCO TARGETS IN SMOKERS AND NONSMOKERS Matthew Light[1], Natalie Ceballos[1], Shelby Bertsch[1], Ben Euhus[1], Reiko Graham[1]; [1]Department of Psychology, Texas State University — Evidence regarding the moderating role of facial expression on gaze-triggered orienting has been mixed, suggesting that experimental context and task demands are important factors in these effects. This study examined how attitudes toward tobacco and smoking status might influence gaze and expression interactions in an attentional orienting task with expressive gazing cues and tobacco/non-tobacco targets. Eighty-three participants (61 nonsmokers, 22 smokers; Mage = 20.7 years) completed a Posner-style cuing task wherein expressive faces (disgusted vs. smiling) either validly or invalidly cued the location of cigarettes or pens. Smokers and nonsmokers did not differ with respect to negative attitudes toward tobacco; however, smokers were less likely to endorse positive attitudes. Repeated measures ANOVA of mean reaction times to identify targets revealed that nonsmokers were faster to identify cigarette targets than smokers. Main effects of cue expression and validity were mitigated by an interaction, such that cuing was only present for disgusted faces. There was also a target type by validity interaction: the cuing effect was only present for control images. Error analyses revealed that smokers were more likely to misidentify tobacco images cued by disgusted faces. Exploratory correlations revealed that positive tobacco attitudes were associated with fewer errors to tobacco targets cued by disgusted faces, whereas negative attitudes were related with more errors to tobacco targets cued by happy faces. These results suggest that experimental context is an important determinant of gaze / expression interactions and gaze-triggered orienting, as are pre-existing attitudes toward target objects.

F5

BLUE LIGHT MODULATES EEG ALPHA ACTIVITY HongChae Baek[1], Insoo Kim[1], Hyensou Pak[2], Yeon-Hong Jeong[2], Byoung-Kyong Min[1]; [1]Department of Brain and Cognitive Engineering, Korea University, Seoul 136-713, Republic of Korea, [2]LGE Advanced Research Institute, LG Electronics Inc., Seoul 137-724, Republic of Korea — We experience that lighting conditions influence on our daily physiological and psychological phenomena. Light substantially affects brain functions through modulation of alertness and performance. In the present study, we used monochromatic blue light exposure to promote alertness during the post-lunch dip hours. In order to investigate lighting designs that are actually applicable in a real workplace, we used 33.33 % (x=0.2364, y=0.1765 on CIE chromaticity) and 66.66% (x=0.1787, y=0.0828 on CIE chromaticity) blue-enriched lights. The peak wavelength of blue was 451nm. EEG data were collected from 10 healthy individuals while they performed a continuous performance task under 4 different illumination conditions: white, dark, light blue (33.33% blue-enriched), and dark blue (66.66% blue-enriched). All measures were analyzed with a repeated measures analysis of variance, which included a within-subjects factor (illuminance). We observed a gradual increment in the upper alpha power (10 to 13Hz) as the blue-enriched component was gradually enhanced ($F(3,27)=4.773$, $p<0.01$; dark=1.15ã□¶2; 33% blue= 1.37ã□¶2; 66% blue= 1.52ã□¶2; white= 2.24ã□¶2). Since upper alpha activity reflects cognitive processes such as perceptual performance, blue light seems to modulate the efficacy of our work-performance. Further studies on illumination parameter-dependent efficacy of the cognitive performance are necessary to develop appropriate applications to enhance the efficacy of our work-performance.

F6

COMPARING THE ORIENTING OF ATTENTION TO TWO TYPES OF TASK-IRRELEVANT AUDITORY STIMULI UNDER VARYING LEVELS OF TASK LOAD: IMPLICATIONS FOR MEASURING ATTENTIONAL RESERVE Matthew Miller[1], Amber Leiker[1], Kirk Grand[1], Andrew Thompson[1], Ford Dyke[1], Maurice Godwin[1], Jeremy Rietschel[2], Craig McDonald[3]; [1]Auburn University, [2]Veteran's Health Administration, Baltimore, Maryland, [3]George Mason University — The availability of spare attentional resources (attentional reserve) during task performance determines the ability to process unexpected events. Thus, the development of a metric of attentional reserve is of interest. Attentional reserve can be indexed by the magnitude of attentional orienting to task-irrelevant auditory stimuli, as reflected by the amplitude of the P3a component of the event-related potential. As such, the utility of the P3a in indexing attentional reserve is dependent upon the ability of stimuli to elicit contrasting degrees of attentional orienting under varying task conditions. Therefore, an important question is which types of task-irrelevant auditory stimuli most effectively elicit attentional orienting? To begin to answer this question, an experiment was conducted in which participants engaged in the videogame Tetris under incrementally-varied levels of task load while being probed at random times with one of two different types of task-irrelevant auditory stimuli: an ecologically-valid sound or a pure tone. Attentional orienting to the stimuli, as reflected by P3a amplitude, was contrasted among Tetris levels to determine which stimulus was most effective in yielding load-dependent changes in orienting. P3a amplitude to the ecologically-valid sounds significantly decreased as a function of task load, whereas P3a amplitude to the pure tones did not. This suggests that ecologically-valid sounds are more effective at eliciting contrasting degrees of attentional orienting under varying task load than pure tones; and, as such, ecologically-valid sounds are more effective in indexing attentional reserve.

F7

AUTOMATIC ACTIVATION OF SEMANTIC COLOUR CONCEPTS MODULATES ATTENTIONAL SELECTION Sol Z. Sun[1], Jenny Shen[1], Mark Shaw[1], Susanne Ferber[1]; [1]University of Toronto — Object information is represented as a distributed pattern of activation for different physical and semantic features with related physical characteristics and concepts sharing overlapping neural networks. Behaviourally, it has been shown that words can prime other words based on similarity in shape and in action affordances, making these primed words easily accessible for other aspects of cognition. The results for colour word priming have been less clear, possibly owing to contextual effects of different paradigms. However, colour is a strong featural characteristic that can direct attention based on top-down mediated control sets. We sought to investigate how the representational activation of colour (e.g., presenting the word "frog") would affect search times on a secondary visual search task and how this interacts with visual working memory (VWM). Participants began each trial by studying a memory array of either one (low load) or three (high load) words. In the high load condition, all three words shared colour concept information (e.g., forest, algae, frog), although this information was irrelevant to task performance. Next, the items were removed from the display and during this delay period, participants engaged in an intervening visual search task with target items congruent, neutral, or incongruent with the colour information of words held in memory. We found faster response times for the congruent item in both low and high-load conditions. These results suggest that words held in VWM are automatically processed to the semantic level, activating the shared representational feature, leading to facilitative effects spreading to subsequent attentional tasks.

F8

ASSESSING COGNITIVE LOAD USING A THREE-DIMENSIONAL MULTIPLE OBJECT TRACKING TASK. Domenico Tullo[1,2], Jocelyn Faubert[3,4], Armando Bertone[1,2]; [1]The Perceptual Neuroscience Laboratory (PNLab) for Autism and Development, [2]McGill University, [3]Laboratoire de psychophysique et de perception visuelle, [4]Université de Montréal — As attentional abilities become more efficient, the individual's requisite for attention during academic task completion declines. This results in the general reduction of the cognitive load of the task, which leads to an increased probability of a successful performance (Maddox, Bohil, & Ing, 2004). One component of the attentional process is the ability to selectively attend to specific targets while ignoring others, a process referred to as selective attention. The use of a three-dimensional multiple object-tracking task (3D-MOT) can be used as an accurate measure of everyday attentional processing. In the present study, measuring performance on a 3D-MOT task while manipulating the number of targets to be tracked, determined participants' processing capacity, or cognitive load. Eleven adult participants (7 M, 4 F) were asked to follow 1 through 4 target spheres (separate trials) among 8 distractor spheres moving randomly in a virtual volumetric space during an 8 second trial. Depending on correct or incorrect responses, the speed of spheres changed for each trial until threshold performance was attained, defined by the average speed at which target spheres for each condition (1 through 4) could be tracked. An analysis of variance revealed that increasing the number of objects tracked significantly decreased performance ($p < .001$) in a linear fashion. In addition to our finding suggesting that performance on the 3D-MOT is a good indicator of cognitive load, we are presently assessing the differences across development as well as the role of feedback using the same 3D-MOT paradigm.

F9

ATTENTIONAL SELECTION CAN BE AUTOMATIZED BY LEARNING Mahalakshmi Ramamurthy[1], Erik Blaser[1]; [1]University of Massachusetts, Boston — The selective processing of visual information, through attention, is based on bottom-up biases and top-down intentions. Here we sought evidence for a third way, through learned rules that are implemented automatically, without cognitive supervision; what we term "dark attention". Methods: Our main goal was to find evidence for selection in the absence of bottom-up demands and top-down intentions. We used the duration of the motion aftereffect (MAE) as a passive assay of selective resource allocation. In our main condition, observers saw two superimposed fields of limited-lifetime dots, green and red, moving coherently to the left and right, respectively. Such a stimulus is physically balanced and should yield no net MAE (as tested by a static test field of red/green dots), unless the observer selectively attends to one field. In our attempt to train a new selection rule, eight observers participated in a three-day training paradigm where they explicitly attended to the red field (encouraged through: direction detection task on the attended field). Before training, MAE's were measured while observers concurrently performed an auditory two-back memory task (a distracting task aimed at disrupting top-down selection); MAE's were minimal as expected (Mean: 0.37s; SE: 0.10). Following training, observers were retested in the same condition. Results: show that, despite of maintaining physical salience (sidestepping bottom-up selection), and being distracted by the two-back task (preventing top-down selection), MAE's were significantly increased without a significant decrease in the auditory performance (Mean: 2s; SE: 0.47; two-tailed t-test =-3.45; p= 0.01): an existence proof for dark attention.

EMOTION & SOCIAL: Development & aging

F10

TRAIT IMPULSIVITY AND REWARD-RELATED BRAIN ACTIVATION IN ADOLESCENCE Merav Silverman[1], Robert Krueger[1], William Iacono[1], Stephen Malone[1], Ruskin Hunt[1], Kathleen Thomas[1]; [1]University of Minnesota — Background: Research using fMRI suggests increased ventral striatal (VS) activation during reward processing in adolescents, although this finding is not universally replicated, indicating the need for more research in this area. Furthermore, despite evidence for behavioral impulsivity during adolescence, and research suggesting a relationship between impulsivity and reward-related brain activation in adults, less is known about associations between trait impulsivity and reward-related brain activation in adolescents. This study tested the hypothesis that trait impulsivity positively correlates with increased VS activation in a community sample of adolescents. Methods: Our study consisted of 92 adolescents ranging from 15 to 17 years of age, who completed the monetary incentive delay task, an fMRI-based reward task. The contrast of interest was the anticipation of reward greater than no incentive. Trait impulsivity was measured with the Multidimensional Personality Questionnaire (MPQ) for each subject. Findings: In a voxel wise whole brain analysis, trait impulsivity was positively

correlated with activation in the VS, including in the right putamen and the right caudate, as well as activation in the right orbital frontal cortex and the right pallidium. Conclusion: We provide evidence for a positive correlation between VS activation and trait impulsivity, extending the existing literature, which focuses primarily on adults, to adolescents. The finding that increased VS activation during reward processing positively correlates with trait impulsivity may help explain the neurobiological processes involved in impulsive behaviors. Understanding the neural correlates of trait impulsivity can provide the groundwork for developing better methods of prevention of high-risk impulsive behaviors.

F11

DEVELOPMENTAL ASPECTS OF FEAR: COMPARING FEAR GENERALIZATION PATTERNS BETWEEN CHILDREN AND ADULTS

Miriam A. Schiele[1], Julia Oechsner[1], Christian Baumann[1], Marcel Romanos[1], Paul Pauli[1], Jürgen Deckert[1], Andreas Reif[1]; [1]University of Würzburg — Overgeneralization of conditioned fear is one learning mechanism thought to be involved in the pathogenesis of anxiety disorders. However, developmental aspects of fear generalization throughout the life span remain poorly understood. Comparing fear generalization patterns in children and adults may help to shed light on the developmental trajectories of anxiety disorders. We investigated 53 healthy adults and 53 healthy children (8-12 years) in a fear generalization paradigm. Neutral facial expressions of two actresses were used as conditioned stimuli, one of which (CS+) was paired with an aversive stimulus, while the other was not (CS-). Four generalization stimuli (GS1-4) were presented during the generalization phase, depicting gradual morphs of CS+ to CS-. Skin conductance response (SCR) was measured continuously during the experiment. Subjective ratings of valence and arousal of the stimuli were obtained. Both groups rated CS+ as most arousing; expressed arousal for the GS correlated negatively with their similarity to the CS+; and CS- was rated as least arousing. However, compared to adults, children rated CS- and GS1-3 as overall more arousing. No differences were found regarding valence. Similar patterns in SCR were observed in children and adults, depicting a decrease from CS+ over GS to CS-. The observed pattern of enhanced arousal may point to difficulties in differentiating threat cues from safety cues in children. Developmental differences such as maturing into the ability to distinguish between aversive and non-aversive stimuli more efficiently, or failing to do so, may be a key aspect related to the development of anxiety disorders.

F12

RECOGNITION OF FACIAL EMOTIONS IN ADOLESCENCE

Klara Mareckova[1,2,3], Claire Lawrence[2], Gabriel Leonard[4], Michel Perron[5,6], Louis Richer[6], Suzanne Veillette[5,6], Zdenka Pausova[2,7,8], Tomas Paus[1]; [1]Rotman Research Institute, University of Toronto, Canada, [2]University of Nottingham, United Kingdom, [3]Central European Institute of Technology, Masaryk University, Czech Republic, [4]Montréal Neurological Institute, McGill University, Canada, [5]Recherche et transfert, Cegep de Jonquière, Canada, [6]Université du Québec a Chicoutimi, Canada, [7]The Hospital of Sick Children, Toronto, Canada, [8]Centre hospitalier de l'Université de Montréal, Canada — Effective recognition of emotions is essential for appropriate approach-avoidance behavior and social interactions. We used Morphed Faces Task (Pollak & Kistler, 2002) to study development of face processing during adolescence (451 males, 390 females; 12-18 years old). Adult male and female "Ekman" faces were morphed along happy-sad, happy-fear, angry-sad, and angry-fear continuum (11 morphs per continuum). Sex of the face was a between-subject factor. Emotion-recognition skills of adolescents were described by inverted efficiency scores (Townsend & Ashby, 1978), calculated as the ratio of reaction time and accuracy. MANOVA showed that effects of adolescent's age, adolescen's sex, and face sex were changing in a contrast-dependent manner. Emotion recognition improved with age particularly in the unambiguous contrasts (3 morphs at each end of the continuum). Largest female advantage in emotion recognition was in the unambiguous contrasts of happy-sad and happy-fear continuum. Largest effects of face sex were in the ambiguous contrasts (morphs in the middle of the continuum): happiness and anger were easier to read in female faces, sadness in male faces. Next, multiple regression explored the relative contribution of performance IQ, verbal IQ, age, and sex on emotion recognition (mean performance on unambiguous contrasts). Performance IQ was the strongest predictor of emotion recognition, followed by age, and sex. Verbal IQ had no effect. Together, performance IQ, age, and sex explained 29% variance in the performance. We conclude that recognition of emotions in faces continues to develop during adolescence in a contrast-dependent manner and that performance IQ significantly contributes to these skills.

F13

DISCRIMINATION OF SPECIES-SPECIFIC EMOTIONS ACROSS DEVELOPMENT: AN ERP STUDY

Lina Montoya[1], Alissa Westerlund[1], Sarah McCormick[1], Charles Nelson[1,2]; [1]Boston Children's Hospital, [2]Harvard Medical School — Event-related potentials (ERPs) recorded from occipital-temporal regions of the scalp elucidate perceptual processing of structural information from faces. Developmentally, emotional information in faces has been shown to drive differences at the N290 component, a precursor for the N170 component in adults (Leppänen, Moulson, Vogel-Farley & Nelson, 2007; Rigato, Farroni, & Johnson, 2010). The purpose of the current study is to examine the neural mechanisms underlying infants ability to discriminate emotions across species-specific stimuli. Five-, 7-, and 12-month-old infants were shown either female human or animal faces expressing happy, fearful, and angry expressions while ERPs were recorded. Across every age and emotion, infants who saw human faces (n = 36) presented a more negative N290 compared to infants who viewed animal faces (n = 34), $F(2, 63) = 12.530$, $p < .001$. Further, infants who saw human faces displayed a more negative N290 to fearful faces, whereas infants who saw animal faces showed a more negative N290 to angry faces. The results of this study illustrate the conditions under which different electrophysiological patterns are present; namely, infants processing of human versus animal faces, and, within the human species, emotions impact the way a particular face is processed. The findings of this study ultimately shed light on the typical trajectory of emotion processing.

F14

DRAWN TO DANGER: WHY TEENS APPROACH RATHER THAN RETREAT FROM FEAR

Michael Dreyfuss[1], Kristina Caudle[1], Andrew T. Drysdale[1], Natalie E. Johnston[1], Alexandra O. Cohen[1], Leah H. Somerville[2], Adriana Galván[3], Nim Tottenham[3], Todd A. Hare[4], BJ Casey[1]; [1]Sackler Institute, Department of Psychiatry, Weill Cornell Medical College, [2]Department of Psychology, Harvard University, Cambridge Massachusetts, USA, [3]Department of Psychology, University of California, Los Angeles, Los Angeles California, USA, [4]Laboratory for Social and Neural Systems Reasearch, Department of Economics, University of Zurich, Zurich, Switzerland — There is a significant inflection in risk taking and criminal behavior during adolescence, but the basis for this increase remains largely unknown. An increased sensitivity to rewards has been suggested to explain these behaviors. Yet juvenile offenses often occur in emotionally charged situations of negative valence. How behavior is altered by changes in negative emotional processes during adolescence has received less attention than changes in positive emotional processes. The current study uses a measure of impulsivity in combination with cues that signal threat or safety to assess developmental changes in emotional responses to threat cues. We show that adolescents, especially males, impulsively react to threat cues relative to neutral ones, more than adults or children, even when instructed not to respond. This adolescent specific behavioral pattern is paralleled by enhanced activity in limbic cortical regions implicated in detection and assignment of emotional value to inputs and in the subsequent regulation of responses to them when successfully suppressing impulsive responses to threat cues. In contrast, prefrontal control regions implicated in detecting and resolving competing responses show an adolescent emergent pattern (i.e., greater activity in adolescents and adults relative to children) during successful suppression of a response regardless of emotion. Our findings suggest that adolescence is a period of heightened sensitivity to social and emotional cues that results in diminished regulation of behavior in their presence.

F15

USING DIFFUSION TENSOR IMAGING (DTI) TO EXPLORE EFFECTS OF AGE AND PUBERTY ON WHITE MATTER INTEGRITY IN ADOLESCENCE

Lara Menzies[1], Anne-Lise Goddings[1], Emily Garrett[1], Sarah-Jayne Blakemore[1], Russell Viner[1]; [1]University College London — White matter development continues throughout adolescence and is critical in the maturation of connectivity pathways between brain regions. During this time puberty

also occurs, bringing about physiological and hormonal changes with considerable inter-individual timing variation. While DTI studies have investigated effects of age on white matter development during adolescence (e.g. Lebel et al., 2008), our goal was to understand the differential effects of age and puberty on this process. Strong sex-based variation in brain development suggests that pubertal maturation may have an important effect on white matter development. We used a 64-direction DTI-MRI protocol to acquire diffusion images from 60 boys, aged between 12-16 years, at varying stages of pubertal development with individuals being at all stages from early puberty to post-pubertal. Saliva samples were collected to measure levels of Testosterone, Dehydroepiandrosterone and Oestradiol. Additionally, pubertal stage was assessed using self-report measures (Pubertal Developmental Scale [Petersen et al., 1988] and a pictorial Tanner stage). Behavioural measures were obtained through completion of validated questionnaires of risk-taking, impulsivity and sensation-seeking. Two repetitions of DTI acquisition were performed, allowing improved estimation and correction of susceptibility-induced distortions during pre-processing within FSL (FMRIB, Oxford, UK). DTI structural indices including voxel-based fractional anisotropy were then calculated for participants. Our results incorporate both group-based and regression analyses to show relationships between puberty, chronological age and white matter structure. In conclusion, this work aids our understanding of the factors influencing brain development during adolescence, using DTI to probe differential effects of age and puberty on white matter development.

F16

NEURAL AUDIENCE EFFECT ON RELATIONAL REASONING IN ADOLESCENCE Laura K Wolf[1], Iroise Dumontheil[1,2], Sarah-Jayne Blakemore[1]; [1]University College London, [2]Birkbeck, University of London — When children enter adolescence, relationships with peers become increasingly elaborate and important. Adolescents have also been found to be particularly sensitive to peer influence relative to younger children and adults. Previous studies have focused on peer influence on risk-taking and little is known about the neural mechanisms of peer influence on adolescent decision-making. The aim of the current study was to investigate the effect of the presence of peers on a cognitively challenging task - relational reasoning, which is the ability to evaluate and integrate multiple mental representations. Previous functional imaging studies have consistently shown the activation of a frontoparietal network of regions including the parietal cortex, dorsolateral, ventrolateral and rostrolateral prefrontal cortex during relational reasoning. Here, we were interested in the effect of the presence of a peer relative to being alone on the recruitment of this frontoparietal network associated with relational reasoning and its development between mid-adolescence (14-16 years) and adulthood (23-28 years). These questions were studied in a 2x2x2 factorial design including within-subjects factors audience condition (peer vs. alone) and task condition (relational vs. control), and between-subjects factor age group (mid-adolescent vs. adult). Regions of interest analysis on the task-related clusters (relational>control) showed that adolescents' and adults' activation patterns in the frontoparietal regions during relational reasoning were differentially modulated by an audience (peer vs. alone). Findings from this study might have implications for educational contexts in which adolescents do classwork or homework in the presence of an audience of peers.

F17

RECONSOLIDATION UPDATE: A NOVEL METHOD FOR PREVENTING THE RETURN OF FEAR IN ADOLESCENTS David Johnson[1], B.J. Casey[1], Alisa Powers[2]; [1]Weill Cornell Medical College, [2]Long Island University — The ability to learn the associative relationship between aversive stimuli and the environmental elements that predict their presence is critical for adaptive function. However, these forms of learning can sometimes become maladaptive and result in the kind of dysregulated fear responding that characterizes psychiatric and anxiety disorders, which often emerge during adolescence. The most efficacious treatment for adolescent anxiety disorders is cognitive behavioral therapy, a therapeutic approach based on the principles of fear extinction learning. However, this method is not always effective in persistently attenuating fear responses. Furthermore, adolescents may be additionally challenged, as suggested by recent evidence that fear extinction learning is compromised during this developmental stage. These findings suggest that alternatives to extinction-based attenuation of learned fear should be explored. Reconsolidation update offers a promising alternative approach. This method is based on the principles of memory reconsolidation and has been shown to prevent the return of fear memory in adult humans and rodents. In the current study, we used a three-day Pavlovian fear conditioning/extinction/reinstatement paradigm to test the effect of reconsolidation update to attenuate the return of fear memory in adolescents and adults as measured by skin conductance response. Both adolescents (n=29, aged 12-17) and adults (n=28, aged 18-35) in the reconsolidation update condition showed attenuated post-reinstatement fear compared to their respective cohort in the extinction only condition. These preliminary results are consistent with recent adult findings and suggest the possibility for novel approaches to designing more efficacious treatment therapies targeted especially for adolescents.

EMOTION & SOCIAL: Emotion-cognition interactions

F18

TWO ROUTES TO THE ATTRIBUTION OF EMOTIONAL REACTIONS: EMOTION CONTAGION VERSUS COGNITIVE PERSPECTIVE TAKING Brian Haas[1,2], Ian Anderson[1], Megan Filkowski[1]; [1]Department of Psychology, University of Georgia, [2]Interdisciplinary Neuroscience Graduate Program, University of Georgia — The ability to understand the cause of another person's emotional reaction is an essential component leading to the success of human social relationships. It is currently unclear how the social-cognitive brain identifies the cause of another person's emotional reaction. This study was designed to test the hypothesis that identifying the cause of another person's emotional reaction is achieved through dissociable routes of information processing. In this study, participants underwent functional magnetic resonance imaging while identifying the cause of another person's emotional reaction. Here we present evidence that emotional attribution is accomplished through either an emotion contagion route or a cognitive perspective-taking route within the brain. The emotion contagion route acts to engage a visceral experience of the target's emotion and leads to a rapid identification of attribution. Conversely, the cognitive perspective-taking route acts to evaluate potential target-cause associations and leads to a delayed identification of attribution. Within the brain, we found that the emotion contagion route is processed through regions that include the insula, and the cognitive perspective-taking route is processed through regions that include the medial and prefrontal cortex. These findings provide support for the existence of dissociable information processing streams that function to identify the cause of other people's emotional reactions.

F19

FROM SELF TO SOCIAL COGNITION: THEORY OF MIND MECHANISMS AND THEIR RELATION TO EXECUTIVE FUNCTIONING Elisabeth E.F. Bradford[1], Ines Jentzsch[1], Juan-Carlos Gomez[1]; [1]University of St Andrews, Scotland — "Theory of Mind" refers to the ability to attribute mental states to oneself and other people (Premack & Woodruff, 1978). This study examined the extent to which "Self" and "Other" belief-attribution processes within the Theory of Mind (ToM) mechanism could be distinguished behaviourally, and whether these separable components differentially related to Executive Functioning (EF) abilities. A computerized false-belief task was utilized to assess ToM, and a face-image Stroop task was employed to assess EF, within a population of typically-developed adults. Results revealed significantly longer reaction times when attributing beliefs to other people as opposed to recognizing and attributing beliefs to oneself. Intriguingly, results revealed that "perspective-shift" requirements (i.e. changing from adoption of the "self" perspective to the perspective of the "other", or vice versus) across false-belief trials influenced reaction times. When the perspective shift was from self-to-other, reaction times were significantly longer than when they were from other-to-self. It is suggested that the "self" forms the stem of understanding the "other", and is therefore processed regardless of ultimate task demands; in contrast, the "other" perspective is only processed when explicitly required. Two Stroop scores (emotion-recognition and gender-recognition) were calculated. Affective Stroop scores positively correlated with performance on the ToM task, whilst non-affective Stroop scores negatively correlated with ToM task performance. Results indicate that adopting another person's perspec-

tive, even when their belief state is matched to one's own, requires more cognitive effort, as indicated through longer reaction times, than recalling and reflecting on self-oriented belief-states.

F20

THE EFFECT OF INVERSION ON EMOTION DISCRIMINATION DECREASES WITH FIXATION ON THE MOUTH AT BRIEF PRESENTATION TIMES: A BACKWARD MASKING AND EYE-TRACKING STUDY Karly Neath[1], Roxane Itier[1]; [1]University of Waterloo — Support for holistic processing of emotional faces comes from the disruption of emotion discrimination performance by face inversion. However, the effect of inversion on each emotion remains inconsistent between studies. Here we examined whether the impact of inversion on facial emotion discrimination varies with fixation to facial features and presentation time. Eye-tracking was used to ensure fixation to the mouth, nose, left eye or right eye of neutral, disgusted, fearful, happy, surprised and angry faces. Faces were presented for 17, 50 and 100ms and then immediately masked by an upright or inverted neutral face. Greatest performance was seen across all timings for neutral, happy and angry faces which were impacted by inversion as early as 17ms, demonstrating their holistic processing even with brief presentation time. Disgust, fear and surprise yielded lower performance across all timings and were impacted by inversion from 50ms onward. However, performance for inverted disgusted, happy and surprised faces increased when participants fixated on the mouth for 50ms compared to the other features while this mouth advantage was seen for fearful faces at 100ms presentation. Thus, the mouth improves discrimination performance for these emotions but only when holistic processing is disrupted. Results support a general holistic processing of facial emotions but suggest an important role of the mouth for disgusted, fearful, happy and surprised faces when holistic processing is disrupted.

F21

AN FMRI STUDY OF THE GENDER AND CULTURE EFFECTS IN VIEWING TAIWANESE AND CAUCASIAN EMOTIONAL FACES Sigmund Hsiao[1], Hsu-Huei Weng[1,2,3], Mei-Yu Yeh[2], Ho-Ling Liu[4,5], Liwen Lee[1], Shihtseng T. Huang[1]; [1]Department of Psychology, National Chung-Cheng University, Taiwan, [2]Department of Diagnostic Radiology, Chang Gung Memorial Hospital at Chiayi, Chang Gung University College of Medicine, Chiayi, Taiwan, [3]Departments of Respiratory Care, Chang Gung University of Science and Technology, Chiayi, Taiwan, [4]Department of Medical Imaging and Radiological Sciences, Chang Gung University, Taoyuan, Taiwan, [5]MRI Center, Chang Gung Memorial Hospital, Taoyuan, Taiwan — The present study investigated the gender and culture effects in mediating emotional processes through evaluation of the brain areas associated. Twenty Taiwanese participants participated. Pictures of happy, angry, fearful, and neutral expressions of Taiwanese and Caucasians and non-face pictures were presented in eight event-related functional runs, with 40 trials in each. Participants were asked to view the pictures with attention while undergoing functional magnetic resonance imaging (fMRI) scanning. The results found a culture and gender interaction with higher activations in the left post-central cortex, left middle occipital cortex, left superior frontal cortex, and right medial frontal cortex. Results supported a cultural specificity hypothesis, evidence suggested higher activations in responses to the female and Caucasian faces relative to those of Taiwanese faces. It is suggested that the participants had higher activations at the primary areas related to emotional processes as well as at those related to the frontoparietal attentional network when viewing emotional expressions from people of other culture than viewing expressions from one's own culture.

F22

PARANOID TRAITS ARE RELATED TO DEFICITS IN COMPLEX SOCIAL DECISION-MAKING AND REDUCED SUPERIOR TEMPORAL SULCUS VOLUME Lauren Demers[1], Elizabeth Olson[1], Mareen Weber[1], Shreya Divatia[1], Lily Preer[1], William Killgore[1]; [1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Harvard Medical School — Paranoid traits are often characterized by inaccurate interpretation of other people's motives. Individuals with high trait paranoia may have difficulties in interpersonal situations involving complex social judgments. Social decision-making has previously been related to superior temporal sulcus volume. To explore these relationships, 59 healthy adults (ages 18-45, M=30.66, SD=8.00; 30 males) underwent neuroimaging and completed the Personality Assessment Inventory (PAI) to measure paranoid tendencies, the Ekman 60 Faces Test (EFT) to control for potential differences in emotional face recognition abilities, and a novel task, the Facial Intuition Task (FIT), probing social complex decision-making. In FIT, participants decided whether computer-generated face stimuli were high or low on an unspecified trait determined by principal components analysis of previously rated traits. Trial-by-trial feedback was provided to help participants learn to make correct discriminations. Higher scores on the PAI paranoia scale correlated with lower average accuracy on FIT, even when controlling for basic emotional recognition scores on the EFT, $r(58)=-.33$, $p=.01$. Voxel-based morphometry, controlling for age and gender, was used to explore neural correlates of this finding, using a mask to restrict the analysis to the superior and middle temporal gyrus. Multiple regression analysis revealed a negative relationship between paranoia scores and a cluster of gray matter volume (k=69 voxels) in a region proximal to the superior temporal sulcus ($p<.001$, uncorrected; MNI:68,-43,6). Results suggest that paranoid traits are related to reduced gray matter volume in a region associated with social processing and poorer ability to integrate learning of subtle social cues into complex decision-making.

F23

CAN THE ACTIVATION OF ANTERIOR CINGULATE PREDICT THE EMOTIONAL SUPPRESSION? A FMRI STUDY WITH MASKED FACES Jiaolong Cui[1], Olga Tkachenko[1], William "Scott" Killgore[1]; [1]Social, Cognitive, & Affective Neuroscience Laboratory, McLean Hospital, Harvard Medical School — Purpose: Emotional suppression (ES) plays a very important role in emotional self-regulation. People who demonstrate chronic ES often experience heightened anxiety or depression. The role of ES in brain responses to emotional stimuli has been relatively unexplored. Currently, we aim to examine the relationship between the level of ES and the functional response to backward-masked facial expressions of various affects presented below the threshold of conscious perception. Method: Sixty-three healthy adults (Age: 30 ±8; 33 males) were recruited. The Courtauld Emotional Control Scale (CECS) was used to assess the tendency to suppress negative emotions including anxiety, anger, and depression. Blood oxygen level-dependent fMRI was acquired at 3T with TR/TE/flip angle=3.0s/30ms/90degree, 60 images per slice. Three 3-minute sessions were acquired during backward masked presentations of anger/happy/fearful faces separately. Each session included a neutral Control face masked with a Neutral face, the stimulus (Angry/Happy/Fearful) masked with Neutral. Each trial was 1500ms, containing the 20ms-Target, 80ms-Mask, and 1400ms-Blank screen. Data were preprocessed and analyzed in SPM8. CECS-anger was the covariate of interest, controlling for age and gender. The threshold was set at FDR corrected $p<0.05$. Result: There was a cluster located within the rostral anterior cingulate gyrus (rACC) (MNI: -2, 36, 8; 297 voxels; $p=0.006$, FDR corrected) showing a significant positive correlation between Anger/Control contrast and CECS anger score. No significant correlation was found with Happy or Fearful faces. Conclusion: Functional activation within rACC was positively correlated with higher CECS anger suppression during masked-anger perception, suggesting a role of rACC in emotional control.

F24

THE INTERACTION BETWEEN LEARNING AND MOOD Eran Eldar[1], Yael Niv[1]; [1]Princeton University — Fluctuations of good and bad mood characterize the emotional life of many. We show that fluctuations of mood may emerge from trial-and-error learning if we assume that surprising outcomes affect mood and mood biases perception of outcomes (i.e., the same outcome seems better when in a good mood and worse when in a bad mood). Accordingly, we show empirically that a large surprising outcome affects both mood and the perception of subsequent outcomes, specifically in individuals who are susceptible to mood fluctuations: In participants who were characterized as susceptible by the hypomanic personality scale, both choice behavior and blood-oxygen-level-dependent striatal response to reward reflected higher valuation of rewards received after a mood-affecting gain, as compared to rewards received after a mood-affecting loss. Less susceptible participants were not biased by mood in either choice behavior or neural response. We present a reinforcement-learning model that captures the proposed interaction between learning and mood. The

model outperforms standard reinforcement learning in explaining trial-to-trial choices and striatal activity of participants whose behavior reflected a mood-related bias. The model correctly predicts participants' mood, and the reward-perception bias that it infers from behavior correlates with individual susceptibility to mood fluctuations. In sum, our findings suggest that learning affects and is affected by mood, and that the dynamics that result from this interaction may contribute to mood instability. The findings uncover a decision bias relevant to behavioral-economics models of sequential decisions. Our theory may inspire novel approaches to the study and treatment of disorders of mood instability.

F25

THE ERP STUDY OF THE BRAIN ACTIVATIONS IN PROCESSING CONGRUENCY OF FACIAL EXPRESSION AND EMOTIONAL PROSODY

Liwen Lee[1,3], Shih-tseng Tina Huang[1,2,3], Ming-Chun Lee[1,3]; [1]Department of Psychology, National Chung-Cheng University, Taiwan, [2]Center for research in Cognitive Science, National Chung-Cheng University, Taiwan, [3]Laboratory of Brain and Emotion, Department of Psychology, National Chung-Cheng University, Taiwan — The present study used ERP to investigate the brain activations in processing acoustic emotional prosody and facial expression. Twenty young adults participated. Congruous and incongruous of angry and sad face and voice were presented. In each congruous pair, an angry (or sad) voice fragment accompanied with a congruous angry (or sad) facial expression. Each incongruous pair contained an angry voice prosody was paired with a sad face, or a sad face paired with an angry voice. Ten runs of 80 trials were presented with two kinds of percentage in combinations of the congruous and incongruous trials. Five of them contained 85% congruous trials (as standard pairs) and 15% incongruous trials (as deviant pairs). The other five runs contained 85% incongruous trials and 15% congruous trials. The results found both P120 and N170 at Pz was higher than Fz and Cz and N170 at Cz was higher than Fz. It was also found that higher mean amplitudes (MAs) of P300-500 in processing incongruous standard trials and congruous deviants when the standard trials were incongruous at Fz and Pz. Similar results were found in P500-800 at Fz and Pz. The Results suggested higher activation at the frontal and parietal lobes in the integration of face with voice information in the processing of affect.

F26

SOCIAL OBJECT KNOWLEDGE: EVERYDAY OBJECTS VARY IN THEIR SOCIAL POTENTIAL

Kathryn Russo[1], Vanessa Troiani[1,2], Brooks Rudy[1], Ingrid Olson[1]; [1]Temple University, [2]Center for Autism Research — The mental representations of common objects consist of visual features as well as semantic and social-emotional information. In many instances, these various attributes are so indelibly linked that they are nearly inseparable. For instance, an image of a stroller is more than shape and color - it has an important social attributes such as being a common baby shower gift that is typically pushed by parents to transport infants. Similarly, previous work has found that seemingly neutral objects vary on a subtle emotional dimension, termed "microvalences". Here we present a corpus of objects that vary on several dimensions, including social and emotional dimensions, and discuss the relationship between this social property and other high-level object properties. Three sets of participants (N=29) independently rated a set of 795 objects on three property dimensions using the following instructions: Is this object social or non-social? Is this object pleasant or unpleasant? How many people would you share this object with? Participants consistently identified 158 of the images as social (average>7 across participants) and 175 images as non-social (average <1 across participants). When these images were grouped into High Social and Low Social objects, categories significantly differed on their pleasantness ($t(332)=7.2$, $p<0.001$) but not on their sharedness. This shared variance between the social dimension was confirmed with a significant correlation between the two object dimensions across all images $r(793)=0.246$, $p<0.001$. Further exploration of the relationship between this social dimension and other high-level object properties will inform explorations of social knowledge in the brain.

F27

CHARACTERIZING THE SOCIAL PROFILES OF ADULTS WITH WILLIAMS SYNDROME THROUGH NARRATIVE AND QUESTIONNAIRE

Casey O'Loughlin[1,2], Philip Lai[1,2,3], Judy Reilly[3], Ursula Bellugi[1]; [1]The Salk Institute for Biological Studies, La Jolla, California, [2]University of California San Diego, La Jolla, California, [3]San Diego State University, San Diego, California — Williams Syndrome (WS) is a genetic disorder, sometimes characterized by an unusual inclination towards hyper-sociability. Children with WS are considered gregarious and display an almost magnetic attraction to strangers. The goal of the present study is to investigate two separate channels of sociability in adults with WS. Subjects included 21 adults with WS, and 19 typically developing (TD) adults. Sociability was measured through duration of eye contact with the experimenter while subjects described a complex scene in a picture, and via the Salk Institute Sociability Questionnaire (SISQ), which provides an independent measure of propensity of individuals to approach strangers. This pattern has not been frequently reported in TD adults. Differences in duration of eye contact over time were significant, with the WS group engaging in more eye contact than the TD group ($p<.026$). The WS group spent 25.8% of the time looking at the experimenter, compared to only 13.2% in the TD group. On the SISQ, the WS group were rated far more likely to approach strangers than were the TD group ($p<.001$). With regards to the number of words produced, no significant differences were found ($p=.336$). Thus the WS adults showed a greater affinity toward social interaction through eye contact as well as through interacting with strangers. Importantly, this provides added information about how WS adults behave through two separate social dimensions. Specifically, differences in eye gaze may index the characteristic WS attraction toward social interaction, suggesting the power of the genetic underpinnings of the disorder throughout their lifetime.

F28

DOES CULTURE PLAY A ROLE IN THE PROCESSING OF EMOTIONAL NON-VERBAL VOCALIZATIONS? AN EVENT-RELATED POTENTIALS STUDY

Cameron Davidson[1], Marcelo Dias[2], Margarida Vasconcelos[2], Jason Ridge[2], Andréia Rauber[2], Laura Donaldson[1], Amanda Henderson[1], Kristina Hernandez[1], Gabrielle Andrick[1], Heather Daly[1], Kristin Perrone-McGovern[1], Stephanie Simon-Dack[1], Oscar Gonçalves[1], Ana P. Pinheiro[1]; [1]Ball State University, [2]Universidade do Minho — We investigated the role of focused attention in the processing of non-verbal vocalizations with neutral and emotional (happy and angry) valence, by using the event related potentials (ERP) methodology. A modified version of the auditory oddball task was used. Stimuli were vocalizations selected from the Montréal Affective Voices database, which were presented pseudorandomly in four blocks. Each block was composed of 210 standard and 40 deviant vocalizations (block 1: neutral standards and happy deviants; block 2: happy standards and neutral deviants; block 3: neutral standards and angry deviants; block 4: angry standard and neutral deviants). In order to examine cross-cultural differences in vocal emotional processing, eleven American and fifteen Portuguese individuals participated in the study. The analysis of P300 was based on a subtraction method (the ERP activity of a standard was subtracted to the ERP activity of the same sound presented as a deviant). P300 mean amplitude and peak latency were measured from a time window ranging from 350 to 450ms post-stimulus onset. In American participants, P300 amplitude tended to be more positive for angry relative to happy vocalizations ($p= 0.072$), and was increased for neutral (presented in the context of angry sounds) compared to happy vocalizations ($p=0.029$). In the Portuguese sample, P300 amplitude was more positive for happy relative to neutral (presented in the context of happy sounds) vocalizations ($p=0.015$), and for angry relative to neutral (presented in a happy context) vocalizations ($p=0.003$). These findings suggest that the attentive processing of emotional vocalizations may be modulated by culture.

F29

TITLE: ROLE OF ROSTRAL ANTERIOR CINGULATE CORTEX FUNCTIONAL CONNECTIVITY IN EMOTION REGULATION

Akos Szekely[1], Wendy Heller[2], Gregory A. Miller[3], Aprajita Mohanty[1]; [1]SUNY Stony Brook University, [2]University of Illinois at Urbana-Champaign, [3]University of California at Los Angeles — The rostral ventral anterior cingulate cortex (rACC) has strong anatomical connections to other regions of the ACC and to amygdala, insula, and motor and prefrontal (PFC) cortices. An examination of its functional connectivity to limbic, motor, and prefrontal cortices can clarify how it contributes to the integration of emotional, cognitive, and behavioral processes. This integration is critical for emotion regulation in normal individuals and may play a role in emotion dysregulation in anxiety. In the present study, three groups of adult participants, 11 high in anxious

apprehension, 10 high in anxious arousal, and 18 controls scoring low in both, indicated the ink color of unpleasant and neutral words during fMRI. RT was slower for unpleasant than for neutral words. For unpleasant relative to neutral words, rACC showed elevated functional connectivity with anterior insular cortex, dorsal ACC , dorsolateral PFC, and motor cortex. This connectivity was reduced in anxious groups. The anxious arousal group showed stronger rACC connectivity with left lateral parietal lobe for unpleasant versus neutral words than did the anxious apprehension and control groups. These findings provide evidence for the critical role rACC plays in integrating interoceptive emotional experience (via connectivity to insular cortex) with appropriate cognitive and behavioral processes (via connectivity to dACC, DLPFC, and motor cortices) to regulate emotional interference in normal individuals as well as its dysregulation in individuals with anxiety.

F30

CULTURAL DIFFERENCES IN THE EMOTION-INDUCED MEMORY TRADE-OFF EFFECT Laura Ligouri[1], Aysecan Boduroglu[2], Angela Gutchess[1]; [1]Brandeis University, [2]Bo aziçi University — Numerous previous studies reveal emotion trade-off effects, with emotional items (of positive or negative valence) impairing memory for neutral background information, compared to when neutral items are present. This research, however, has primarily been conducted with Americans; it is possible that Easterners, who attend to contexts more than Westerners, may show a reduced emotion trade-off effect or exhibit differences in the tradeoffs for positively vs. negatively valenced items. The present study investigated whether culture impacts the emotion trade-off effect, comparing participants originating from Turkey, a country shaped by both Eastern and Western values, to those from the United States, a Western country. Participants (44 Americans, 32 Turks) studied complex visual scenes that included an item (positive, negative, or neutral) placed on a neutral background. Participants later completed a recognition memory test for the items and backgrounds separately. A 2x2x3 ANOVA tested the effect of culture (U.S. or Turkish) on memory of a given component of an image (item or background) as related to a specific emotional valence (positive, neutral, or negative) of the item. An emotional-induced memory trade-off occurred when there was worse memory for backgrounds that had been paired with an emotional item as opposed to a neutral item. Results indicated that in comparison to American participants, Turkish participants showed a reduced emotional-induced memory trade-off effect. These results support the idea that culture mediates memory for emotional events, specifically impacting emotion-induced memory trade-offs. Implications for cross-cultural differences in neural regions underlying emotional memory will be discussed.

EMOTION & SOCIAL: Self perception

F31

ANTERIOR INSULA ACTIVITY MANIPULATION THROUGH REAL-TIME FMRI FEEDBACK INFLUENCES ERROR AWARENESS Andrea Caria[1], Rahim Malekshahi[1], Niels Birbaumer[1], Anil Seth[2]; [1]University of Tübingen, [2]University of Sussex — A range of previous literature emphasized a core role for the anterior insula cortex (AIC) in interoceptive processing supporting both autonomic control and conscious access to emotional states. This study builds on our previous results showing that both healthy participants and patients can achieve successful regulation of insular cortex that in turn is associated with changes in behaviour and brain connectivity. Here, we adopted an instrumental learning of BOLD response paradigm to study the effects of AIC manipulation on human awareness. We aimed to assess the effects on conscious error perception using an antisaccadic task in which subjects were required to fixate a central position on the screen and to make an antisaccade (i.e., to look away from this stimulus) to an abruptly appearing peripheral stimulus. During rtfMRI feedback training three subjects were trained to voluntarily control the local BOLD signal of the right AIC. The three subjects learned to control the BOLD signal in the target region. Post-to-pre assessment showed no differences in error rate of aware and unaware trials comparing last to first regulation condition. Interestingly, in two subjects an increase of error aware rate was observed in post error trials in the last regulation condition with respect to the first. These preliminary results suggest that increased activity in the right AIC might modulate error awareness. In particular, augmented insular activity associated with increased sensitivity to interoceptive signals might lead to increased error awareness.

F32

NEURAL CORRELATES OF OWN, FAMILIAR AND UNFAMILIAR VOICE RECOGNITION Christine Heinisch[1], Patrik Roser[2], Martin Brüne[2]; [1]Friedrich-Alexander Universität Erlangen-Nürnberg, [2]Ruhr University Bochum — Voice recognition is a crucial part of social interaction. Although highly familiar, listing to the own voice usually sounds strange. There are only few studies on the cortical responses related to the recognition of the own voice and studies on voice identity matching are still in its infancies. In the present study, twelve subjects listened to syllables spoken with their own, a familiar (friend) and an unfamiliar voice in an oddball paradigm. The Mismatch Negativity (MMN) and the P3 were analysed. Amplitudes and latencies of all voices were correlated to the experienced nearness to the person with the familiar voice, indicating that the context influences brain activity towards all stimuli. Furthermore, the results of the experimental group were compared to a control group for whom the same set of voices was completely unfamiliar. Results indicate that early potentials differ between the unfamiliar and the two other familiar voices at fronto-central areas, lateralised to the right hemisphere. Activation for the own voice to the familiar voice differs in a later potential occurring after 300ms. This is the first study comparing the own voice to familiar and unfamiliar voices in an EEG paradigm. It can be stated, that the brain is able to discriminate between these three voice familiarity very early. In the brain the own voice is processed different from the familiar voice.

F33

SELF-ENHANCEMENT INFLUENCES MEDIAL FRONTAL CORTEX ALPHA POWER TO SOCIAL REJECTION FEEDBACK Jordan Leitner[1], Eric Hehman[2], James Jones[1], Chad Forbes[1]; [1]University of Delaware, [2]Dartmouth College — While previous research has demonstrated that individuals are motivated to self-enhance, the neurocognitive mechanisms and temporal dynamics of self-enhancement are poorly understood. The current research examined whether self-enhancing motivations affect early-stage perceptual processing of social feedback. Participants who varied in self-enhancement motivations received accept and reject feedback while EEG was recorded. Following this task, we measured perceptions of feedback by asking participants to estimate the number of times they were rejected. Source localization and time-frequency analyses were used to examine alpha power, a neural oscillation associated with attention. Alpha power in the medial frontal cortex (MFC) fully mediated the relationship between self-enhancement motivations and rejection estimates. Specifically, greater self-enhancement motivations predicted decreased MFC alpha power to reject compared to accept feedback, which predicted decreased rejection estimates. These findings suggest that self-enhancement motivations decrease attention to social rejection by influencing how the MFC processes social feedback.

F34

PAYING ATTENTION TO SELF: PERSONALLY SALIENT CUES AFFECT SELF-REFERENT AND AFFECTIVE PROCESSING IN DEPRESSION Roselinde Kaiser[1,2], Jessica Andrews-Hanna[3], Franziska Goer[1,2], Miranda Beltzer[1,2], Diego Pizzagalli[1,2]; [1]McLean Hospital, [2]Harvard Medical School, [3]University of Colorado Boulder — Major Depressive Disorder (MDD) is characterized by increased attention to negative information, reduced attention to positive information, and difficulty disengaging from self-referent thought. However, the relative contributions of emotional valence or personal salience to cognitive biases remain unclear. The present studies aimed to disentangle such effects. In Study 1, individuals with or without MDD performed a task in which they evaluated the self-descriptiveness of emotional words while ignoring distractor images of themself or a gender/race-matched stranger. Results showed that participants were faster and more accurate evaluating self-descriptive words in the presence of self- than other-images, suggesting priming effects of self-imagery. Valence and depression moderated these effects: priming emerged for depressed individuals responding to positive words, and healthy individuals responding to negative words. Critically, opposing affective biases detected in the other-image condition drove this pattern. In the absence of

self-imagery, depression predicted poorer accuracy for positive traits, but psychiatric health predicted poorer accuracy for negative traits. In the presence of self-imagery, affective biases were reduced for both depressed and healthy individuals, i.e. better recognition of positive and negative traits, respectively. These findings converge with schema theory, which holds that the tendency to ruminate on negative self-referent thought strengthens its availability for information processing. Accordingly, negative beliefs about the self may be easily accessible in depression, regardless of stimulus context, whereas retrieval of positive beliefs may be facilitated by priming. Ongoing studies investigate the effects of self-imagery when task goals change (Study 2) and the neural substrates of these effects (Study 3).

F35

RESTORING JUSTICE: PUNISHING ON BEHALF OF ANOTHER, BUT NOT FOR ONESELF Oriel FeldmanHall[1], Peter Sokol-Hessner[1], Jay Van Bavel[1], Elizabeth Phelps[1]; [1]New York University, Department of Psychology — Classic social psychology and experimental economics studies argue that punishment is the ubiquitous response to violations of fairness norms. Here we show that expanding choice options (e.g. to include compensation of the victim) reveals that alternative forms of justice restoration are strongly preferred to punitive measures. Furthermore, we find that these other-regarding preferences for justice restoration are differentially deployed depending on the perspective of the deciding agent. When people are the recipient of an unfair offer, they prefer to compensate themselves and apply no punishment to the transgressor. However, when people observe a fairness violation targeted at another, people compensate the victim and punish the transgressor. Such choices were made far more swiftly and automatically compared to the same choices made for the self, suggesting that retributive decisions involving the self require greater deliberation. Together, our findings challenge the classic theory that humans have strong other-regarding preferences to punish violators of fairness norms. Instead, when we are personally a victim of a fairness violation, it seems that we only punish when we must; when there are other options to restore justice, punishment is no longer preferred.

F36

FROM ARMCHAIR TO WHEELCHAIR: HOW PATIENTS WITH A LOCKED-IN SYNDROME INTEGRATE BODILY CHANGES IN EXPERIENCED IDENTITY Marie-Christine Nizzi[1], Athena Demertzi[2], Oliva Gosseries[2], Marie-Aurelie Bruno[2], Francois Jouen[3], Steven Laureys[2]; [1]Harvard University, [2]Universite de Liege, [3]Ecole Pratique des Hautes Etudes — Different sort of people are interested in personal identity. Philosophers frequently ask what it takes to remain oneself. Caregivers imagine their loved-one's experience. Healthcare professionals rely on their technical knowledge. But all of them think from the armchair: they can only make assumptions about what it is like to experience a sudden and massive bodily change. Patients with a locked-in syndrome (LIS) suffer a full body paralysis without cognitive impairment. They can tell us how LIS impacts their sense of self. In this study, 44 chronic LIS patients and 20 age-matched healthy healthcare professionals (MD) answered a 15-items questionnaire targeting: (A) global evaluation of experienced identity, (B) body representation and (C) experienced meaning in life. Literature so far assumes that LIS patients reporting a preserved identity do so in virtue of their preserved cognitive functions and despite their bodily changes. In our patients, self-reported identity was strongly correlated with body representation and experienced meaning in life. Patients' reports differed with controls' predictions in the experienced meaning in life. These results suggest that the paralyzed body remains a strong component of patients' experienced identity, that patients can adjust to drastic objectives changes when perceived as meaningful and that healthcare professionals fail in predicting patients' experience. We draw both clinical recommendations and ethical implications of these findings, namely: to increase physical therapy aiming at body integration on top of rehabilitation purposes and to develop tools to access non-communicative patients' own decision.

F37

FUNCTIONAL RELATIONSHIPS BETWEEN MEDIAL PREFRONTAL CORTEX AND POSTERIOR CINGULATE CORTEX DURING SELF-REFERENTIAL PROCESSING Yunjin Bak[1], Kyeong-jin Tark[1], Hyo Jeong Kim[1], Do-Joon Yi[1]; [1]Yonsei University — It is thought that the cortical midline structures (CMS) including medial prefrontal cortex (mPFC) and posterior cingulate cortex (PCC) are involved in self-referential processing. However, it remains unclear how each sub-region of the CMS dynamically interplays with each other. Here, we used fMRI with a modified version of self-reference paradigm to examine the functional connectivity patterns between sub-regions of the CMS during self-referential processing (Lee, Ahn, & Yi, 2013). In each trial, participants viewed a trait adjective and judged how well it described a given person (referent: myself vs. president) from a given point of view (viewpoint: my own view vs. my friend's view). The results showed a significant two-way interaction in bilateral PCC, temporal poles and left temporoparietal junction (lTPJ); specifically, these regions showed greater activity for thinking of a president (rather than the self) when participants thought from their own viewpoint, but no difference for two different referents when they thought from their friend's view. In contrast, mPFC showed greater activity when evaluating themselves regardless of the type of viewpoints. We further conducted a generalized psychophysiological interaction (gPPI) analysis with a PCC region as a seed and found that the connectivity between PCC and mPFC was greater when participants evaluated themselves, compared to a president. These findings corroborates a hypothesis that the self-related information may be initially represented in mPFC and integrated with social perspectives in PCC.

EXECUTIVE PROCESSES: Development & aging

F38

RELATIONSHIP BETWEEN CREATIVITY AND COGNITIVE CONTROL DIFFERS FOR YOUNGER AND OLDER ADULTS Jennifer L. Mozolic[1], Jonna Kwiatkowski[2], Michael F. Neelon[3]; [1]Warren Wilson College, [2]Mars Hill University, [3]University of North Carolina at Asheville — Creative problem solving requires a number of complex brain processes, many of which are likely influenced by the cognitive and sensory changes that occur with age. Currently, there are several conflicting ideas about the nature of the association between creativity and cognitive control, and there is much still to learn about this relationship, especially within the context of aging. This study enrolled 41 older adults (mean age = 70) and 42 younger adults (mean age = 21) in behavioral testing and a subset of these individuals in EEG testing in order to examine how the relationship between cognitive control and creativity changes with age. All participants were healthy and had normal sensory and cognitive function. Older adults demonstrated significantly poorer performance than younger adults on cognitive control tasks of visual working memory and spatial reasoning, however, there were no age-related differences on the Remote Associates Test (RAT) of creative problem solving. Interestingly, there was a significant positive correlation between these measures of cognitive control and RAT performance in older adults (visual working memory: r=.55. p=.032; spatial reasoning: r=.38. p=.013), but no significant correlation between these measures in younger adults (visual working memory: r=.13; spatial reasoning: r=-.076). Additionally, EEG results partially support previous findings (Gazzaley et al., 2008) suggesting that there are age-related deficits in our ability to suppress distracting information and this may play a role in the altered relationship between cognitive control and creativity observed in healthy older adults.

F39

AGE-RELATED DECLINE IN DUAL-TASK PROCESSING IS RELATED TO REDUCED PREFRONTAL ACTIVATION Benjamin Boller[1,2], Samira Mellah[1], Sylvie Belleville[1,2]; [1]Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal, [2]Université de Montréal — Many studies have reported an age-related decrease in dual-task performance. It has been proposed that the ability to perform dual-tasks is supported by attentional control processes. Neurophysiologically, attentional control processes involve the prefrontal cortex. Moreover, the prefrontal cortex is particularly vulnerable to changes associated with aging. The purpose of the current study was to examine the relationship between aging and regional brain activity (fMRI, 3T) while performing a dual-task. Forty healthy older adults aged 60 to 84 performed a dual-task that was comprised of a visual detection task and a visual alpha-arithmetic judgment task. Participants were instructed to control their attention by modulating the proportion of attentional resources allocated to each task (20%, 50% and 80%). Positive and negative correla-

tions between the BOLD signal and the participant age were analyzed with SPM8. To account for individual differences years of education, gender and MOCA score were included as covariates. This analysis revealed a negative correlation between age and BOLD signal in the medial prefrontal regions (mPFC, BA 10), suggesting decreased neural efficiency for the oldest individuals. These results are even more striking in that this negative correlation was found for each of the three attentional modulation conditions. Accordingly, age-related reduction of activation in the medial prefrontal cortex may underlie an age-related decline of attentional control processes.

F40

OF GOALS AND HABITS: AGE-RELATED CHANGES IN MODEL-BASED AND MODEL-FREE LEARNING AND DECISION-MAKING

Benjamin Eppinger[1], Hauke R. Heekeren[2], Shu-Chen Li[1,3]; [1]Chair of Lifespan Developmental Neuroscience, TU Dresden, Germany, [2]Department of Education and Psychology, Freie Universität Berlin, Germany, [3]Center for Lifespan Psychology, Max-Planck Institute for Human Development, Berlin, Germany — Foresighted, strategic decisions depend on the ability to learn the value of future rewards and the means to achieve them. In two recent studies we investigated age-related impairments in learning of sequential task structures that lead to future reward. In the first study we used a three-state Markov decision and functional MRI to investigate age differences in the neural systems that mediate the learning of transition structures. We found pronounced age-related learning impairments, which were associated with an under-recruitment of the prefrontal cortex (PFC) in the elderly. Furthermore, our results show that in younger adults learning of transition structures is characterized by abrupt shifts in PFC activity, which were predictive of choice behavior. In older adults PFC activity was delayed, less pronounced and not related to behavior. In the second study we examined the interplay of goal-directed (model-based) and habitual (model-free) decision mechanisms using a two-stage Markov task. The results show a shift from model-based to model-free decision-making with age. This shift in decision strategies is particularly pronounced in situations in which unexpected rewards signal the need for behavioral adaptations. In these situations, younger adults use their knowledge of the task structure to optimize decision-making, whereas older adults show perseverative behavior. Taken together, our results suggest that age-related impairments in the learning of sequential task structures are related to functional deficits in the PFC. Age-related impairments in the application of model-based decision strategies are due to perseverative behavior in situations in which unexpected rewards signal the need for behavioral adjustments.

F41

PREFRONTAL CORTEX RECRUITMENT DURING WORKING MEMORY FILTERING IN ADOLESCENTS AND ADULTS

Matthew Peverill[1], Amy Finn[2], Katie McLaughlin[3], Margaret Sheridan[1,4]; [1]Boston Children's Hospital, [2]Massachusetts Institute of Technology, [3]University of Washington, [4]Harvard Medical School — Previous research has demonstrated that dorsolateral prefrontal cortex recruitment increases with load and presence of distractors during working memory encoding. It has been amply demonstrated that this effect of load on prefrontal activation increases across age from childhood through adulthood (Thomason, et al., 2008), however, the development of working memory filtering remains relatively unexplored. We recruited 14 adults (mean age 26, sd=4.915) and 19 adolescents (mean age 17, sd=1.45) to participate in an fMRI study of visual-spatial working memory. Participants were asked to remember the location of 2 or 4 stimuli. When 2 stimuli were presented they were sometimes presented with two distractors which participants were told to ignore (McKnab & Klingberg, 2008). Images were acquired at the Center for Brain Science at Harvard University on a 3T Siemens Tim Trio MRI scanner and analyzed using Freesurfer and FSL through Nipype. Adult and Adolescents performed similarly on the task. There was a trend towards better performance in adults ($p=.058$), but there were no significant age by condition interactions. We observed that dorsolateral prefrontal and occipital activation for high relative to low load trials increased with age, consistent with previous work (Scherf et al., 2006). For the distractor relative to non-distractor trials, we observed increasing frontal and occipital activation with age. These findings are consistent with a difference in strategy for adults relative to adolescents where older participants filtered less, reflecting age related increases in working memory capacity.

F42

RECALL-TO-REJECT: STRATEGIES TO REDUCE FALSE RECOGNITION IN PATIENTS WITH MILD COGNITIVE IMPAIRMENT

Neil Nadkarni[1], Sean Flannery[1,2], Rebecca Deason[3], Bruno Frustace[1,2], Sahar Ahadi[1,2], Brandon Ally[4], Andrew Budson[1,2]; [1]Center for Translational Cognitive Neuroscience, VA Boston Healthcare System, Boston, MA,, [2]Boston University Alzheimer's Disease Center, Department of Neurology, Boston University School of Medicine, [3]Texas State University, San Marcos, TX, [4]Vanderbilt University, Nashville, TN — Mild cognitive impairment (MCI) patients often demonstrate high rates of false memories, which can often create stressful and frustrating situations for both patients and caregivers in everyday life. What types of interventions can be used to enhance the ability of MCI patients to use a "recall-to-reject" metacognitive strategy to lower their false memory rates? We set out to use the picture superiority effect (remembering pictures better than words), which has been shown to be at least as large of an effect in MCI patients as in healthy older controls, to help MCI patients use this recall-to-reject strategy in a simulation of real-world memory task. In this experiment, MCI patients and healthy older adults were asked to simulate preparing for and then taking a trip to the market. First, subjects studied 30 pictures of items in their "cupboard," and then they studied a list of 30 words of items on their shopping list. At test, participants saw 90 pictures (30 cupboard, 30 list, 30 new) as they would if walking down the market aisles, and are provided with either standard or metacognitive instructions. With standard instructions, they were asked if they needed to buy the item. With the metacognitive instructions, they were asked a series of questions to help guide them through a recall-to-reject strategy. Our results showed that the metacognitive instructions did significantly reduce the false memory rates for the MCI patients. Further studies need investigate how to best implement these practical strategies into the everyday lives of patients.

EXECUTIVE PROCESSES: Goal maintenance & switching

F43

COGNITIVE FLEXIBILITY IN AN INSTRUCTION-BASED RULE REVERSAL TASK CUEING PARADIGM

Yiquan Shi[1], Uta Wolfensteller[1], Torsten Schubert[2], Hannes Ruge[1]; [1]Technische Universität Dresden, [2]Humboldt-Universität zu Berlin — Cognitive flexibility is essential in an environment full of changing demands. Using fMRI, we compared multiple levels of demand changes and explored the underlying neural mechanisms for level-specific flexible control. On a global block level, rules guiding responses for a certain number of trials were reversed in half of the blocks. On a local trial level, switching between different rules was required in half of the trials. The current rules were instructed either globally or additionally locally on each trial. Each block started with a display of the current rules for 4.5s (female-left, male-right for face task; odd-left, even-right for number task; or the reversed mappings). After this block-level instruction, each trial in the block was cued by a task-cue (e g., face) or a rule-cue which explicitly reminded subjects of the current rule (e. g., female-left, male-right).The results suggest a fast initiation of reversed rules during block-level instructions, which relies on elevated activation in the common executive control network including dorsal pre-motor cortex, pre-SMA, lateral prefrontal cortex, anterior insula, and parietal regions. Another large scale network showed increased activation throughout practice within a block. This network overlapped with that observed previously for instruction-based learning of novel rules and included medial anterior prefrontal cortex, anterior caudate, posterior insula, superior temporal gyrus, and parahippocampus. These results indicate that instructed rule reversal is achieved through complementary neural mechanisms: one for fast initiation of rules and another for pragmatic implementation of rules.

F44

DISTINCT FRONTO-STRIATAL COUPLINGS REVEAL THE DOUBLE-FACED NATURE OF DIFFERENTIAL RESPONSE OUTCOMES IN INSTRUCTION-BASED LEARNING OF GOAL-DIRECTED ACTION

Hannes Ruge[1], Uta Wolfensteller[1]; [1]Department of Psychology,Technische Universitaet Dresden — It is well-established that distinct striatal sub-regions

serve purely stimulus-based habitual action on the one hand and goal-directed action directed towards anticipated outcomes on the other hand. Recent research suggests that striatal areas interact with lateral prefrontal cortex (LPFC) when learning of novel contingencies is based on explicit rule representations. Yet it remains largely unknown whether under such model-based learning conditions a similar striatal differentiation emerges through fronto-striatal interactions. First evidence suggests that LPFC-caudate coupling but not LPFC-putamen coupling is sensitive to response-outcome (R-O) contingency during instructed stimulus-response (S-R) learning. Yet, sensitivity to R-O contingency alone is not sufficient to conclude an involvement in goal-directed action. The present fMRI study addressed the fundamental question whether R-O sensitive LPFC-caudate coupling indicates merely the rapid learning of R-O associations by itself or rather their actual usage for goal-directed action selection. We correlated learning-related functional couplings with behavioral indices of both R-O association strength and R-O usage. R-O strength was exclusively correlated with LPFC-putamen coupling consistent with a habit-like nature of R-O associations. By contrast, the behavioral index of actual R-O usage was correlated with LPFC-caudate coupling consistent with an involvement in goal-directed action selection. This fronto-striatal differentiation was paralleled by similar dissociations between fronto-hippocampal couplings, suggesting a tripartite neural architecture of instruction-based learning. Together, our results suggest a similar differentiation of the striatal machinery under model-based learning conditions as described previously for feedback-driven learning conditions - with the important distinction that this striatal differentiation emerges specifically through functional couplings with the LPFC.

F45

DYSFUNCTIONAL ERROR-RELATED EVENT-RELATED POTENTIALS (ERPS) IN INCARCERATED ADOLESCENTS WITH PSYCHOPATHIC TRAITS

J. Michael Maurer[1], Vaughn R. Steele[1,2], Lora M. Cope[1,2], Vince D. Calhoun[1,2,3], Kent A. Kiehl[1,2]; [1]The Mind Research Network and Lovelace Biomedical and Environmental Research Institute, [2]University of New Mexico, [3]Yale School of Medicine — Adult incarcerated offenders with psychopathic traits show an increased propensity towards impulsivity, violence, incarceration, and recidivism. Recent evidence suggests that youth with psychopathic traits show similar personality traits, remaining constant throughout the life span. Identifying specific cognitive deficits in juvenile offenders consistent with adult psychopathy is necessary to further develop treatment techniques aimed towards early intervention. Here, incarcerated male juvenile offenders (n = 100) performed a Go/NoGo response inhibition task while event-related potentials (ERPs) were recorded. Both the error-related negativity (ERN/Ne) and the error-related positivity (Pe) elicited by a response error were analyzed with classic windowed components and principal component analysis. As predicted, and consistent with adults, juveniles with high, compared to those with low levels of psychopathic traits, exhibited similar ERN/Ne amplitudes, but reduced Pe amplitudes. These results suggest that juveniles with elevated psychopathic traits are deficient in post-error processing (as indexed by the Pe), but not in error-monitoring (as indexed by the ERN/Ne). Linear regressions were performed, associating reduced Pe amplitude with the developmental, antisocial, impulsive, and early behavioral problems associated with high levels of psychopathic traits. This is the first evidence to suggest that juvenile delinquents with high psychopathic traits are deficient in post-error processing. Successful treatment approaches could further benefit by specifically targeting post-error processing in juveniles with high psychopathic traits.

F46

AN FMRI EXAMINATION OF BILINGUAL NON-VERBAL TASK SWITCHING

Kelly Vaughn[1], Maya Ravid[1], Aurora Ramos[1], Arturo Hernandez[1]; [1]University of Houston — How do bilinguals switch between tasks and what factors may help to reduce switching costs? Previous research using non-verbal switching tasks examined differences between bilinguals and monolinguals, but not differences between cue presentation and response trials, nor the effects of second language age of acquisition (AOA). A group of Spanish-English bilinguals (n=44) performed a rule-switching task inside an MRI scanner. Participants switched between responding to the shape or color of a stimulus, signaled by a single non-verbal cue. The cues (switch or non-switch) were separated by 8-12 response stimuli. Activation in cue and stimulus response trials differed, along with activations in the switch and non-switch conditions. While greater activity in visual and cognitive control regions appeared during switch compared to non-switch cues, the opposite pattern emerged for switch versus non-switch response trials. Furthermore, regression analyses indicated that AOA is positively related to activity in visuo-motor areas during switch response trials. Greater activation for switch cues suggests that participants engaged in more effortful task switching during the cue. Greater activation during the non-switch response trials may indicate that bilinguals are attempting to recall/maintain the previous rule. Additionally, higher AOA may put bilinguals at a disadvantage for this task. These results extend previous studies by showing that switching and maintaining a rule may involve many of the same neural areas in differing configurations. Furthermore, type of bilingualism may interact with these neural areas. Hence, learning a second language later in life may result in less efficient switching on non-verbal tasks.

F47

OCULOMOTOR TASK-SWITCHING: UNIDIRECTIONAL REACTION TIME SWITCH-COST WHEN ALTERNATING FROM A NON-STANDARD TO A STANDARD RESPONSE

Jeff Weiler[1], Matthew Heath[1]; [1]The University of Western Ontario — The non-standard antisaccade task requires the top-down and cognitively based inhibition of a standard prosaccade (i.e., response suppression) and the execution of a saccade to a target's mirror-symmetrical location. Recent work by our group has shown that the completion of an antisaccade imparts a selective reaction time (RT) switch-cost on subsequent prosaccades (i.e., unidirectional prosaccade switch-cost). We, in turn, proposed that such a result reflects that response suppression engenders a residual inhibition of the oculomotor networks supporting prosaccades. Here we sought to confirm this hypothesis by determining whether prosaccades requiring response suppression similarly increase the RTs of subsequent prosaccades. To that end, participants alternated between pro- and antisaccades in a pseudo-randomized trial order wherein task instructions (prosaccade, antisaccade) were provided prior to response cuing (i.e., target onset) or concurrent with response cuing. Notably, trials wherein task instructions were given concurrent with response cuing required the suppression of a stimulus-driven saccade and thus provided equivalent response suppression across pro- and antisaccades. Results showed that an increase in prosaccade RT was restricted to the completion of a preceding antisaccade. Indeed, that prosaccades requiring response suppression did not increase RT on subsequent prosaccade trials demonstrates that response suppression does not selectively engender a residual inhibition of the oculomotor networks supporting prosaccades. Instead, the present findings are in line with task-set inertia which predicts a unidirectional switch-cost when alternating from a response with a non-standard stimulus-response mapping (e.g., antisaccade) to a response with standard stimulus-response mapping (e.g., prosaccade).

F48

THE INTERPLAY BETWEEN EXECUTIVE CONTROL AND MEMORY ENCODING IN TRAUMATIC BRAIN INJURY: AN FMRI STUDY

Jessica Paxton[1,2], Nancy Chiaravalloti[1,2], Glenn Wylie[1,2]; [1]Kessler Foundation, [2]Rutgers, the State University of New Jersey — Individuals with traumatic brain injury (TBI) demonstrate impairment in the encoding phase of memory and a tendency to remember more task-irrelevant (distracting) information than healthy adults (HCs). The current study investigated the effect of executive control demands on the ability to encode task-relevant instead of task-irrelevant information in TBI. A task-switching paradigm was used to manipulate executive control demands, and memory was assessed for both task-relevant and task-irrelevant information. Specifically, TBI and HC participants switched between classifying words and pictures during an fMRI scan, which was followed by a recognition test outside the scanner. Picture-specific ROIs were derived from a scan with only picture stimuli and determined to be task-relevant on picture task trials and task-irrelevant on word task trials. Overall, TBI participants demonstrated greater recognition scores for task-irrelevant information and lower recognition scores for task-relevant information compared with HCs. Differences between groups were increased under high executive demands. While HCs showed the expected pattern of greater task-relevant compared with task-irrelevant activation, individuals with TBI showed the reverse pattern (i.e., greater task-irrelevant compared with task-relevant activation). Results suggest that individuals with TBI demonstrate deficits encoding task-rel-

evant information and inhibiting encoding of task-irrelevant information, especially under high executive demands. Likewise, individuals with TBI demonstrate a pattern of lower task-relevant activation compared with HCs, suggesting that difficulty directing attention to task-relevant stimuli contributes to memory encoding deficits post-TBI.

F49

INCREASED GLOBAL CONTROL IN SIMULTANEOUS INTERPRETERS

Laura Babcock[1], Antonino Vallesi[2]; [1]Scuola Internazionale Superiore di Studi Avanzati, Trieste, Italy, [2]University of Padova, Italy — Previous research has shown enhanced cognitive control in bilinguals, posited to be due to practice managing two languages. In particular studies have shown smaller switching costs on non-linguistic task-switching paradigms for bilinguals compared to monolinguals and for bilinguals who regularly code-switch than for those who do not. Despite the important effect that dual language management has on cognitive abilities, little research has focused on the cognitive control abilities of simultaneous interpreters. In Simultaneous Interpretation (SI) the individual must comprehend a stream of oral material in one language and with a few seconds delay produce the same content in another language; a process that requires a high level of language management. Thus, benefits in cognitive control beyond those seen for bilingualism may be expected for SI. The present study examined professional interpreters and matched multilinguals on a non-linguistic task-switching paradigm. The interpreters were overall faster, on both single-task and mixed-task blocks, and they showed a smaller mixing cost (the difference between single-task blocks and repetition trials in the mixed-task block), though no difference in switching cost (the difference between repetition and switch trials in the mixed-task block). Switching costs index the difficulty in switching between task-sets and often exhibit an advantage for bilinguals. While mixing costs, which do not usually show advantages for bilinguals, index the global sustained control required for maintaining two task-sets. The results suggest that interpreters are generally advantaged in this sustained control, a process that might enable the simultaneous access to two languages needed in SI.

EXECUTIVE PROCESSES: Working memory

F50

WORKING MEMORY ACCUMULATES MORE INFORMATION FROM REAL-WORLD OBJECTS THAN FROM SIMPLE STIMULI: EVIDENCE FROM CONTRALATERAL DELAY ACTIVITY

Timothy F. Brady[1], Viola S. Störmer[1], George A. Alvarez[1]; [1]Harvard University — Visual working memory (WM) is an active storage system into which visual information can be encoded to make it resistant to interference from new perceptual input. Information about simple stimuli - colors, orientations - is encoded into visual WM rapidly: in under 100ms, WM 'fills up', revealing a stark capacity limit of 3-4 items. However, for real-world objects, the same limits do not hold: with increasing encoding time, observers store more real-world objects and do so with more detail (Brady et al., 2009). We tested whether the benefit of extra time for real-world objects reflects the consolidation of information into long-term memory (LTM), as traditionally assumed, or whether it reflects active WM storage. To address this directly, we measured the contralateral delay activity (CDA)-a marker of WM capacity, which reflects active storage of visual information in the parietal lobe (Vogel & Machizawa, 2004). We manipulated encoding time (200ms and 1s) for real-world objects and found that:(1) the CDA continues to build in strength during the entire 1s encoding interval, and (2) this results in a CDA that is significantly larger after 1s than after 200ms ($t(11)=2.8$, $p=0.01$). Thus, the ability to remember more information about real-world objects with increased encoding time does not merely reflect LTM consolidation, but reflects active storage in WM. These results demonstrate that WM shows different properties for simple stimuli and real-world stimuli, and suggest that more work is needed to understand the properties of the WM system as we use it in the real world.

F51

REDUCING THE DECREMENT: TRANSCRANIAL DIRECT CURRENT STIMULATION REDUCES RESUMPTION TIME POST-INTERRUPTION

Cyrus K. Foroughi[1,2], Eric J. Blumberg[1,2], Melissa R. Scheldrup[1,2], Matthew S. Peterson[1,2], Raja Parasuraman[1,2], Deborah A. Boehm-Davis[1,2]; [1]Center of Excellence in Neuroergonomics, Technology, and Cognition (CENTEC), [2]George Mason University — Previous research has shown working memory is mediated by the dorsolateral prefrontal cortex (DLPFC). Transcranial direct current stimulation (tDCS) over the DLPFC modulates working memory performance. Research has shown that working memory performance can predict resumption time for a task following an interruption. The goal of this research was to determine whether tDCS would modulate resumption time of a task post-interruption. Resumption lag, or the time it takes to restart a task after being interrupted, is a common measure of the disruptiveness of an interruption. Generally speaking, the longer the resumption lag, the more disruptive an interruption is considered. Therefore, we hypothesized that anodal stimulation of the right DLPFC (F4 on the 10-20 EEG system) would reduce resumption lag post-interruption, reducing the overall disruptiveness of an interruption. Participants performed a procedural data entry task containing periodic interruptions while receiving either active (2mA) or sham anodal stimulation of F10. Participants receiving stimulation resumed tasks faster post-interruption compared to sham. These data suggest that tDCS can be used to reduce the decrements caused by interruptions.

F52

WORKING MEMORY FOR ACTION: EVIDENCE FOR USING MOTOR REPRESENTATIONS IN ENCODING VISUO-SPATIAL STIMULUS SEQUENCES

Robert Langner[1,2], Melanie A. Sternkopf[2,3], Tanja S. Kellermann[2,3], Christian Grefkes[4,5], Florian Kurth[6], Frank Schneider[3], Karl Zilles[2], Simon B. Eickhoff[1,2]; [1]Heinrich Heine University Düsseldorf, Germany, [2]Research Centre Jülich (INM-1), Germany, [3]RWTH Aachen University, Germany, [4]University of Cologne, Germany, [5]Max Planck Institute for Neurological Research, Cologne, Germany, [6]UCLA — The mechanisms of action-oriented visual working memory are not yet well understood. Here, we studied the neural correlates of translating visuo-spatial stimulus sequences into delayed (memory-guided) sequential actions to clarify whether motor representations are involved in the encoding of visual sequences that are to be reproduced subsequently. Using fMRI, we measured brain activity in 36 healthy adults while they encoded sequences of 4-7 dots appearing on fingers of a left or right schematic hand. After delays of either 500 or 7000 ms, these sequences were to be reproduced with the corresponding fingers. Recall became less accurate with longer sequences and was initiated faster after long delays. Across hands, both encoding and recall activated bilateral prefrontal, premotor, superior and inferior parietal regions as well as the basal ganglia, whereas hand-specific activity was found (albeit to a lesser degree during encoding) in contralateral premotor, sensorimotor and superior parietal cortex. Activation differences after long versus short delays were restricted to motor-related regions, indicating that rehearsal during long delays might have facilitated the conversion of the memorized sequence into concrete motor programs at recall. Furthermore, basal ganglia activity during encoding selectively predicted correct recall. Taken together, these results suggest that to-be-reproduced visuo-spatial sequences are encoded as prospective action representations ("motor intentions"), possibly in addition to retrospective sensory codes. Overall, our study supports and extends multi-component models of working memory, highlighting the notion that sensory input can be coded in multiple ways depending on what the memorandum is to be used for.

F53

STRUCTURAL DIFFERENCES IN GRAY MATTER VOLUME CORRESPOND TO INDIVIDUAL DIFFERENCES IN SPATIAL NAVIGATION ABILITY

Elizabeth R. Chrastil[1,2], Katherine R. Sherrill[1,2], Irem Aselcioglu[1], Chantal E. Stern[1,2]; [1]Boston University, [2]Athinoula A. Martinos Center for Biomedical Imaging — Spatial navigation is an important part of our everyday lives, but it is also a cognitive ability that has notable individual differences. Here we investigate how this variability relates to differences in underlying brain structure. 25 healthy young adults completed a battery of stan-

dardized spatial navigation and spatial ability measures. Participants then underwent structural MRI scanning using a high-resolution T1-weighted multi-planar rapidly acquired gradient echo (MP-RAGE) scan (TR =2530 ms; TE = 3.31 ms; flip angle = 7°; slices = 176; resolution = 1 mm isotropic). Spatial measures included a perspective-taking test (Perspective Taking/ Spatial Orientation Test, PTSOT), a route turn-following test (Road Map Test, RMT), a self-report questionnaire about navigational ability (Santa Barbara Sense of Direction Scale, SBSOD), and a questionnaire that we developed detailing video game experience. We used SPM8 to conduct voxel-based morphometry, analyzing the relationship between navigational ability and gray matter volume across the whole brain. Preliminary analysis found a relationship between task performance on the PTSOT, SBSOD, and RMT and gray matter volume in brain regions that functional studies have shown to be associated with navigation, including medial temporal lobe structures, striatum, orbitofrontal cortex, and posterior parietal cortex. Gray matter volume in the insula was also found to correlate with abilities that involved perspective-taking. Since the standardized spatial navigation and spatial ability measures focus on different aspects of spatial abilities, these results can help us develop a richer understanding of the diverse underlying cognitive processes involved in spatial navigation and their relationship to brain structure.

F54

NEURAL CORRELATES OF WORKING MEMORY DEFICITS FOLLOWING TRAUMATIC BRAIN INJURY Starla M. Weaver[1,2], Helen M. Genova[1,2], Nancy Chiaravalloti[1,2], Glenn Wylie[1,2]; [1]Kessler Foundation, [2]Rutgers New Jersey Medical School — Working memory tends to be impaired following brain injury. For example, in the popular N-back task used to assess working memory under various loads, persons with traumatic brain injury (TBI) tend to miss targets more often than their healthy counterparts. The current study assessed brain activity related to this reduced working memory performance. Persons with a TBI and healthy controls performed an N-back tasks under small, 0-back, and large, 2-back, load conditions. An event related paradigm was used to allow for a comparison of brain activity associated with both target and non-target trials. Among TBI participants, increased working memory load was associated with increased neural activation. In addition, changes in activation associated with increased working memory load varied as a function of whether the current trial was or was not a working memory target. For non-target trials, increased working memory load was associated with increased activation in frontal, anterior cingulate and parietal regions, suggesting increased engagement of the attention network. On target trials increased working memory load was associated with decreased activation of the insula and posterior regions, suggesting reduced used of the default network. It seems that increases in working memory load result in both target specific and more tonic changes of brain activation among persons with TBI. These results will be compared to those found among healthy controls.

F55

FUNCTIONAL CONNECTIVITY CORROBORATES DISSOCIABLE ABSTRACT-CATEGORY AND SPECIFIC-EXEMPLAR VISUAL OBJECT SUBSYSTEMS Brenton W. McMenamin[1], Chad J. Marsolek[2], MacKenzie F. Speer[3], Brianna K. Morseth[3], Philip C. Burton[2], E. Darcy Burgund[3]; [1]University of Maryland - College Park, [2]University of Minnesota, [3]Macalester College — A controversial issue regarding visual object representations involves categories and exemplars. Visual object representations may be abstract and categorical, in that a common representation can be activated by multiple object exemplars within a category. Alternatively, visual object representations may be specific and exemplar-based, in that different representations can be activated by different object exemplars. In contrast with the notion that a single, unified system accomplishes visual object processing, divided-visual-field studies have supported the hypothesis that dissociable and asymmetric neural subsystems underlie the ability to recognize the abstract category to which an image belongs and the ability to recognize the specific exemplar to which an image corresponds. However, neuroimaging tests of the dissociable neural subsystems theory are lacking. Here we used event-related functional magnetic resonance imaging during abstract and specific visual working memory tasks and examined functional connectivity involving visual object processing areas (left and right lateral occipital cortex) during working memory maintenance. We found that a region in the right inferior parietal lobule (RH IPL) that previously has been implicated in working memory maintenance exhibited the expected pattern of asymmetry in functional connectivity. During the abstract category task, the RH IPL had greater connectivity with left lateral occipital cortex than right lateral occipital cortex. In contrast, during the specific exemplar task, the RH IPL had greater connectivity with right lateral occipital cortex than left lateral occipital cortex. This neuroimaging evidence corroborates evidence from divided-visual-field studies in support of dissociable neural subsystems for abstract-category and specific-exemplar visual object processing.

F56

AN N250 INVESTIGATION OF WORKING MEMORY SELECTIVITY UNDER STRESS Ash Tilak[1], Lauren Walter[1], Samuel Warn[1], Martin Paczynski[1], Amishi Jha[1]; [1]University of Miami — Previous work has demonstrated that individuals readily maintain complex visual information within working memory. In the current study, we investigated how maintenance of such complex visual representations is affected by low intensity psychological stress, induced by presentation of disturbing visual images. Participants first learned to discriminate a Target face from probes which share 80%, 60%, 40%, or 20% of visual features with the Target. Participants' EEG (N=17) was recorded as they then engaged in a continuous target discrimination task in both "safe" and "stress" blocks during which either neutral or negative IAPS images, respectively, were presented. Consistent with previous behavioral findings, we found that participant performance for easily discriminable stimuli (e.g. 40%, 20%, and novel faces) was improved under stress (increased accuracy and reduced reaction time), while performance for difficult-to-discriminate (e.g., 80%) faces was impaired (decreased accuracy and increased reaction time). Behavioral responses to Target faces were unaffected by stress. The N250 monotonically decreased as a function of target-probe similarity (Target>80%>60%>40%>20%). A significant stress by target-probe similarity interaction was also found, driven by a stress-induced increase in N250 amplitude to Targets and decreased N250 amplitude to 80% probes; this decrease correlating with stress-induced reaction time increases to 80% probes. Taken together, our results suggest that participants may maintain representations of both Target and 80% probes in working memory to aid in discriminating between two visually similar stimuli, while, under mild stress, only the Target representations may remain active. Thus, representation selectivity to target stimuli may increase under mild stress.

LANGUAGE: Development & aging

F57

LANGUAGE DEFICITS IN AUTISM AND ASSESSMENT OF THE CNTNAP2 KNOCKOUT MOUSE Amanda Rendall[1], Dongnhu Truong[1], Brian Castelluccio[1], Inge-Marie Eigsti[1], R. Holly Fitch[1]; [1]University of Connecticut — Autism Spectrum Disorder (ASD) is a heterogeneous neurodevelopmental disorder with deficits in social interactions, language/communication and repetitive behaviors. ASD has a strong though complicated genetic basis, with at least 100 risk genes identified. One of these genes, contactin associated like protein 2 (CNTNAP2), was first associated with Specific Language Impairment (SLI) and has been linked to ASD. CNTNAP2 is responsible for encoding a cell adhesion protein that regulates signal transmission at the synapse. In addition, Cntnap2 has been found to promote myelin formation and speed/efficacy of signal transmission. Therefore, disruption of CNTNAP2 may impair synapse formation, resulting in disruptions in language development. Research on language deficits in ASD and SLI indicates that low-level deficits in temporal auditory processing may impair language development. In contrast, hyper-acute pitch discrimination was found to correlate with early language delays in ASD (Eigsti, 2013). To better understand the behavioral and biological mechanisms of ASD, a transgenic mouse model was generated with a genetic knockout (KO) of the rodent homolog of CNTNAP2. Studies of this model reported poor social interactions and reduced vocalizations (Peñagarikano, 2011). The current study was designed to assess the intermediate behavioral phenotype, focusing on temporal auditory processing and pitch discrimination abilities. Results show Cntnap2 KO mice exhibit significant deficits in rapid auditory processing and significant strengths in pitch discrimination. These findings suggest CNTNAP2 may have an underlying role in the develop-

ment of neural systems important to auditory temporal processing, and disruption of this function could be associated with language impairments in ASD.

F58

INVESTIGATING THE NEURAL CORRELATES OF VOICE OR CONTENT DIRECTED INFORMATION WITHIN HUMAN SPEECH IN PRE-SCHOOL CHILDREN

Sara Ashley Smith[1,3], Nora Maria Raschle[1,2], Jennifer Zuk[1,2], Maria Regina Dauvermann[1,2], Michael Joseph Figuccio[1], Nadine Gaab[1,2,3]; [1]Laboratories of Cognitive Neuroscience, Division of Developmental Medicine, Department of Medicine, Boston Children's Hospital, [2]Harvard Medical School Boston, [3]Harvard Graduate School of Education — Speech processing implicitly requires the analysis of the human voice, which conveys both linguistic and extra-linguistic information. Studies in newborns and infants propose that the superior temporal sulcus (STS) is involved in speech processing soon after birth. However, due to technical and practical challenges when neuroimaging young children, evidence of neural correlates of voice processing in young children remains scarce. In the current study, we employed whole brain functional magnetic resonance imaging (fMRI) in 20 typically developing children (mean age=5.8y) to investigate the neuronal correlates of voice matching with a particular view on directing attention to speaker identity (VM: voice matching) as opposed to the verbal content (FSM: first sound matching) of speech. Results (p=0.005) reveal a common network of brain regions responsible for processing content directed and voice-specific components of speech including bilateral primary and secondary language brain areas. The contrast VM>FSM predominantly activates the anterior part of the right-hemispheric STS. This finding underlines the importance of the right STS as a temporal voice area and indicates that this brain region is specialized, and functions similarly to adults by the age of five. Furthermore, analyses of functional connectivity with seeds in bilateral STS reveal positive coupling between right STS and temporal as well as prefrontal regions. We thus extend previous knowledge of voice-specific regions and their functional connections to the young human brain which may further our understanding of the neuronal mechanism of speech-specific processing in children with developmental disorders, such as autism or specific language impairments.

F59

SUCCESSFUL SECOND LANGUAGE LEARNING IS MODULATED BY NEURAL MECHANISMS RESPONSIBLE FOR PROCESSING OF FEEDBACK

Olga Kepinska[1], Ferdi van de Kamp[1,2], Johanneke Caspers[1], Niels O. Schiller[1]; [1]Leiden University, [2]Utrecht University — This study aimed to examine the role of Language Analytic Ability (LAA) in feedback processing during the acquisition of a novel language. We investigated whether the neural basis of feedback processing during an artificial grammar-learning (AGL) task differs between populations of highly and moderately skilled second language learners. Two groups (high vs. moderate LAA) of 15 participants each were formed on the basis of a test measuring LAA (part of the LLAMA language aptitude test) in a large group of participants (N=200). Participants performed an AGL task that consisted of learning and test phases. Event-related potentials (ERPs) evoked by feedback provided after participants' grammaticality judgments on test items were analyzed. Behavioral data showed a learning effect in both groups, with a faster rate of learning for the highly skilled learners. Between-group analyses were performed with group as independent variable and mean amplitudes of feedback-related negativity (FRN) and positivity (FRP) at midline electrodes as dependent variables. In addition, an analysis examining learning-related development of these ERP components was performed. Mean amplitude of the FRN was higher over the whole task for highly compared to moderately skilled learners. Also, a larger decrease of FRP over time among the highly skilled learners was observed. The results suggest that successful and efficient second language learning is modulated by neural mechanisms responsible for processing of feedback.

F60

PHONOLOGICAL AND LEXICAL-SEMANTIC EVENT-RELATED POTENTIALS ARE ATYPICAL IN CHILDREN WITH DEVELOPMENTAL LANGUAGE DISORDER (DLD)

Sergey Kornilov[1,2,3], James Magnuson[1,3], Natalia Rakhlin[2], Elena Grigorenko[2,3,4], Nicole Landi[1,2,3]; [1]University of Connecticut, [2]Yale University, [3]Haskins Laboratories, [4]Moscow City University for Psychology and Education — Most ERP studies of DLD to date have focused on auditory (tone) and speech processing. We investigated phonological and lexical-semantic processing in school-aged children with DLD (n=23) and their typically developing (TD, n=16) peers, drawn from a population in rural Russia with high incidence of DLD in the absence of apparent sensory, neurological, or genetic pathology. We used a cross-modal auditory word-picture matching paradigm where children saw pictures and heard words in five conditions: a) Match (target condition; see and hear "cat"); b) Cohort (initial phonological overlap; see "cat", hear "coat"); c) Rhyme (see "cat", hear "hat"); d) Semantic (semantically related, see "cat", hear "mouse"); and e) Unrelated (see "cat", hear "doll"). Conventional amplitude/latency analysis and temporospatial principal component analysis indicate that children with DLD showed atypical early occipital negativities (N2, 196 ms post-stimulus-onset) across all conditions ($p = .002$). Crucially, children with DLD showed reduced N400s for Cohorts ($p = .001$) and Unrelated words ($p = .024$). The N400 reduction for Cohorts but not Unrelated words was associated with lower scores on behavioral indices of phonological ($r = -.46$, $p = .006$) and lexical development ($r = -.47$, $p = .004$). These results suggest that children with DLD display deficits in the dynamics of lexical activation and lexical semantic processing potentially coupled with or mediated by deficits in phonological processing. In particular, the reduced Cohort and Unrelated N400 effects - both failures to show robust responses to mismatches in onset phonology - are consistent with weak phonological inhibition.

F61

LONGITUDINAL INVESTIGATION OF RISK FACTOR IN EMERGING WEAKNESS IN GRAMMAR UNDERSTANDING IN RUSSIAN-SPEAKING CHILDREN

Sergey Kiselev[1]; [1]Ural Federal University — The goal of this research was to examine the hypothesis that Russian-speaking children at the age of 4 with weakness in holistic abilities have a risk in emerging weakness in grammar understanding at the age of 6. 78 children at the age of 4 were assessed with the Rey-Osterieth Complex Figure Test to reveal children with different level of holistic abilities. We have revealed 14 children with immature (part-oriented) strategy in copying Complex Figure. These children were included in the experimental group with weakness in holistic abilities. The control group included 12 children with holistic strategy in copying Complex Figure. In the framework of longitudinal research children at the age of 6 from both groups were assessed by Grammar Understanding Test from Luria's neuropsychological assessment technique. Two-way ANOVAs with repeated measures revealed significant differences between groups for scores in the Grammar Understanding Test. Children from experimental group had weakness in grammar understanding. Therefore, we revealed that children at the age of 4 with weakness in holistic abilities have a risk in emerging weakness in grammar understanding at the age of 6. In view of the obtained results, it can be assumed that brain mechanism responsible for holistic abilities has influence on the development of grammar understanding in preschool children.

LANGUAGE: Lexicon

F62

AN ERP STUDY FOR THE PHONETIC CONSISTENCY AND HOMOPHONE DENSITY EFFECTS IN WRITING CHINESE CHARACTERS

Pei-Chun Chao[1], Wei-Fan Chen[2], Chia-Ying Lee[1,2]; [1]Institute of Neuroscience, National Yang-Ming University, Taiwan, [2]Institute of Linguistics, Academia Sinica, Taiwan — The bi-modal interactive-activation model (BIAM) assumes that the bidirectional mapping consistency between orthography (O) and phonology (P) (P-to-O and O-to-P consistency) shall influence a word's recognition in both visual and auditory modalities. In Chinese, most of characters are phonograms that consist of a semantic radical and a phonetic radical. The reliability of a phonetic radical in providing the whole character's phonological clue can be defined by phonetic consistency (whether the pronunciation of a character agrees with those of its orthographic neighbors containing the same phonetic radical). Studies have demonstrated the phonetic consistency effect in reading, yet it is unclear such an effect could be found in auditory modality. This study aims to investigate the bidirectional

coupling between orthography and phonology in writing Chinese characters with dictation by manipulating the O-to-P consistency (measured by the phonetic consistency) and P-to-O consistency (the homophone density, the number of characters sharing exactly the same pronunciation). Participations would hear 108 monosyllabic Chinese spoken words, and then were asked to write down the corresponding characters. These candidates for orthographic outputs were divided into four conditions based on their phonetic consistency (high/low) and homophone density (high/low). The event-related potentials (ERPs) to the spoken words revealed an interaction between phonetic consistency and homophone density on N400 and typical homophone density main effect at the later time window (600-800msec). These findings support the reverberation of the O-to-P consistency effect in Chinese writing to dictation.

F63

LEVELS OF VISUAL WORD PROCESSING IN TYPICAL ENGLISH SPEAKING ADULTS: AN FMRI STUDY Elpis Pavlidou[1,2], W. Einar Mencl[2], Dina L. Moore[3], Stephen J. Frost[2], Kenneth R. Pugh[2,4,5]; [1]The University of Edinburgh, [2]Haskins Laboratories, [3]Southern Connecticut State University, [4]University of Connecticut, [5]Yale University — We examined the effects of different levels of visual word processing on the neural circuitry for reading in 20 (10 males; 10 females) neurologically normal native English speakers (20-46 years, Median = 28). Behavioral and neuroimaging data were obtained from three experimental conditions, which increased the degree of processing demands (i.e. simple naming < Go/No-Go lexical < Go/No-Go semantic). We manipulated the spelling-to-sound consistency of the words within each task and stimuli were matched on frequency, number of letters, and on number and summed frequency of friends (words with the same spelling and pronunciation of the word body, e.g., MILL vs. PILL) and enemies (words with the same spelling of the word body but a different pronunciation, e.g., PINT vs. MINT). Tasks were conducted in separate functional imaging runs. We observed that as the demands on processing increased so did the role for posterior reading areas, including the middle temporal gyrus (MTG) and the angular gyrus (AG) as well as the connectivity between these areas. Thus, the role of AG in reading may go beyond its proposed involvement in the mapping of letters to phonemes. Analyses on the effects of consistency of words confirmed the involvement of more posterior regions of inferior frontal gyrus (IFG) in phonological processing: inconsistent words activate IFG more than consistent due to resolving competing phonological codes. In line with developmental studies, we speculate that this anterior system operates in close conjunction with the temporoparietal system to decode new words during normal reading development.

F64

CLASSIFIER INFORMATION AFFECTS SPEECH PRODUCTION: ELECTROPHYSIOLOGICAL EVIDENCE FROM OVERT SPEECH IN MANDARIN CHINESE Man Wang[1,2], Yiya Chen[1,2], Niels O. Schiller[1,2]; [1]Leiden Institute for Brain and Cognition (LIBC), Leiden, The Netherlands, [2]Leiden University Centre for Linguistics (LUCL), Leiden, The Netherlands — The current study investigated the role of classifier selection in speech production in Mandarin Chinese. This study asked native Mandarin speakers to name pictures using the picture-word interference paradigm in two different tasks while measuring their electroencephalogram. Bare noun naming yielded both semantic congruency and classifier congruency effects. Participants also named the same pictures in a noun phrase consisting of the elements "one + classifier + noun". In this condition, the semantically-related distractor words affected picture naming in contrastive ways depending on whether or not their classifiers were congruent with those of the picture names. Results of bare noun naming showed stronger N400 effects when the distractor (e.g. duck) and the picture name (e.g. hand) belonged to different semantic categories, compared to when the distractor (e.g. foot) was from the same category as the picture name, regardless of classifier congruency. In semantically congruent trials, stronger late positive effects were observed around 600 ms after picture onset when the classifier of the distractor was incongruent (e.g. classifier-ge4, head) with the picture name (e.g. classifier-zhi1, hand), compared to the congruent condition (e.g. classifier-zhi1, duck). These results provide evidence supporting the hypothesis that our brain retrieves and encodes linguistic information in a sequential manner - semantic congruency occurs at an earlier stage whereas classifier congruency affects a later stage in speech production.

F65

IMPLICIT LEARNING OF NOVEL COLOR WORDS IN A MANUAL STROOP TASK? - DISTINGUISHING RESPONSE LEARNING FROM SEMANTIC LEARNING Sebastian Geukes[1], Dirk Vorberg[1], Pienie Zwitserlood[1]; [1]University of Muenster, Germany — In the manual version of the Stroop task, participants are asked to press the button whose color corresponds to a presented word's text color. If the word is a color word that is incongruent to the text color, responses are typically slower compared to the case where the color word is congruent to the text color. If in such a task, pseudowords are presented instead of color words, and if each of the pseudowords is presented in one of the colors more frequently than in the others, a similar but smaller congruency effect emerges over time. This phenomenon promises to be an interesting approach for the investigation of basic semantic integration effects in novel word learning. However, because this paradigm includes a fix layout of colored buttons, it is unclear whether the learned association is that of the word and the color meaning or that of the word and the response position. To test whether word learning in this paradigm represents semantic learning, response learning, or a mixture of both, we independently varied color and response contingencies. We found strong evidence for response learning but none for semantic learning. Thus, this implicit learning procedure seems to lack the prerequisites necessary for the semantic integration of novel words. Nevertheless, because such a low-level investigation of novel word integration allows to exclude many potentially contributing factors, we consider it a valuable complement to the more natural and more complex studies on novel word learning.

F66

NEUROCOGNITIVE PROPERTIES OF CONCATENATIVE AND NON-CONCATENATIVE MORPHOLOGY IN ARABIC: EVIDENCE FROM MULTIVARIATE FMRI ANALYSES. Francesca Carota[1], Sami Boudelaa[1,2], Mirjana Bozic[1], William D. Marslen-Wilson[1]; [1]Neurolex Group, Department of Psychology, Downing Site, University of Cambridge, Cambridge CB2 3EB, UK, [2]Department of Linguistics, United Arab Emirates University, Po Box 17771 Al Ain, UAE — Results from Indo-European languages suggest that morphological derivation activates a bilateral fronto-temporal network underlying whole-form access processes, whereas inflection involves a left-lateralised fronto-temporal subsystem specialised for grammatical combinatorial processes (Bozic et al. 2010; 2013). However, it is unclear whether these patterns also hold for typologically more distant languages. Recent fMRI work on the Semitic language, Arabic, analysed using classical univariate methods, suggested that non-concatenatively complex words (kaatib, "writer", derived by interleaving roots ktb, "writing" and word patterns -aa-i-, "agent noun") as well as concatenatively complex words (kitaab+uhaa, "her book", formed by linearly adding an inflectional affix to a non-concatenative stem) activated the same left-lateralised fronto-temporal network as supports concatenative inflection in English and in Slavic languages. Here we explored the neurocognitive properties of Arabic morphology using multivariate Representational Similarity Analysis (RSA: Kriegeskorte et al., 2006) to ask whether differences in morphological organization were coded in neural activation patterns across key fronto-temporal regions. Brain responses to non-concatenative and concatenative complexities were correlated to theoretical models that predict distinct similarity-patterns for each process, using partial correlation to separate out process-specific similarity effects. RSA revealed fine-grained fronto-temporal similarities between non-concatenatively complex words in bilateral inferior frontal areas (BA45-47), left temporal pole and left inferior temporal areas, related to semantic comprehension. In contrast, concatenative complexity was correlated with left-lateralised inferior frontal (BA44) and bilateral superior/middle temporal areas, relevant to the processing of syntactic structure. These results suggest subtle underlying parallels and differences in the neural encoding of morphological functions across contrasting language families.

F67

NEUROCOGNITIVE SUBSTRATES OF MORPHOLOGICAL REGULARITY IN ARABIC: BEHAVIOURAL AND IMAGING EVIDENCE

Sami Boudelaa[1,2], Francesca Carota[2], Mirjana Bozic[2], William Marslen-Wilson[2,3]; [1]United Arab Emirates University, Linguistics Department, PO. Box: 15551 Al Ain, UAE, [2]University of Cambridge, Department of Psychology Downing St, Cambridge CB2 3EB, UK, [3]MRC Cognition and Brain Sciences Unit, Cambridge, 15 Chaucer Road, Cambridge CB2 7EF — Behavioural and neuroimaging studies of English suggest that regular and irregular inflectional processes depend on distinct cognitive mechanisms and associated cortical structures. Here we combine behavioural and imaging methods to re-examine the role of regularity in the context of Arabic inflectional morphology, where the plural system allows novel and unconfounded contrasts between regular and irregular plurals (known as sound and broken plurals, respectively). Three lexical decision experiments, using masked, cross-modal and intra-modal auditory-auditory priming, found that regular plurals (as in prime/target pairs like jawolAt / jawola , tours/tour) and irregular plurals (as in pairs like EawASim /EASima , capitals/capital) were equally effective in priming their stems, showing that regularity contrasts need not invoke different cognitive response patterns. A fourth experiment used event-related fMRI to contrast spoken regular and irregular singular and plural forms, employing a passive listening paradigm with occasional 1-back memory tests. Consistent with the behavioral results, no differences were found as a function of regularity, either for the singular source nouns or for the regular (sound) or irregular (broken) plurals. Bilateral STG and MTG were strongly activated for all stimulus sets, but LIFG activation was only seen for the singular forms possibly implying a greater degree of storedness for the plural forms. The overall convergence of the behavioural and imaging data for Arabic suggest that regularity, per se, is not a universal determinant of neurocognitive processing style.

F68

NEURAL CORRELATES OF A LANGUAGE AND NON-LANGUAGE VISUOSPATIAL PROCESSING IN ADOLESCENTS WITH READING DISABILITY

Anish M. Kurian[1,2], Joshua J. Diehl[1,3], Stephen J. Frost[1], W. Einar Mencl[1], Kenneth R. Pugh[1,2]; [1]Haskins Laboratories, New Haven, CT, [2]Department of Psychology, University of Connecticut, Storrs, CT, [3]Department of Psychology, University of Notre Dame, Notre Dame, IN — The current study examined the cognitive and neural bases of visuospatial processing abilities in adolescents with reading disability (RD) relative to typically developing (TD) peers. Research on RD has often focused on the neurocognitive basis of phonological deficits; however, there remains interest in the contributions of visual processing abilities to reading and its disorders. In the current study, we used several cognitive tasks along with functional Magnetic Resonance Imaging (fMRI) to contrast print processing tasks with non-language visuospatial processing tasks. Specifically, we expect to see an enhanced ability in RD individuals in visuospatial processing tasks compared to TD peers. Behaviorally, RD individuals showed a visuospatial processing advantage (shorter latencies and equivalent accuracy) on a geometric figure-processing task relative to TD peers, replicating findings in two published studies. Analysis of fMRI data revealed a disordinal pattern across fronto-striatal networks (putamen, motor and premotor sites) with decreased activation for RD relative to the TD for figures but the opposite pattern for print. Additionally, fMRI data revealed a stronger hemispheric differentiation for print vs. figures for TD but not for RD participants. For TD individuals, several LH networks responded more strongly to print than figures (fusiform and IFG), while a number of RH networks (IPL, fusiform, and MFG) showed stronger responses to figures relative to print, with less overall hemispheric differentiation for RD individuals. These findings suggest a more circumscribed and efficient neural organization for those stimuli in which a given group showed a latency advantage; thus revealing convergent brain and behavioral data.

LANGUAGE: Other

F69

LANGUAGE MODULATED COLOR PERCEPTION IN GREEK-ENGLISH AND RUSSIAN-ENGLISH BILINGUALS

Brendan Tomoschuk[1], Janet G. van Hell[1], Guillaume Thierry[2], YanJing Wu[3]; [1]Pennsylvania State University, [2]Bangor University, [3]University of Sheffield — Can the language you speak affect your perception of the world? Thierry et al. (2009) showed that the Greek language affects how native Greek speakers process the color blue (two terms in Greek: ghalazio light blue and ble dark blue). Using the visual Mismatch Negativity (vMMN) component of Event Related Potentials (ERPs) as an index of perceptual change, they showed that native speakers of Greek perceived the switch between these two shades more saliently in an oddball paradigm than the switch between two shades of green (one term in Greek - prasino). We sought to show that color perception can be modulated by the alphabetic context in the task at hand. Greek-English bilinguals were subjected to a go-no go judgment task while ERPs were recorded. Participants were presented with letters from the Roman alphabet in the first block, letters from the Greek alphabet in a second. They pressed a button for upper case letters (5%) and ignored lower case ones (95%). Letters were surrounded by peripherally perceived color circles in light or dark blue and light or dark green. The probability of occurrence of the circles conformed to an oddball paradigm and participants received no instruction regarding color. Greek and Roman letters created a language-based script context. Findings show that language context does not affect color perception. We are currently running a follow up using Russian-English bilinguals to understand the role of attention on color perception (Russian, like Greek, has two terms for blue - ”goluboy” and ”siniy”).

F70

RELATIONSHIPS BETWEEN SEQUENCE LEARNING, LANGUAGE, AND SOCIAL ENVIRONMENTAL VARIABLES: AN EVENT-RELATED POTENTIAL STUDY.

Joanne A. Deocampo[1], Leyla Eghbalzad[1], Michelle Pinns[1], Jerome C. Daltrozzo[1], Christopher M. Conway[1]; [1]Georgia State University — Research suggests sequence learning (SL) is an essential component of language development; however, neural evidence, especially in children, is scarce. In addition, although research has shown that certain demographic variables, such as primary caregiver’s (PC) education level, are related to language outcomes, there has been minimal research examining the relationship between these and SL. We measured event-related potentials (ERPs) in 10 children aged 7-12 while performing a SL task. Participants pressed a button when they saw targets in a stream of standards. Embedded within the sequence were high and low predictor items that preceded the target with 90% and 20% probability. ERPs time-locked to each predictor and reaction times (RTs) were obtained for the 3 probability conditions. Various language, cognitive, and demographic measures were also obtained. ERP results revealed a late positivity (300-800ms post-predictor onset in the left posterior region) that showed a trend toward increasing with probability [$F(2, 18) = 2.958$, $p = .078$]. Furthermore, Spearman’s correlations indicated that PC education was significantly positively correlated with the difference in RT between the low-high predictor conditions [$rs(8) = .658$, $p = .039$]; other correlations were observed between language, SL, and demographic measures. These results suggest that SL is associated with an ERP component similar to a P300 or P600, replicating earlier results with adults and children (Christiansen et al., 2012; Jost et al., 2011). Furthermore, PC education appears to modulate SL, providing new evidence that social environmental factors can contribute to the development of SL.

F71

DISRUPTED WHITE MATTER IN APHASIC PATIENTS WITH MOVEMENT DEFICITS

Y. H. Wu[1], Fan-pei Yang[1], Y. L. Tsai[1], C. M. Lin[2], C. Y. Hsu[3], B. S. Yip[3], S. H. Lin[3], T. M. Chiang[4], L. Y. Tseng[3], L. Y. Hong[3], L. P. Chen[3], L. W. Kuo[5]; [1]National Tsing Hua University, Taiwan, [2]Changhua Christian Hospital, Taiwan, [3]National Taiwan University Hospital, Hsinchu Branch, Taiwan, [4]Hsinchu Cathay General Hospital, Taiwan., [5]National Health Research Institutes, Miaoli, Taiwan. — Stroke patients with aphasia often demonstrate deficits in various domains. Some preserve good language abilities but poor motor movements; others retain good movements but poor speech; still others

show severe deficits in both. Disruptions in white matter (WM) tracts may be associated with these impairments. Current research has not shown consistent findings. The study aims to investigate WM damage in aphasic patients with or without movement disorders using diffusion tensor imaging (DTI). Six stroke patients with Broca's Aphasia (4 males, 2 females, mean age = 48.3, SD =10.4) underwent DTI and T1 scans and the Concise Chinese Aphasia Test (CCAT). The tractography revealed that longitudinal tracts are mostly intact in patients, suggesting that motor or speech deficits are less associated with these tracts. Interestingly, corpus callosum (CC) was severely damaged in patients with severe aphasia but moderately damaged in patients with serious movement deficits. This suggests that CC's connection between two hemispheres is crucial for speech, but less so for movement. Besides, patients with poor speech while retaining good movements usually show great damage in cortico-spinal tracts in the frontal branch (CSf). This suggests that CSf affects speech production but not motor movement coordination. In sum, the hemispheric disconnection due to damaged CC have moderate to large impacts on speech and movement, whereas CSf only affects the speech ability. Continuous analysis of more aphasic stroke patients' WM will reveal more insights into the functions of specific pathways, affected or rewired, in this population.

F72

PRE-EXISTING AUDITORY PERCEPTUAL ABILITIES, NOT BILINGUALISM, PREDICT NOVEL SPEECH LEARNING Pilar Archila-Suerte[1], Arturo Hernandez[1]; [1]University of Houston — The goal of this study was to investigate how phonetic experience in two languages influences the perception of novel speech sounds and to reveal the underlying neural mechanisms involved in novel speech learning. Adult English monolinguals (n = 20) and early Spanish-English bilinguals (n = 24) participated in four consecutive sessions of phonetic discrimination training (same vs. different) while listening to Hungarian pseudowords that contained novel phonemes. Participants completed two fMRI sessions, one before training and another one after training. The in-scanner task consisted of passively listening to the novel speech stimuli with which participants trained outside the scanner. The behavioral results showed that even though monolinguals and bilinguals learned after training, the groups did not significantly differed from each other in the discrimination of novel speech. Nonetheless, the neural processes engaged by monolinguals and bilinguals differed after training (left anterior cingulate gyrus in monolinguals and bilateral parietal regions in bilinguals). An additional post-hoc regression analysis examined how participants' overall discrimination performance predicted brain activity before and after training. Here it was found that, regardless of language group membership, better perceivers were more likely to recruit sensory-perceptual areas (bilateral superior temporal gyrus), whereas worse perceivers were more likely to recruit higher-order cognitive areas after training (right postcentral gyrus, superior parietal lobule, and left supramarginal gyrus). These findings suggest that growing up in bilingual phonetic environments does not facilitate novel speech learning. Instead, the ability to discriminate novel speech appears to originate from individual enhanced perceptual abilities present prior to training.

F73

BUILDING PHRASES VS. WORDS: AN MEG INVESTIGATION Meera AlKaabi[1], Liina Pylkkänen[2]; [1]New York University, NYNYC, [2]NYUAD Institute, NYUAD — A central part of knowing a language is the ability to combine basic linguistic units into more complex representations. Whether complex phrases and complex words are built by the same combinatory mechanisms has been a matter of significant theoretical debate (e.g., Aronoff, 1994; Marantz, 1997). Within cognitive neuroscience, composition has so far been studied at the phrasal level, but not at the word level. Within the phrasal research, several recent studies have implicated the left anterior temporal lobe (LATL) as the strongest candidate for combinatory effects across words (Bemis & Pylkkänen, 2011; 2013ab). This study is an MEG investigation of the neural correlates of within-word vs. across-words composition. The main goal was to test whether within-word composition deploys the same brain mechanisms as across-words composition, with a primary focus on the LATL. Our design used three noun types, varying in internal structure: compound, suffixed and monomorphemic nouns. Each condition appeared in a modified (preceded by an adjective) and non-modified (preceded by an unpronounceable string of consonants) context. ROI and full brain analyses showed significantly larger activity in the LATL for compounds and suffixed nouns than for monomorphemic nouns, in the non-modified context. However, within-word and across-word composition interacted interestingly: across word composition effects were only observed when the target noun was itself structurally simple, i.e., across words and within-word composition effects did not linearly add up. In sum, our results provide the first neurophysiological demonstration that composition mechanisms within-words and as across-words may in fact be qualitatively the same.

F74

NEURAL BASIS OF THE LEFT VISUAL FIELD SUPERIORITY FOR PROCESSING CHINESE CHARACTERS Wen-Jui Kuo[1], Chad Chen[1], Ovid Tzeng[2]; [1]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan, [2]Institute of Linguistics, Academia Sinica, Taipei, Taiwan — The goal of this study is to examine neural basis of the left visual field (LVF) superiority for processing Chinese characters. Chinese characters were simultaneously, bilaterally presented to the participants, one in the LVF and one in the RVF. On the same (visual) presentation frame, there was a central cue (< or >) accompanying the two characters to indicate which character (the LVF one or the RVF one) to attend and process for lexical decision. For robustness checking, frequency of the characters was included as a variable and varied (low, medium, and high). Behavioral data of reaction time and accuracy, across all three frequency levels, showed robust, stable LVF superiority. That is, characters presented in the LVF were processed with higher efficiency and accuracy. Our findings are consistent with what a previous study reported (Tzeng et al., 1979). By suing fMRI, we found that the processing characters presented in the LVF resulted in greater activity in the right parietal region. Therefore, the LVF superiority for processing Chinese characters seems to be supported by the higher efficiency of the dorsal processing stream.

F75

THE NEURONAL LATERALITY OF THE PHONOLOGICAL AND VISUAL SIMILARITY EFFECTS IN PROBED SERIAL RECOGNITION IN CHINESE-ENGLISH BILINGUALS Monica Y.C. Li[1,2], Daisy L. Hung[1,2], Ovid J.-L. Tzeng[2,3], Denise H. Wu[1,2]; [1]National Central University, Taiwan, [2]National Yang-Ming University, Taiwan, [3]Academia Sinica, Taiwan — Previous behavioral findings of verbal short-term memory (STM) have suggested that English monolinguals mainly depend on phonological representation to retain English words, whereas unbalanced Chinese-English bilinguals utilize both phonological and orthographic information to retain English (L2) words as they do with Chinese (L1) characters. To determine whether such functional differences between the two groups of participants reflect distinct neural mechanisms underlying verbal STM, the current fMRI study investigates the neural responses associated with the effects of phonological and visual similarity (PSE and VSE) of English words in a probed serial recognition paradigm in English monolinguals and in Chinese-English bilinguals. The neuroimaging results generally showed a left lateralized fronto-temporo-parietal network of verbal STM for both groups of participants. The PSE was associated with a left lateralized and a more bilateralized fronto-parietal networks in native English readers and in Chinese-English bilinguals, respectively. On the other hand, the VSE was only associated with a right lateralized fronto-parietal network in Chinese-English bilinguals, but not with any brain region in native English readers. The present findings indicate that reading experiences modulate the neural mechanisms underlying verbal STM. They also suggest that the behaviorally observable VSE only in Chinese-English bilinguals might be associated with the right lateralized fronto-parietal activations which support the successful retention of visual/orthographic information of verbal materials.

LANGUAGE: Semantic

F76

EFFECTIVENESS OF LOW-FREQUENCY REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION ON POST-STROKE CHINESE APHASIA Yu-Chun Liao[1], Wen-Hsu Sung[2], Po-Yi Tsai[3], Tzu-Chen Yeh[3]; [1]National Taiwan University, [2]National Yang-Ming University, [3]Taipei Veterans General Hospital — Previous studies have shown that low-frequency repetitive transcranial magnetic stimulation (LF-rTMS) activates aphasic patients' left

inferior frontal gyrus (IFG) and improves their naming ability. However, most of the studies examine the effects of LF-rTMS on English-speaking aphasics, but not post-stroke Chinese aphasia (pSCA). Therefore, the aim of the current study was to investigate the effectiveness of LF-rTMS in patients with pSCA. More specifically, we were interested in how LF-rTMS would change Chinese-speaking aphasic individuals' linguistic performance and brain activities. The patient was a 27-year-old woman with chronic nonfluent pSCA. LF-rTMS was applied to her pars triangular portion of right Broca's homologue at 1 Hz, 20 minutes per day over the period of ten days. Additionally, functional magnetic resonance imaging (fMRI) data and scores on a set of neurolinguistic tests were obtained before and after the LF-rTMS sessions. The results showed that the average response time was significantly decreased to 24.5 (±4.95) seconds from 56.5 (±10.60) seconds after the LF-rTMS sessions. Additionally, the fMRI data showed that the patient with pSCA used the right Brodmann area 44/ 47/ 22/ 39 (language-homologous areas, LHAs) to compensate for the language-impaired abilities. In sum, the patient with pSCA used the right LHAs but not the left hemisphere to shorten the speed of linguistic processing, suggesting that Chinese-speaking aphasics and English-speaking aphasics might use different neural circuits to compensate for their speech impairment.

F77

NEURAL CORRELATES OF VERBAL FLUENCY Alex Teghipco[1], Eduardo Navarrete[2], Bradford Mahon[1,3,4]; [1]Department of Brain & Cognitive Sciences, University of Rochester, USA, [2]Department of Developmental and Social Psychology, University of Padova, Padova, Italy, [3]Department of Neurosurgery, University of Rochester Medical Center, USA, [4]Center for Language Sciences, University of Rochester, USA — Neuroimaging studies employing exogenous paradigms that utilize carefully controlled stimuli have demonstrated the importance of a network of brain regions involved in semantic processing and language production. The present study used an overt speech production task during functional Magnetic Resonance Imaging (fMRI) to study regions associated with letter, noun and verb fluency. We developed a new method for clustering the words that participants produce in verbal fluency into clusters, defined either by inter-item latency or inter-item semantic similarity; this new method was validated with a behavioral study (Experiment 1). We then repeated this experiment during fMRI scanning, while also recording all response latencies in the magnet. We show that we are able to replicate the findings from previous studies of the neural correlates of verbal fluency, and to significantly extend those findings. For instance, previous work had shown that Blood Oxygen Level Dependent (BOLD) contrast in the left inferior frontal gyrus dissociates clusters from cluster switches. We replicated that finding, and then showed that the left inferior frontal gyrus tracks inter-item response latency in clusters, but only during letter fluency. Furthermore, BOLD responses in the left fusiform gyrus and posterior middle temporal gyrus negatively correlate with inter-item semantic similarity and inter-item latency, both for clusters but also for cluster switches. These findings shed new light on the roles played by left hemisphere regions long identified to be involved in semantic and language processing, and provide a new means with which to study spontaneous speech in a controlled fashion with fMRI.

F78

FAST RIGHT-HEMISPHERE NEURAL SYSTEMS FOR READING EMOTION FROM WRITTEN WORDS Tomoe Inomata[1], Kimihiro Nakamura[2], Akira Uno[1], Hidenao Fukuyama[2]; [1]University of Tsukuba, Japan, [2]Kyoto University, Japan — Reading is generally known to involve distributed regions in the left hemisphere. However, previous research suggests that written words with emotional valence quickly activate additional neural components distinct from this reading network, such as the left and right amygdala showing sensitivity to fearful non-linguistic stimuli. We examined the entire stretch of the neural systems for emotion words and its potential hemispheric bias by using functional magnetic resonance imaging. Fifteen healthy adults participated in the present study. In each trial, participants made concrete/abstract judgment about a centrally presented target preceded by a masked prime flashed to the left or right visual field. Targets and primes were Japanese Kanji (logographic) words having either positive or negative emotional valence, and were either emotionally congruent or incongruent with each other. Frequency and imageability were matched between positive and negative words. Behaviorally, reaction time for emotionally congruent targets were faster than that of incongruent targets for positive primes, and negative primes produced opposite patterns of congruency priming, irrespective of their visual field, creating a significant interaction between affect type and emotional congruency. At the neural level, this affective priming was associated with repetition suppression primarily in the right hemisphere, including the temporo-parietal junction and amygdala previously associated with emotion processing. These results suggest that subliminal emotion words rapidly engage these structures outside the typical reading network in the left hemisphere, and that this automatic activation occurs irrespective of the functional requirements of behavioral tasks.

F79

DISSOCIATING SEMANTIC REPRESENTATION AND COMBINATORIAL PROCESSING IN HUMAN VENTRAL PATHWAY Gangyi Feng[1], Qi Chen[1], Jian Huang[1], Suiping Wang[1]; [1]School of Psychology, South China Normal University, Guangzhou, China — Comparing with reading or listening random word lists, reading or listening sentences evoke greater BOLD signal changes in left ventral pathway, including fronto-tempo-parietal regions. Two theoretical components, semantic association and combinatorial processes, have been proposed to be critical for sentence comprehension. However, the contributions of sub-regions within this ventral pathway to these two components are elusive. We addressed this question by using a priming paradigm and manipulating the linguistic relationship between prime and target. Word-pair phrases with four types of relationships were constructed: combinatorial ("lemon-cake"), semantically associated ("bread-cake"), unrelated ("driver-cake"), or pseudoword-word ("kmbol-cake") relation. Both implicit (Experiment 1) and explicit (Experiment 2) semantic processing tasks were used to explore how different task demands modulate activation of related regions. Twenty-six subjects were recruited in this fMRI study, in which subjects were required to participate in both two experiments. Experiment 1 used a lexical-semantic decision task. It is demonstrated that implicit combinatorial processing evoked enhanced activation in left inferior frontal gyrus (LIFG), left anterior superior temporal gyrus (LaSTG), and left inferior parietal lobule (LIPL), and semantic association effect was found in LaSTG and left middle temporal gyrus (LMTG). Experiment 2 employed a prime-target relationship judgment task. LaSTG was found to be the only one region exhibiting task-invariant activation pattern for both combinatorial processing and semantic association effect, whereas the LIFG, LMTG, and LIPL were modulated by tasks. These results suggest that there is a neural dissociation between semantic representation and combinatorial processing during sentence comprehension.

F80

EVENT-RELATED POTENTIALS IN RESPONSE TO SIMILAR AND RELATED WORDS Alice F. Jackson[1], Donald J. Bolger[1]; [1]University of Maryland, College Park — The present study investigated neurophysiological correlates of different types of relationships between words, namely "ssociated" and "similar" words (Chiarello, Burgess, Richards, & Pollock, 1990). Event-related potentials (ERPs) were collected from 19 high-skill native English speakers during a relatedness decision task. Our analyses compared neural activity in response to word pairs that were associated only, similar only, and both associated and similar, to words that were rated as dissimilar and unrelated in a separate judgment task. ERPs were analyzed using cluster-based permutation testing (Groppe, Urbach, & Kutas, 2011). It was found that relationship type modulated ERP amplitude such that words pairs that were both associated and similar elicited a less negative N400 than words that were only similar or only associated; word pairs that were similar only or associated only elicited less negative N400s than unrelated/dissimilar words; but, similar-only word pairs did not elicit a different effect than associated-only word pairs with respect to timing or scalp distribution. The present findings do not support a multiple-mechanism account of processing relationships among words. However, differences in stimulus duration, stimulus quantity, and other features of experimental design may influence differing results and will be discussed.

F81

BILATERAL PREFRONTAL CORTICES SUPPORTING SEMANTIC, PHONOLOGICAL AND NON-LINGUISTIC SELECTION PROCESSES

Jie Zhuang[1], Micah Johnson[1], Deborah Burke[2], David Madden[1,3], Trevor Thomas[1], Mary Elizabeth McLaughlin[1], Sarah Danehower[1], Michele Diaz[1,3]; [1]Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, USA, [2]Department of Linguistics and Cognitive Science, Pomona College, Claremont, CA, USA, [3]Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, Durham, NC, USA — Left inferior frontal gyrus (LIFG) has been taken as a critical region supporting selection or cognitive control in many neural models (e.g. Thompson-Schill et al. 2005), however the role of right (R) IFG remains underspecified. Previous research (Bozic et al. 2010) suggests that RIFG might play a similar role as LIFG in cognitive control of sound to lexical mapping in spoken language comprehension. To further understand the function of bilateral IFG, we manipulated selection demands as continuous variables in word-level semantic, phonological and non-linguistic visual processes. Specifically, we tested whether left-lateralization of neural activity in prefrontal cortex is driven by linguistic properties, perceptual properties, or a combination of the two. In an fMRI study, participants were instructed to select which of two items better matched a cue based on a) shared semantic features, b) phonemic overlap, or c) perceptual similarity. A measure of selection demands was calculated in each task by subtracting the similarity between the cue and target from similarity of the cue and distractor. Behavioral results showed increasing response times for higher selection demands across all three tasks. Accordingly, greater activation was observed in bilateral IFG and insula when the selection demands increased across all three tasks. These findings suggest that selection processes are supported by a bilateral prefrontal system and RIFG might play a similar role as LIFG in selection processes.

F82

THE EFFECTS OF CUE MODALITY ON AN OBJECT MEMORY RETRIEVAL TASK

Justin Eroh[1], Hsueh-Sheng Chiang[1], Raksha A. Mudar[2], Michael A. Kraut[3], John Hart, Jr.[1]; [1]University of Texas at Dallas, TX, [2]University of Illinois at Urbana-Champaign, IL, [3]The Johns Hopkins Hospital, MD — There has been debate as to how to demonstrate the presence of multiple semantic memory systems. The purpose of this study is to investigate the retrieval of semantic information when cued in different modalities. We administered an object-memory retrieval task where participants were given two features of an object and then indicated whether the combination of the two features resulted in retrieval of an object memory (retrievals vs. non-retrievals). We used a between-subjects design with 3 different versions of the task where the first feature was presented either as a spoken word (AW, N=16), as a line drawing (PW, N=16), or as a written word (WW, N=18), while the second feature was always presented as a written word. The same features and feature pairings were used in all three versions (e.g. hear a speaker say "arm" (AW), drawing of an arm (PW), written word "arm"). All participants were undergraduate students (mean age = 22.39). Reaction times were faster for retrievals than non-retrievals for the AW and WW conditions, but showed no difference for PW. ERPs time-locked to the second feature (written word) showed a late separation over the left frontal and left temporal regions from 600 - 1200 ms with retrieval trials having more negative potentials than non-retrievals only in the AW and WW conditions. Our data suggest that receiving cues via the language system facilitates the retrieval process and that semantic information may be stored and/or retrieved differently among sensory/perceptual modalities.

F83

INDIVIDUAL VARIABILITY IN A CORTICAL SEMANTIC HUB

Michael Bonner[1], Jonathan Peelle[2], Amy Rose Price[1], Murray Grossman[1]; [1]University of Pennsylvania, [2]Washington University in St. Louis — Semantic memory underlies the representation of meaning in language. The neural system for lexical-semantic memory is often assumed to be highly similar across healthy individuals. Here we challenge this assumption in a series of experiments, which demonstrate that individual variability in the anatomy of a cortical semantic hub relates to lexical-semantic performance, functional activation, and the shared anatomic properties of the lexical-semantic network. We examined fMRI activation and cortical thickness in healthy young adults performing a word-recognition task. A cortical hub in the left angular gyrus was strongly activated during word recognition ($p<.05$ whole-brain corrected). We next identified critical structure-behavior and structure-function relationships in this region, demonstrating that increased cortical thickness accounts for both faster performance and greater semantic activation (all $p<.05$, corrected within search volume). Furthermore, we found that this region covaries with the structural properties in a broad network of lexical-semantic regions ($p<.05$ whole-brain corrected). Altogether, these findings illustrate the fundamental biological link between structural neuroanatomy and the functional, behavioral, and network properties of the lexical-semantic system.

LONG-TERM MEMORY: Episodic

F84

THE OCCURRENCE OF REFERENCES TO RECENT WAKING LIFE EVENTS IN REM SLEEP DREAMS IS CORRELATED WITH FRONTAL THETA ACTIVITY

Jean-Baptiste Eichenlaub[1], Elaine van Rijn[1], Gareth Gaskell[2], Penelope Lewis[3], Emmanuel Maby[4], Matthew Walker[5], Frederic Boy[1], Mark Blagrove[1]; [1]Department of Psychology, Swansea University, Swansea, Wales, UK, [2]Department of Psychology, York University, York, UK, [3]School of Psychological Science, Manchester University, Manchester, UK, [4]Lyon Neuroscience Research Center, INSERM, CNRS, University of Lyon, Lyon, FR, [5]Sleep and Neuroimaging Laboratory, University of California, Berkeley, US — One constituent of dreams are past memories. Although prior waking events are not replayed identically in dreams, dreams are believed to arise from recent and often emotional memories recombined together into a series of images (Stickgold et al., 2001). There is evidence of the involvement of Rapid-Eye Movement (REM) sleep, and associated frontal theta EEG oscillations, in the processing of recent emotional memories (Nishida et al., 2009; Payne et al., 2012). While recent work has attempted to link sleep physiology with the content of dreams (Dresler et al., 2011; Horikawa et al., 2013), no study has examined how specific sleep oscillation is related to the memory sources of that dream content. Here, using EEG recordings during 1 night with multiple REM awakenings and diary records across the previous 10 day period, the incorporation of events from daily life into dream reports was investigated. We assessed the number of incorporations from each of the 10 prior days in each REM dream. Analyses were conducted separately for incorporation of recent events (from the 2 days prior to sleeping in the laboratory) versus older events (from 3 to 10 days prior). The number of recent incorporations was found to be positively correlated with theta EEG activity over the frontal cortex during the last 3 minutes of the REM sleep period (F3: $r=0.65$ $p=.003$; F4: $r=0.68$ $p=.002$) while no such correlation was observed for references to older events. These findings suggest that dream content may index the processing/consolidation of recent memories in REM sleep.

F85

FROM THE LAB TO REAL LIFE: BRIDGING A GAP BETWEEN LABORATORY EPISODIC MEMORY AND MEMORY FOR REAL-LIFE EVENTS

Talya Sadeh[1], Asaf Gilboa[1], Yonatan Goshen-Gottstein[2]; [1]Rotman Research Institute, Baycrest Centre, [2]School of Psychological Sciences, Tel-Aviv University — Laboratory tests of episodic memory often examine recognition or recall of individual items, wherein each item is treated as a distinct event, independent of other studied-items. However, a key feature of memory for real-life events is that they are embedded in time. As eloquently articulated by Tulving: "Organization of knowledge in the episodic system is temporal. One event precedes, co-occurs, or succeeds another in time." In laboratory settings the unfolding of events in time is captured by the temporal-contiguity effect. This finding entails that the closer two words are during the study phase, the higher the probability that they will be retrieved in succession during the test phase. In the current fMRI study, participants were scanned while retrieving 24 lists of 12 words in a free recall test. Recalled items were classified as contiguous if they were recalled following an item that preceded or followed them at study. Activity in the hippocampus was detected when contrasting the contiguous versus non-contiguous items. A functional-connectivity analysis with the hippocampus as a seed region revealed a set of structures including the medial prefrontal cortex (BAs 9 and 10), posterior-cingulate and cerebellum. This set of regions is strikingly similar to that commonly detected in studies of autobiographical memory. The similarity in brain activation

between free recall of temporally-successive items and memory for real-life events implies that important aspects of the processes underlying retrieval of real-life memories may be captured in laboratory-controlled settings via examination of the temporal-contiguity effect.

F86

THE EFFECT OF POST-ENCODING STRESS ON PERFORMANCE IN THE DRM FALSE MEMORY PARADIGM Enmanuelle Pardilla-Delgado[1], Sara E. Alger[1], Brian Kinealy[1], Jessica D. Payne[1]; [1]University of Notre Dame — Stress has a marked influence on how information is remembered. However, whether stress facilitates or impairs memory depends on several factors, including the stage of processing during which it occurs (i.e. encoding, consolidation, retrieval). Although an increasing number of studies have investigated the impact of stress on veridical memory, the research on stress and false memory formation is lacking. The majority of this research has involved inducing stress prior to encoding and, coupled with short experimental sessions (i.e. 1-3 hours between encoding and retrieval), it has been difficult to isolate the effects of stress to a single stage of memory. The current study targeted the consolidation phase of memory by administering psychosocial stress immediately after the encoding of fifteen emotionally neutral Deese-Roediger-McDermott (DRM) false memory wordlists. Twenty-four hours after encoding, participants were given a free recall test followed by a recognition test. True recognition memory was impaired in stressed participants, compared to controls, $t(29)=2.41$; $p=.02$, but there was no change in false recognition memory ($t=1.09$, $p=.28$). However, while control participants recognized true and false words equivalently, paired $t(14)=.84$, $p=.42$, stressed participants recognized more false than true words, paired $t(15)=2.63$, $p=.019$. Although true free recall results were numerically similar ($t= 1.64$, $p=.11$), only when controls were compared to stress responders (those with an increase from baseline in cortisol) is the difference nearly significant, $t(23)=1.99$, $p=.058$. These results suggest that stress impairs true memory consolidation, arguably by hindering specific-event processing in the hippocampus and facilitating gist-based processing in cortical regions

F87

DOES A SLOWLY-CHANGING REPRESENTATION OF WHAT AND WHEN EXIST IN MULTIPLE BRAIN REGIONS? Zoran Tiganj[1], Shinya Nakamura[2], Inderdeep Singh[1], Marc Howard[1]; [1]Center for Memory and Brain and Department of Psychology, Boston University, [2]Institute for Behavioral Genetics, University of Colorado — It is well known that the brain shows long-range temporal correlations. It is not clear, however, whether these autocorrelations reflect the maintenance of information about external stimuli or intrinsic dynamics that are independent of external stimuli. We analyze temporal correlations of neural data from a variety of data sets at different time scales. The autocorrelation is noticeable along multiple trials and, in at least some cases, appears to be stimulus-locked. Also, consistently with the theoretical predictions, information about the time of occurrence of a stimulus grows more fuzzy as time passes, consistent at least qualitatively with Weber-Fechner scaling. These results suggest that the brain is indeed capable of maintaining information about the recent past in the dynamics of neural firing. With other data sets, the strategy could be applied to establish stimulus-specificity over longer time scales. More broadly, this strategy for data analysis can be extended to other recording methodologies, including fMRI.

F88

RETRIEVAL CONTROL IN SCHIZOTYPY Amie N. Doidge[1], Edward L. Wilding[1], Lisa H. Evans[1]; [1]Cardiff University Brain Imaging Centre (CUBRIC), School of Psychology, Cardiff University, UK — Individuals with schizophrenia have memory impairments. This study was designed to determine whether these deficits arise from failures of cognitive control operations. This was achieved by measuring dimensional correlates of schizophrenia (schizotypy ratings) in healthy volunteers, alongside event-related potential (ERP) markers of successful cognitive control. In an initial study phase, equal numbers of words were presented in one of two study contexts. ERPs were acquired in a test phase where these words were re-presented, interspersed with unstudied words. Participants made binary responses; one for studied words from a 'target' context, another for unstudied words and studied words from the alternate 'non-target' context. This judgment can be made by prioritising retrieval of the target context and making a non-target response when recovery of the target context fails. ERPs were acquired because they can index how well people prioritise target over non-target context retrieval. Correlations between schizotypy measures and how well people prioritise retrieval of certain contexts would point to one locus for memory problems associated with schizophrenia. The ERP measures indicated participants could prioritise recovery of target information at the expense of non-target information. There was, however, no correlation between schizotypy scores and the ERP evidence for the extent of retrieval prioritisation. One potential explanation is that in this sample the range of schizotypy scores was insufficient to extrapolate to cognitive dysfunction in schizophrenia patients. Alternatively, it could be that control processes during encoding, rather than at retrieval, are responsible for the memory problems experienced by schizophrenia patients.

F89

ELECTROPHYSIOLOGICAL INDICES OF PREPARATION FOR EPISODIC MEMORY RETRIEVAL Angharad N. Williams[1], Lisa H. Evans[1], Edward L. Wilding[1]; [1]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, UK — This experiment was designed to delineate the processes engaged while people prepare for memory retrieval. This was achieved by comparing event-related potentials (ERPs) elicited by two preparatory cues signalling that participants should prepare for different retrieval tasks. One cue signalled episodic retrieval: identify the location in which an object had been seen in a prior study phase. The other signalled semantic retrieval: identify the location in which an object is most commonly found. Participants were cued trial-by-trial as to which task to complete, and only two trials of the same task were completed in succession. This enabled contrasts between ERPs elicited by cues on "stay" trials, where the cue on the preceding trial signalled the same retrieval task, and "switch" trials, where the cue differed from that on the preceding trial. A significant difference between the preparatory activity following each cue was evident for switch trials only. These findings diverge from previous outcomes where the activity differentiating cues signalling preparation for episodic or semantic retrieval has been restricted to stay trials. In previous studies the episodic/semantic switching requirement was accompanied by the additional requirement to switch to recover different kinds of contents. This second requirement was minimised here because location information was required for both episodic and semantic judgments. These findings suggest, therefore, that inferences made previously about consistent neural signatures associated with preparation for episodic retrieval do not hold under certain circumstances.

F90

EPISODIC SIMULATION AND PROSPECTIVE MEMORY: CORRELATES OF SUSTAINED EXECUTIVE ACTIVITY Kevin P. Madore[1], R. Nathan Spreng[2], Daniel L. Schacter[1]; [1]Harvard University, [2]Cornell University — The ability to form and later retrieve a task intention has implications for functioning in everyday life. In the current study we examined the relationship between episodic simulation of an intention and prospective memory using fMRI and a within-subjects design. Before scanning began, 28 healthy young adults were introduced to a lexical decision paradigm where they practiced classifying words, non-words, and special target words (from the categories of animals or tools) with different fingers. For half of the target words participants simulated what they would do in the scanner when they saw the respective words (i.e., the simulation intention condition), whereas for the other half they rhymed with the words (i.e., the control condition). In the scanner, participants encountered blocks where they 1) classified words and non-words alone, 2) classified words, non-words, and simulated or rhymed target words, and 3) classified words and non-words alone but were told they would see simulated or rhymed target words. Contrasts focused on blocks where participants made word or non-word classifications alone, with the additional instruction that they would see simulated or rhymed target words or not. These blocks differed only in the instruction to maintain an intention. We found that maintaining an intention for simulated target words reduced sustained activity in executive regions during the classification task compared to maintaining an intention for rhymed target words. These regions included dorsolateral prefrontal cortex, anterior insula, and superior parietal lobule. Our findings suggest that simulation can reduce executive demands on prospective memory.

F91

CONFIGURAL MEMORY DISRUPTIONS ASSOCIATED WITH CHEMOTHERAPY AND HORMONE DEPLETION IDENTIFIED USING CONCURRENT EYETRACKING AND FMRI. Alyssa B. Cunningham[1], Anthony J. Ryals[1], Kelly L. Brandstatt[1], Joel L. Voss[1]; [1]Northwestern University — Subjective and objective memory and cognitive deficits have been identified in individuals receiving chemotherapy and hormone depletion for cancer treatment. Although rodent models suggest that both chemotherapy and hormone depletion cause specific damage to hippocampus and reduced hippocampal-dependent memory performance, relatively little is known regarding the functional neuroanatomical basis of impairment in humans. We therefore investigated scene configural memory (SCM), which is related to hippocampal function in healthy individuals, in 17 premenopausal breast cancer survivors who received chemotherapy combined with hormone depletion therapy within 18 months prior to the study. SCM was studied using a scene recognition task that incorporated eye-tracking task during fMRI scanning. Eye tracking provided a covert measure of hippocampal function as eye movements reflected SCM for repeated scene configurations. Subjects also made overt recognition decisions for repeat versus novel scenes. Relative to an equal number of healthy age-matched controls, patients demonstrated significantly reduced eye-movement expressions of SCM, despite intact overt recognition memory performance. Patients were therefore not globally impaired, but instead showed selective disruption of SCM, suggesting that hippocampal function is particularly disrupted by chemotherapy and hormone depletion in humans. Further differences between controls and patients in brain activity in regions such as prefrontal cortex associated with SCM will be discussed. These findings deepen understanding of the nature of impairments in memory and cognition following cancer treatment and could motivate future interventions to improve cognition-related life quality among cancer survivors.

F92

PLURALITY MEMORY ROCS INDICATE RECOLLECTION IS A CONTINUOUS PROCESS Brittany Jeye[1], Chad Dodson[2], Scott Slotnick[1]; [1]Boston College, [2]University of Virginia — Is recollection a continuous (graded) process or a threshold (all-or-none) process? Receiver operating characteristic (ROC) analysis can answer this question, as the continuous model and the threshold model predict curved and linear recollection ROCs, respectively. As memory for plurality - an item's previous singular or plural form - is assumed to rely on recollection, the nature of recollection can be investigated by evaluating plurality memory ROCs. The present study consisted of four plurality memory experiments. During encoding, words (singular or plural) or objects (singular or duplicate/plural) were presented. During retrieval, old items were presented with the same or different plurality along with new items, and participants made confidence ratings from very sure "old" (same plurality) to very sure "new" (different plurality or new). To generate plurality memory ROCs, hit rate and false alarm rate reflected the proportion of old items classified as "old" with the same or different plurality, respectively. Chi-square analysis revealed that the majority of plurality memory ROCs were adequately fit ($p > 0.05$) by the continuous unequal variance model (and better fit by a continuous model that accounted for plurality misattribution), whereas none of the plurality memory ROCs were adequately fit by the two-high threshold model (all $ps < 0.001$). These plurality memory ROC results indicate recollection is a continuous process, which is consistent with previous source memory and associative memory ROC findings. More broadly, ROC analysis can be used to evaluate brain activity to investigate the nature of processing in specific neural regions.

F93

EFFECT OF VALENCE ON THE RECAPITULATION OF SENSORY PROCESSING DURING EMOTIONAL REMEMBERING Sarah M Kark[1], Elizabeth A Kensinger[1]; [1]Boston College — Negative memories tend to be remembered with more sensory detail than positive or neutral memories (Ochsner, 2000). While prior work has separately reported increased sensory processing during encoding (Mickley Steinmetz & Kensinger, 2008) or later retrieval of negative information (Maratos et al., 2001), little is known about the overlap of neural processes engaged during encoding and retrieval of emotional information. Here, we examined the effect of valence on retrieval-related reinstatement (or "recapitulation") of neural processes engaged during encoding. We hypothesized that memory for negative information would be associated with stronger recapitulation of sensory processing activity, compared to positive or neutral information. Participants (ages 19-35) underwent an fMRI scan while studying a line-drawing outline of a negative, positive, or neutrally valenced image from the International Affective Picture System (IAPS), followed by the complete photo. After a twenty-minute delay, participants were shown the line-drawing outlines of the previously studied photos and outlines they never studied. Participants indicated whether the line drawing was old or new. Data were acquired during encoding and retrieval on a Siemens 3T Tim Trio scanner. All fMRI data analysis was performed using SPM8. In agreement with prior research, results revealed that retrieval of negative stimuli elicited more visual activity, compared to positive or neutral stimuli. Further, as hypothesized, conjunction analysis revealed more extensive recapitulation of sensory (temporo-occipital) activity in the negative>neutral condition compared to the positive>neutral condition. These findings suggest stronger retrieval-related recapitulation processes during retrieval of negative information compared to positive or neutral, especially within visual areas.

F94

DIFFERENT MODES OF CONTEXTUAL ASSOCIATION LEARNING AND THEIR NEURAL CORRELATES Daniel O'Young[1], Joel L. Voss[1]; [1]Northwestern University Feinberg School of Medicine — Associative learning occurs in specific contexts that govern the appropriate behavioral expression of memory (e.g. remembering to dress formally for a wedding, but not the gym). Human and animal research implicates differential involvement of hippocampus/prefrontal cortex versus striatum during associative learning, with the former involved in relatively flexible, rule-based memory and the latter in inflexible, habit-based memory. We studied contextual association learning under conditions designed to promote flexible versus habitual memory expression. Trials were presented in one of four quadrants (e.g. contexts). Given a "cue" object, subjects attempted to select the associated "target" object (from a target-foil pair). Cue-target associations varied by context. Each subject performed the task during two sessions, including either: (i) repetitive, predictable trial sequences to promote habitual responding, or (ii) pseudo-randomized trial sequences to promote rule-based responding. Accuracy was high and did not vary by session (N=14), indicating successful learning across conditions. Preliminary ERP findings indicate trends for greater late-frontal potentials for contextual association memory in the rule-based condition, suggesting that different modes of learning distinguished only by the order and predictability of trials can engage different brain systems during contextual association learning. Results are interpreted with regards to distinctions between human and animal memory research, which often differ in consistency and predictability of training, potentially promoting involvement of different brain systems.

F95

A SINGLE BOUT OF RESISTANCE EXERCISE CAN ENHANCE EPISODIC MEMORY PERFORMANCE Lisa Weinberg[1], Anita Hasni[1], Minoru Shinohara[1], Audrey Duarte[1]; [1]Georgia Institute of Technology — Acute stress, both physical and psychological, has the potential to enhance episodic memory consolidation. This enhancement is often specific to emotionally arousing materials. Physical exercise can produce similar beneficial effects on episodic memory performance, as it results in the same physiological response as other stressors. This stress response includes an increase in levels of cortisol and norepinephrine. The goal of this study is to determine if a resistance exercise task performed immediately following encoding will improve recognition memory performance 48 hours later. We used a knee extension/flexion task and measured salivary alpha amylase (a biomarker of central norepinephrine), heart rate, and blood pressure to assess the physiological stress response. To test recognition memory, we used a remember-know paradigm with equal numbers of positive, negative, and neutral IAPS images as stimuli. Overall recognition memory performance was better in the active group, who performed the exercise, than in the passive group, who did not exercise. We found a robust valence effect, with higher accuracy for emotional items than neutral items and no difference in accuracy between positive and negative items. This effect was related to the physiological response, as within the active group, it was only present in the participants who exhibited a high physiological response. These results

indicate that a single bout of resistance exercise can positively impact recognition memory performance for emotional materials and open up the possibility of therapeutic uses of resistance exercise.

F96

COGNITIVE CONTROL OF MEMORY AND MOTOR RESPONSES: A COMPARISON OF NETWORKS SUPPORTING ACTIVE INHIBITION

Avery Rizio[1], Nancy Dennis[1]; [1]The Pennsylvania State University — Active inhibition includes both response inhibition (the suppression of prepotent motor response) and memory inhibition (the suppression of either encoding or retrieval). While the majority of behavioral research has considered them a single process, neuroimaging research suggests otherwise. Specifically, memory inhibition typically exhibits activation in the superior/middle frontal gyrus, while motor inhibition typically activates the inferior frontal gyrus. Despite these findings, there have been no further attempts to investigate the degree to which active inhibition might be mediated by two separate networks. The current study directly compared the neural networks that mediate both response and memory inhibition through the use of fMRI and connectivity analyses. Direct comparisons between each type of inhibition focused on differences within the frontal cortex and neural network supporting each type of inhibitory process. These analyses provide insight into two distinct inhibitory networks that separately support response and memory inhibition. Specifically, memory inhibition is subserved by a network that includes the superior/middle prefrontal cortex and parietal lobe, while successful response inhibition depends on the inferior prefrontal cortex, subthalamic nucleus, and pre-supplementary motor area. Additionally, connectivity analyses help to further differentiate these networks, as memory inhibition relies on the negative connectivity between inhibition and encoding regions, while motor inhibition depends on the negative connectivity between inhibition and motor regions. The current project is the first within-subjects investigation of the neural correlates of both the cognitive control of memory and motor responses. As such, these results provide valuable evidence towards a comprehensive theory of active inhibitory control.

F97

MULTIVARIATE PATTERN ANALYSES REVEAL DISTINCT ELECTROPHYSIOLOGICAL SIGNALS INVOLVED IN CONTINUOUS RECOGNITION

Mason Price[1], Angelica Flores Barrios[2], Jeffrey Johnson[1]; [1]University of Missouri, [2]University of the Americas Puebla — Numerous behavioral, electrophysiological, and functional neuroimaging studies have established that recognition memory can be based on multiple neurocognitive processes. These studies typically employ methods that explicitly encourage the use of different processes, such as having subjects indicate which judgments are based on recollecting details versus a sense of familiarity. However, the extent to which differential processing is also involved in situations requiring relatively simple and speeded recognition judgments remains largely unexplored. Here, subjects (N=15) completed a continuous recognition task in which they made binary old/new judgments to words that were repeated up to four times. Scalp EEG was acquired throughout the task and later subjected to multivariate pattern-classification analyses. Two different classifiers were trained on the EEG data. One was trained to distinguish the first versus fourth presentations, presumably on the basis of broad changes that span multiple intervening items. The other classifier was trained to detect more pronounced differences present between the first and second presentations. Although both classifiers performed at above-chance levels, significant performance for the former emerged at 300-400 ms post-stimulus onset, which was about 200 ms earlier than that for the latter classifier. Furthermore, classifier performance across presentations followed distinct trends: Whereas one exhibited a gradation in accuracy from first to fourth presentations, the other following a threshold-like pattern that leveled off after the second presentation. These findings indicate that even simple recognition tasks can reveal distinct forms of neural signal, lending further support to the idea that memory is supported by multiple neurocognitive processes.

F98

FUTURE ALTRUISM: THE EFFECT OF EPISODIC FUTURE THOUGHT ON INTERPERSONAL DISCOUNTING

Paul F. Hill[1], Lauren Costello[1], Rachel A. Diana[1]; [1]Virginia Tech — Humans have a predisposition to discount the value of larger, temporally distant rewards in favor of smaller but immediate rewards. Mentally simulating hypothetical future events, or episodic future thought (EFT), may override impulsive decisions by creating foresight into the utility of future outcomes (Boyer, 2008). Recent studies have shown that EFT decreases discounting of future rewards through increased functional connectivity between the hippocampus and regions encoding subjective reward value, including the anterior prefrontal cortex (Benoit et al., 2011), and anterior cingulate (Peters & Buchel, 2010). Social cooperation is similarly characterized by decisions involving immediate vs. future consequences and has been linked to discounting rates (Stephens et al., 2002). The current study provides novel insight into the effects of EFT on social decision making. Participants were offered hypothetical monetary rewards and asked to choose to keep that reward or to give a larger amount to others at varying social distances (e.g., closest friend or relative vs. acquaintance). During these decisions, participants were prompted with social and non-social EFT cues as well as semantic visualization cues serving as a control condition. Results indicate that subjects are more altruistic when prompted with social vs. non-social EFT cues; however, this effect diminishes with increasing social distance. Surprisingly, a similar effect is seen in semantic vs. non-social EFT conditions, regardless of social distance.

LONG-TERM MEMORY: Semantic

F99

DIFFERENTIAL BRAIN PROCESSING OF NATURAL AND TRANSFORMED FOOD

Francesco Foroni[1], Giulio Pergola[1,2], Paola Mengotti[1], Georgette Argiris[1], Raffaella I. Rumiati[1]; [1]International School for Advanced Studies (SISSA) - Trieste, Italy, [2]University of Bari - Bari, Italy — Visual recognition and categorization of objects rely on different features depending on the category they belong to. This event-related potentials (ERP) study investigated whether recognition of food differing in the degree of transformation (i.e., natural versus transformed) relies more on sensory and functional features, respectively. Healthy and underweight participants (N=30) were shown a sentence (prime) and a photograph of a food. Primes described either a sensory aspect ("It tastes sweet") or a functional aspect ("It is suitable for a wedding party") of the food, while photographs depicted either a natural (e.g., cherry) or a transformed food (e.g., pizza). Sentence-photograph pairs were either congruent or incongruent. This design aimed at modulating the N400 component. In the healthy participants the magnitude of the late component of the N400 (450-650 ms) yielded a double dissociation with left frontal anterior topography. N400 amplitude was significantly larger for transformed food than for natural food when a sensory prime was shown, while the opposite pattern was found with a functional prime. These results were not replicated with the underweight participants. The pattern inversion in healthy was associated with a peak of activation in the premotor cortex (Brodmann area 6). The evidence suggests that in healthy participants, but not in underweight participants, transformed food is represented more with reference to its function and natural food to its sensory aspects. These findings highlight that the level of transformation of food is an important aspect to be considered in food perception and categorization.

F100

REWARD RELATED DIFFERENCES IN MEMORY OF PICTURES ARE WIPED OUT BY DOPAMINE AGONIST PRAMIPEXOLE GIVEN BEFORE RETENTION SLEEP

Gordon B. Feld[1], Luciana Besedovsky[1], Kosuke Kaida[2], Thomas F. Muente[3], Jan Born[1]; [1]University of Tuebingen, Germany, [2]National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan, [3]University of Luebeck, Germany — The consolidation of memory traces encoded during wakefulness relies on their reactivation during subsequent sleep. Memory for pictures is improved if a reward is promised for successful retention. Activity in the ventral tegmental area, the nucleus accumbens, the hippocampus and connectivity between these areas during encoding predicts these differences, reflecting dopaminergic enhancement of plasticity. In a within-subject placebo-controlled balanced

crossover study we manipulated dopaminergic signalling during sleep using the d2-like dopamine receptor agonist Pramipexole. Sixteen healthy young males were presented 160 pictures of landscapes and interiors, each of which was preceded by a 1 or 2 cents symbol (indicating high or low reward for successful later retrieval). Afterwards, the participants received a single dose of 0.35 mg Pramipexole or Placebo and then slept for 8 hours, while polysomnographic data were recorded. At retrieval, approximately 24 hours after encoding, high and low reward pictures were presented intermixed with an equal amount of completely new pictures and participants had to indicate whether they remembered or knew each picture (d' was estimated as the z-score of the hit-rate minus the z-score of the false-alarm-rate). Under Placebo, high reward pictures were retained better than low reward pictures and this effect was wiped out by Pramipexole. Rapid eye movement sleep and slow wave sleep were reduced by the treatment in favour of sleep stages 1 and 2. These results suggest that reward contingencies are reprocessed during sleep including dopaminergic activity, possibly relying on a striatal feedback-loop initiated by replay in the hippocampus.

F101

THE ROLE OF ATTENTION IN GOAL-DIRECTED SEMANTIC RETRIEVAL: EVIDENCE FROM MULTI-VOXEL PATTERN ANALYSIS

Gavin K. Hanson[1], Evangelia G. Chrysikou[1]; [1]University of Kansas — Neuroimaging studies of semantic memory have revealed different cortical networks supporting semantic retrieval for different kinds of information about common objects. For example, tasks requiring judgments of semantic similarity based on specific object properties, such as color or shape, tend to be associated with activity in the left intraparietal sulcus (IPS). Evidence from transcranial magnetic stimulation studies also shows that disruption of activity in left IPS impairs performance on semantic tasks that require comparisons between such perceptual features. Moreover, semantic judgments can be made with respect to more abstract object properties, such as thematic context or function. However, the functional networks that underlie judgments based on such abstract object features have not been systematically investigated. Here, we use multi-voxel pattern analysis of functional magnetic resonance images to examine the neural representations of both specific and abstract object properties. Participants were required to complete a series of semantic judgment tasks, wherein they were asked to match a target object to one of two response object options along one of five dimensions, namely, color, shape, function, theme, or mode of manipulation. In addition, participants performed a visual search task, requiring attention to color or shape. Results show that activation patterns within the IPS can reliably differentiate between semantic dimensions, both perceptual and abstract. In addition, differences in classification performance within left ventrolateral prefrontal cortex suggest a biasing role of this region for different object attributes. These results are discussed in the context of partially distributed models of semantic memory for object concepts.

F102

TEMPORAL DYNAMICS OF CUED RECALL: AN EVENT-RELATED POTENTIAL STUDY

Robin Hellerstedt[1], Mikael Johansson[1]; [1]Lund University — Retrieval is a fundamental function of long-term memory. Whereas previous event-related potential (ERP) research on the time course of memory retrieval typically has focused on recognition memory, less is known about the temporal dynamics of cued recall. In the present study, electrophysiological measures of brain activity were recorded while the subjects engaged in a semantic cued-recall task. A category (e.g. FRUIT) and a word stem (e.g. Ki___?) were presented sequentially and the subjects were instructed to generate an exemplar that completed this category-plus-word-stem cue. Retrieval attempts were related to a late posterior negativity (LPN), which previously has been suggested to reflect parietal activity related to top-down controlled search in long-term memory. Consistent with this interpretation, retrieval success was related to an attenuation of the LPN, signaling that search was discontinued when retrieval was successful. Interestingly, retrieval success was also related to an early frontal negativity that was elicited by the category cue. Similar frontal negativities have previously been related to semantic preparation processes in the subsequent memory effect literature. The retrieval-success sensitive frontal negativity in the present study may reflect increased accessibility to memories that are semantically associated with the category cue or integration of the category cue and the word-stem cue in working memory. The present study provides new insights into the temporal dynamics of cued recall and suggests that multiple neural mechanisms are involved in this long-term memory function.

F103

SLEEP-RELATED CHANGES OF NOVEL WORD LEARNING IN NATIVE ENGLISH SPEAKERS

Laura Kurdziel[1], Brian Long[2], Rebecca Spencer[1,2]; [1]Neuroscience and Behavior Program, University of Massachusetts Amherst, [2]Psychology Department, University of Massachusetts Amherst — Sleep has been shown to improve the retention of newly learned words. However, most methodologies for examining novel word learning use nonsense or foreign languages to control for previous exposure. These languages typically have different rules and properties than an individual's native language, making the interpretation of this research difficult. In this study, native English speakers were taught forty-five of the least frequently used English words, as designated by the English Lexicon Project. During encoding, words paired with their definitions were displayed on a computer one at a time. Participants were then shown a definition and were asked to provide the corresponding word. Feedback was provided, and encoding continued until a 62% accuracy criterion was reached. To assess baseline knowledge, participants then recalled words for each definition without feedback. Delayed recall was probed twelve hours later, either in the evening (wake group, n=19) or in the morning (sleep group, n=24). Performance change from immediate to delayed recall was significantly better in the sleep than the wake group ($t(41) = 2.94$, $p = 0.005$). Additionally, responses that were incorrect, but similar to the correct words, were quantified. Over sleep, incorrect responses became significantly more similar to correct words compared to wake ($t(41) = -3.07$, $p = 0.004$). This suggests that sleep not only helps with retention of newly learned words within the individual's native language, but also helps to improve recall of words that are not yet accurately learned.

F104

WHAT THE EAR HEARS AFFECTS WHAT THE EYES SEE: SEMANTIC INTERFERENCE ON VISUAL TASK PERFORMANCE

Peter Boddy[1], Eiling Yee[1]; [1]Basque Center for Brain and Language, San Sebastian, Spain — According to sensorimotor accounts of object knowledge, representations of object concepts are distributed over the same brain areas that are active when experiencing those objects. Because these accounts hold that object representations are experience-based, they predict that representations of objects with which we have relatively more visual experience should involve brain areas supporting vision more than those with which we have relatively less. One possible consequence of such an account is that accessing representations of "more-visually-experienced" objects could impair performance on an orthogonal ongoing (and incompatible) visual task more than "less-visually-experienced objects" do because of competition for shared neural substrates in brain areas supporting both visual task performance and "visually-experienced" objects' representations. We tested this prediction in a behavioral experiment where participants performed a Motion Object Tracking visual task while they made concreteness judgments about aurally presented object names which varied (according to ratings) in the relative amount of visual experience participants had of them (e.g. "pencil" = less-visual, "penguin" = more-visual). Results show that participants had greater difficulty with the Motion Object Tracking task when making concreteness judgments on "more-visual" objects than on "less-visual" objects. This interference suggests that: (a) the conceptual representations of frequently seen objects share resources with parts of the visual system required to perform Motion Object Tracking, (b) visual information is accessed when performing concreteness judgments on "more-visual" words, and that (c) visual task performance can be interfered with by thinking about "more-visual" objects.

F105

THE VENTROMEDIAL PREFRONTAL CORTEX (VMPFC) AND SCHEMA INSTANTIATION

Vanessa Ghosh[1,2], Morris Moscovitch[1,2], Brenda Colella[3], Asaf Gilboa[1,2,4]; [1]Rotman Research Institute, Baycrest, [2]University of Toronto, [3]Toronto Rehabilitation Institute, [4]Canadian Partnership for Stroke Recovery — Neuroimaging and animal studies have shown that the vmPFC is involved in mediating the influence of prior knowledge, and more specifically schemas, on learning and memory. We hypothesized that: (1) the

human vmPFC is critical for schema representation; (2) supports the instantiation of appropriate schemas that are represented elsewhere; (3) is differentially involved in schema representation and not other types of prior knowledge: categories. In a first study, two groups of vmPFC patients, those who confabulate and those who do not, and controls made speeded decisions about whether words were closely related to a schema (visiting a doctor). Ten minutes later they repeated the task for a new schema (going to bed), which included some lures related to the first schema. Non-confabulating vmPFC patients performed similarly to controls, with accuracy close to ceiling. However, confabulating vmPFC patients were impaired on the task. Interestingly, these patients accurately identified words that belonged to the schemas, implying that the representation itself was still present. However, they showed difficulty constraining their responses to the relevant schema, suggesting an error in schema instantiation. In a second study of healthy adults, performance on the schema paradigm was compared to an identical task probing membership of words to one of two categories. Results indicate that, in contrast to schema instantiation, previously relevant categories do not affect current category membership decisions. Schemas and categories may thus be instantiated differently, with differing vulnerabilities to previously relevant categories. Electrophysiological data will also be presented.

F106

SEMANTIC BIAS IN VISUAL WORKING MEMORY Farahnaz Ahmed Wick[1], Lucia Saura[1], Chia-Chien Wu[1], Marc Pomplun[1]; [1]University of Massachusetts Boston — Previous studies (Hwang, Wang & Pomplun, 2011) indicate that our strategies for memorizing objects in naturalistic scenes can be predicted by the semantic relationships between objects in that scene. That is, we tend to make saccades to objects that are most semantically related to the object in the current fixation. Why do such biases exist? One possibility is that consecutive inspection of semantically similar objects facilitates object memorization. We tested this hypothesis using an experimental paradigm in which a series of eight grayscale object images were shown for 250 ms each. Subsequently, participants saw another image and indicated whether it had been in the series. In six experiments, we varied the object sets presented (either randomly chosen or taken from a specific context such as airport, park, or bedroom), the target objects for negative responses (objects from same or different contexts, or even of the same type as an object in the set), and their order of presentation (consecutive objects of high versus low semantic relationship). Recall rates were significantly better when objects were from the same context, and improved even further when they were ordered to maximize the semantic similarity of consecutive objects. Generally, these recall rates seemed to be governed by object types and semantics rather than by the specific visual features of individual objects. These results give an insight into the use of the semantic structure of the environment for daily tasks.

F107

WHAT MAKES A GOOD LEARNER? NEURAL EVIDENCE FOR VARIATION IN ENCODING STRATEGIES William J. Beischel[1], Natalie Mandel[1], Bianca Wells[1], Izabelle Rymut[1], Kavita Patel[1], Robert G. Morrison[1]; [1]Loyola University Chicago — Successful encoding is critical for long-term memory and is an important variable in understanding successful learning. In this study we used a retrieval practice paradigm in conjunction with EEG to examine the neural correlates of encoding throughout face-name association learning. For each of 108 unique faces, participants saw the face and then heard an assigned name. After studying several other face-name pairs participants 1) saw the face again while trying to recall the name, 2) made a prospective judgment of learning, and 3) saw the face and heard the correct name again, a sequence which repeated twice during a block of trials. Sixteen participants were divided into high and low performers based on final recall test performance after learning. We focused on neural differences during re-encoding (number 3 above), specifically calculating event-related potentials (ERPs) when participants heard the name again. Presentation of the name served both as feedback for the previous recall attempt and also as an additional study opportunity. High and low performers showed a P300 (Cz) interaction with high performers showing a greater P300 with negative feedback, while low performers showing a greater P300 with positive feedback. Also of note high performers showed a much greater memory updating benefit than low performers as judged by the mean amplitude of the late positive complex (PZ) during re-encoding. These results suggest that the nature of feedback may be critical in appraising learning and allocating encoding resources during iterative learning opportunities may differ according to learning ability.

F108

SEMANTIC STRATEGIES IN VERBAL LEARNING ARE ASSOCIATED WITH GREY MATTER VOLUME IN VENTRAL OCCIPITOTEMPORAL CORTEX. Jeffrey S. Phillips[1,3], Corey T. McMillan[1,3], Brian B. Avants[2,3], Murray Grossman[1,3]; [1]Penn Frontotemporal Degeneration Center, [2]Penn Image Computing and Science Laboratory, [3]University of Pennsylvania — Deficits in verbal learning occur across a number of neurodegenerative diseases and are often presumed to result from disease in the medial temporal lobes, which are typically implicated in episodic memory. However, verbal learning is also affected by semantic strategies for encoding and retrieval of verbal information. We hypothesized that semantic processing in a verbal learning task would depend on the integrity of grey matter in sensory-motor brain areas supporting conceptual knowledge. We examined the immediate recall performance of a heterogeneous group of patients (n=140) with Alzheimer's disease and frontotemporal degeneration on two verbal list learning tasks with similar structure: the Philadelphia Verbal Learning Test (PVLT), which uses semantically related target words, and the verbal learning component of the Philadelphia Brief Assessment of Cognition (PBAC), which does not. Behavioral analysis revealed an interaction of test and clinical phenotype, suggesting that patient groups differed in their ability to employ semantic strategies. Semantic dementia patients performed poorly in both tasks and differed from multiple phenotype groups on PVLT learning scores. In imaging analyses, T1-weighted anatomical magnetic resonance images were used to quantify grey matter volume. Semantic processing was assessed by the residual variance in PVLT scores after accounting for PBAC performance. This measure was associated with grey matter volume in the left anterior temporal lobe and bilateral ventral occipitotemporal cortex. These results corroborated the hypothesis that patients' ability to leverage semantic strategies in an immediate verbal recall task was related to the structural integrity of brain areas associated with semantic memory.

LONG-TERM MEMORY: Skill learning

F109

TIME COURSE OF FACE FAMILIARITY PROCESSING AS REVEALED BY EVENT-RELATED POTENTIALS Wanyi Huang[1], Zhe Qu[1], Yulong Ding[1]; [1]Sun Yat-Sen University — There is often a controversy in previous studies about how early face familiarity can be cognitively processed. The present study used event-related potentials (ERPs) to investigate the time course of face familiarity processing. An explicit familiarity judgment task was adopted in which subjects were presented with upright or inverted faces and were required to judge whether a face was famous or not. The face familiarity effects (FFEs) were defined as ERP differences between famous and unknown faces. Significant FFEs were found on occipital P1 and N170, occipital-temporal N250 and central P300. However, FFEs on P1 and N170 showed reversed polarities for upright and inverted faces, and these FFEs were not correlated with any behavioral measure (accuracy, response time) or modulated by learning sessions, demonstrating that they merely reflected low-level visual differences between stimulus categories. For N250 and P300, instead, the FFE polarities were consistent between face orientations with larger and earlier FFEs for upright relative to inverted faces. More importantly, the amplitudes of these FFEs were significantly correlated with behavioral measures (larger FFEs were accompanied by better or quicker face recognition) and increased through learning, suggesting that these FFEs reflected cognitive extraction of familiarity information. In summary, the present study suggested that cognitive discrimination of familiar and unfamiliar faces begins around 230ms after stimulus onset, and the FFEs of mid-latency ERP component - N250 and P300 - can predict the performance of face recognition.

F110

CUED MEMORY REACTIVATION DURING SLOW-WAVE SLEEP PROMOTES EXPLICIT KNOWLEDGE OF A MOTOR SEQUENCE

James Cousins[1], Penny Lewis[1], Wael El-Deredy[1], Laura Parkes[1], Nora Hennies[1]; [1]University of Manchester — Memories are gradually reorganized after initial encoding, and this can sometimes lead to the emergence of explicit knowledge from what was initially implicit learning. The exact processes underlying this reorganization remain unclear. Here, we test whether active reactivation of procedural memory during seep underlies this restructuring of memories. We used a serial reaction time task (SRTT) to determine whether targeted memory reactivation (TMR) in slow-wave sleep (SWS) promotes the emergence of explicit knowledge for a procedural skill. Participants learned two 12-item sequences (A and B) that differed in cue order and in the set of four associated tones (higher or lower pitch). Overnight sleep was polysomnographically monitored and tones associated with one learned sequence were replayed during SWS. Upon waking, participants demonstrated greater explicit knowledge (P=0.005) as well as improved procedural skill (P=0.04) for the cued sequence relative to the un-cued sequence. Furthermore, slow-wave activity (~1Hz) during cued reactivation predicted explicit knowledge (r=0.7, P=0.01), while local fast spindles (13.5-15Hz) predicted enhanced procedural skill, both during cued replay (r=0.71, P=0.01) and during subsequent silent periods (r=0.69, P=0.01). Conversely, cues had no effect on post-sleep memory performance in a control group receiving tonal replay prior to sleep. These findings show that cued memory reactivation during sleep can alter memory representations to promote the extraction of explicit knowledge, supporting the role of spontaneous reactivation as a central mechanism in actively restructuring memory representations during sleep.

F111

MAKING IT INTERESTING: THE RELEVANCE OF A MOVEMENT SEQUENCE AS A FACTOR IN PROCEDURAL MEMORY CONSOLIDATION IN CHILDREN

Shoshi Dorfberger[1,2], Hazar Moadi[1], Karni Avi[1]; [1]EJ Safra Brain Research Centre for the Study of Learning Disabilities, [2]Gordon College of Education, Haifa, Israel. — Behavioral relevance may constitute an important factor in biasing brain systems toward allowing experience driven adaptation and plasticity in adults. Monetary or social rewards have been shown to improve "offline", between-session, skill consolidation (delayed performance gains). Here, using the finger-to-thumb opposition sequence (FOS) learning task, we show that, in 12 year-olds, the affordance of a context in which task relevance is increased can lead to more robust delayed performance gains. All of the children were given an identical training experience on a 5-element FOS. In Experiment 1 (n=34), children who practiced the sequence of movements in the more meaningful context showed a small advantage in performance speed and accuracy within the training session but in addition were able to express larger delayed gains compared to children practicing the sequence of movements in a neutral context. In Experiment 2 (n=34), practicing the sequence of movements in the more meaningful context, resulted in significantly reduced susceptibility of the trained movement sequence to interference by a subsequent learning experience; more robust delayed gains were expressed in the relevant than in a neutral context. Overall, the results show that the relevance of a task may constitute an important parameter for offline skill consolidation and the generation of procedural memory. We propose that the effects of an expected reward on skill consolidation may constitute a part of a wider spectrum of factors which gate learning processes and contribute to the selection of what is to be maintained in long-term memory in pre-adolescents.

F112

ESTABLISHING THE CAUSAL ROLE OF SLOW WAVE SLEEP IN LEARNING CONSOLIDATION AND NEURAL PLASTICITY

Joseph Arizpe[1,2], Madhumita Shrotri[1], Chris Baker[2], Vincent Walsh[1]; [1]Applied Cognitive Neuroscience Group, Institute of Cognitive Neuroscience, University College London, London, United Kingdom, [2]Unit on Learning and Plasticity, Laboratory of Brain and Cognition, NIMH, NIH, Bethesda, MD, USA — Much correlational evidence suggests that specific electrophysiological stages of sleep (e.g. Slow Wave Sleep, SWS) are involved in specific types of memory consolidation (e.g. declarative memory); however, this evidence is indirect and suffers from critical confounds (e.g. differences in sleep deprivation, body clock, and sleep disruption between conditions). We investigated whether a causal role of sleep architecture in consolidation could be established with administration of the circadian hormone melatonin. Melatonin reduces SWS, has a short one-hour half-life, and no "hangover" effects, affording modulation of endogenous sleep EEG architecture. This enables participants to learn and test under the same circadian, homeostatic, cognitive, and physiological states between high- and low-SWS sleep conditions. Participants were trained on a classic perceptual learning task (line orientation discrimination) and tested again following a 90-minute afternoon nap. We manipulated the amount of SWS during the nap in a within-subject design by administering 3 mg of melatonin or placebo 45 minutes before each nap. As expected, melatonin disrupted SWS, reducing delta (0-4 Hz) EEG power during nap. Critically, this reduction in SWS was associated with reduced improvement on the line discrimination task. In contrast, melatonin increased improvement on a control task (letter discrimination) indicating that its detrimental effect on the perceptual task was not due to reduced vigilance, but rather specifically perceptual discrimination ability. Our findings confirm an afternoon nap is sufficient to consolidate perceptual learning and directly demonstrate that SWS is causally involved in consolidation. Importantly, we established melatonin is useful for overcoming confounds in sleep studies.

F113

MENTAL AND ACTUAL PRACTICE IN LEARNING A COGNITIVE SKILL

Rinatia Maaravi[1,2], Shoshi Dorfberger[1,2], Avi Karni[1]; [1]EJ Safra Brain Research Centre for the Study of Learning Disabilities, University of Haifa, Haifa, Israel., [2]Gordon College of Education, Haifa, Israel — INTRODUCTION: Mental practice refers to a training technique whereby the procedures required in performing a given task are mentally rehearsed in the absence of physical movement. Physiological evidence and neuroimaging studies suggest an overlap in the neural networks activated during mental practice of actions and during their actual execution. We studied the time-course of learning a higher-level cognitive skill - solving a modified version of the Tower of London (ToL) task, and compared, in terms of effectiveness and transferability of the acquired knowledge, between two different training modes - actual vs. mental practice. METHODS: 52 healthy right- handed students were tested and trained using a physical (wood discs and pegs) modified version of the ToL. The task was solved either by actual moving the discs (act) or mentally by visualizing the sequence of moves (ment). RESULTS: Both "act" and "ment" conditions resulted in 'within-session' improvements in speed & accuracy. Only participants who experienced actual training showed 'between-sessions' gains. Mental practice resulted in less effective transfer to actual performance but, a limited experience with actual performance resulted in robust gains in both mental and actual performance. CONCLUSIONS: The gains in the mental and actual practice were accrued in different phases of learning - only the actual training condition resulted in delayed gains, and transfer from ment to act was limited. Mental training was effective in improving performance on the modified ToL task, but actual training may be more similar to the (procedural) learning of simple perceptual and motor tasks.

F114

EVIDENCE FOR DISSOCIABLE NEURAL SUBSTRATES UNDERLYING OPEN AND CLOSED LOOP FORMS OF SKILL LEARNING.

Calvin Goetz[1], Amy Finn[1], Jennifer Minas[1], Zhenghan Qi[1], John D.E. Gabrieli[1]; [1]Massachusetts Institute of Technology — Although the Basal Ganglia and Cerebellum are associated with skill learning, there is evidence that each are more likely to be involved depending on the kind of feedback that is associated with the learning. Specifically, the Basal Ganglia may play a larger role in sequence learning tasks, in which the representation must be open-loop since there is a temporal gap between the mental and physical action and the feedback (one doesn't know whether their action is correct until it is performed). In contrast, the Cerebellum, may be more involved in learning transformations (such as mirror tracing) in which the representation is closed-loop and one receives continuous visual feedback. To investigate these possible distinct roles, we examined the neural substrates involved during a serial reaction time (SRT) task in adults (n=62). The task was a four-choice reaction time task in which subjects were instructed to press the button corresponding with one of 4 locations. Stimuli could be sequential, random, or transformed. In the transformed task, subjects were

instructed to press the button corresponding with the box directly to the right of the box containing the dot. In the other tasks, they were instructed to simply press the button corresponding to the box containing the dot. The transformed task (vs. random) was associated with recruitment in the Cerebellum, while the sequential task (vs. random) was associated with recruitment of the Basal Ganglia (bilateral Caudate). Results indicate that the different kinds of feedback/representation are likely to be associated with distinct neural substrates.

METHODS: Neuroimaging

F115

THE FUNDAMENTAL ERROR IN INTERPRETING BRAIN MAPS AND A PROPOSED SOLUTION

Philip Burton[1], Stephen Engel[1]; [1]University of Minnesota — Neuroimaging activation maps typically color voxels to indicate whether the blood oxygen level-dependent (BOLD) signals measured among two or more experimental conditions differ significantly at that location. This data presentation, however, omits information critical for interpretation of experimental results. First, no information is represented about trends at voxels that do not pass the statistical test. Second, no information is given about the range of probable effect sizes at voxels that do pass the statistical test. This leads to a fundamental error in interpreting activation maps by naïve viewers, where it is assumed that colored, "active" voxels are reliably different from uncolored "inactive" voxels. In other domains, confidence intervals have been added to data graphics to reduce such errors. Here, we first document the prevalence of the fundamental error of interpretation, and then present a method for solving it by depicting confidence intervals in fMRI activation maps. Presenting images where the bounds of confidence intervals at each voxel are coded as color, allows readers to visually test for differences between "active" and "inactive" voxels, and permits for more proper interpretation of neuroimaging data. Our specific graphical methods are intended as initial proposals to spur broader discussion of how to present confidence intervals for fMRI data.

F116

USING STRUCTURAL CONNECTIVITY GRAPH ANALYSIS TO PREDICT COGNITIVE DECLINE IN PATIENTS AFTER CAROTID SURGERY

Salil Soman[1,2], Gautam Prasad[3,4], Elizabeth Hitchner[5,6], Michael Moseley[1], Wei Zhou[5,6], Allyson Rosen[7]; [1]Lucas Center, Radiology Department, Stanford University, [2]California War Related Illness and Injury Study Center, Palo Alto Veterans Affairs Hospital, Palo Alto, CA, [3]LONI, University of Southern California, [4]Psychology Department, Stanford University, [5]Vascular Surgery Department, Stanford University, [6]Vascular Surgery Department, Veterans Affairs Palo Alto Health Care System, [7]Psychiatry and Behavioral Sciences Department, Stanford University — Introduction: While Carotid Endarterectomy or Stenting has been noted to reduce the risk of future stroke in patients with high-grade carotid stenosis, many patients still experience postoperative neurocognitive decline. We sought to apply structural connectivity metrics to identify patients at increased risk for postoperative decline. Methods: 28 patients underwent presurgical evaluation under an IRB approved protocol that included T1 structural and 30 direction diffusion tensor imaging (DTI) MRI and a battery of neuropsychological tests both before and 1 month after surgery. Patients were classified as decliners based on decreased performance on the Rey-AVLT on 1 month follow up. The T1 images were processed using FreeSurfer, with resulting segmentations being reviewed and edited as needed under the supervision of a neuroradiologist. Whole brain tractography was performed using Diffusion Toolkit and visually inspected. Connectivity matrices were then generated from the FreeSurfer segmentation and DTK fiber tracking using Matlab, and graph metrics were computed using the Brain Connectivity Toolbox. Results: Controlling for age, classifiers using the graph analysis metrics "weighted optimal community structure" & "binary component sizes" were able to identify patients that would experience cognitive decline with 81% sensitivity 83% and specificity ($p>.05$, false discovery rate .05). These two measures were computed at 10 proportion edge thresholds from .1 to 1 at intervals of .1 in weighted and binary networks respectively. Conclusion: Applying structural connectivity analysis may be capable of identifying patients at increased risk for postoperative cognitive decline, and can may help guide therapy and provide patients' families guidance regarding prognosis.

F117

POSTERIOR CINGULATE CONNECTIVITY DURING STRESS-INDUCED ALCOHOL CRAVING PREDICTS RELAPSE IN ALCOHOL-DEPENDENT INDIVIDUALS

Yasmin Zakiniaeiz[1,2], Dustin Scheinost[2], Cheryl Lacadie[2], Rajita Sinha[3], R. Todd Constable[2]; [1]Interdepartmental Neuroscience Program, Yale University School of Medicine, New Haven, CT, [2]Diagnostic Radiology, Yale University School of Medicine, New Haven, CT, [3]Department of Psychiatry, Yale University School of Medicine, New Haven, CT — Alcohol-dependence is a chronic relapsing disease known to impact neural network processes subserving cognition and emotion regulation and to influence motivated behaviors. Alcohol craving is an important predictor of drug use and post-treatment relapse. Stressful events increase alcohol craving in alcohol-dependent individuals resulting in increased alcohol consumption to reduce stress. However, we do not fully understand the neural mechanisms of alcohol craving and stress-induced alcohol craving that may jeopardize recovery from the disease. Thirty 4-week, abstinent, recovering alcohol-dependent inpatients and thirty matched healthy controls listened to audiotaped, individualized script-driven imagery of alcohol-cue, stress-cue and neutral content to perpetuate cue-induced alcohol craving, stress-induced alcohol craving and relaxed states during fMRI imaging. Novel voxel-wise global connectivity analyses revealed increased medial prefrontal and decreased bilateral insular connectivity [$t(2,60)=2.00$, $p<0.05$] during drug-cue exposure in alcohol-dependent patients compared to healthy controls, suggesting corticolimbic dysfunction and disruption in emotion regulatory and introspective reward salience circuitry in alcoholic patients. The effect in the medial prefrontal cortex was driven by the interaction between the alcohol-cue condition and alcohol-dependent group. We also found that the interaction between stress-cue and the alcohol-dependent group in the posterior cingulate connectivity correlated with relapse, where greater global connectivity within the posterior cingulate during stress was associated with a longer time to subsequent alcohol relapse [$r(1,28)=0.375$, $p<0.05$]. These findings reveal important functional mechanisms of stress modulation in alcohol craving and suggest that reduced connectivity in the posterior cingulate may serve as a neural marker of increased risk of alcohol relapse in recovering alcohol-dependent individuals.

F118

FUNCTIONAL PARCELLATION OF CORTICAL REGIONS THAT CONTRIBUTE TO SPEECH MOTOR CONTROL

Jason Tourville[1], Alfonso Nieto-Castanon[1], Frank H Guenther[1,2]; [1]Boston University, [2]Massachusetts General Hospital — The goal of this study was to parcellate the cortical areas involved in speech motor control into functionally homogenous regions of interest (ROIs). Between-subjects variability clustering was performed on a large set (140 datasets from 116 unique subjects) of speech production neuroimaging data. Data were pooled over 10 functional magnetic imaging (fMRI) experiments in which blood oxygen level dependent responses were measured while subjects overtly produced speech. Speech conditions included single- and bi-syllable words and pseudowords. Baseline conditions consisted of viewing strings of letters or symbols. Surface-based estimates of the Speech-Baseline contrast were derived for each subject, then mapped to the FreeSurfer 'fsaverage' cortical surface template. The cortex was then subdivided using hierarchical clustering that minimized within-ROI variability in Speech-Baseline contrast. Bootstrap resampling was used to determine the population-level distribution of functional ROI boundaries. This distribution was tested against a null hypothesis of stationary spatial covariance and corrected across the entire brain using false discovery rates to estimate the location of the most robust ROI boundaries. A representative whole-brain parcellation was obtained from these boundary probability maps using watershed-based segmentation with adaptive smoothing to maximize the joint likelihood of the parcellation boundaries. The resulting parcellation divided each hemisphere into 91/93 ROIs (left/right hemispheres). ROI-level statistics were computed to assess within- and between-region functional homogeneity. Boundary-level statistics were also computed to determine between-subject variability in boundary

position and their relationship with macro-anatomical cortical landmarks. ROIs optimized to detect functional differences provide improved statistical power for detecting subtle task and/or population effects.

F119

THE INTERACTION BETWEEN DEPRESSIVE SYMPTOMS AND ADIPOSITY IN THE HYPOTHALAMUS: A FUNCTIONAL MRI STUDY. Elissa McIntosh[1], Aaron Jacobson[1], Erin Green[2], Claire Murphy[1,2]; [1]San Diego State University, [2]SDSU/UCSD Joint Doctoral Program in Clinical Psychology — Depression and obesity affect hedonic evaluation of sweet tastes. People with a history of depression have abnormal neural responses to pleasant taste stimuli in reward processing brain regions. Similarly, obese individuals have decreased neural responses in reward regions during hedonic evaluation of sweet tastes. The goal of this study was to investigate the presence of an interaction between depressive symptoms and adiposity during hedonic evaluation of sucrose. The current study used functional magnetic resonance imaging (fMRI) to investigate the effect of depressive symptoms as measured by the Beck Depression Inventory II (BDI), adiposity as measured by body mass index (BMI), and the interaction between depression and adiposity on neural reward processing. Fifty-seven participants were scanned using an event-related fMRI paradigm. During imaging, participants were orally administered sucrose in aqueous solution. After each taste, water was administered twice and served as a rinse and a baseline. Following each taste presentation, participants used a joystick to indicate the pleasantness of the stimulus. After imaging processing, beta coefficients were extracted from a priori regions of interest (ROIs) implicated in taste and reward processing. For the analyses, activation in a priori ROIs was regressed on BDI, BMI, and their interaction. Results revealed a significant interaction between BDI and BMI in the hypothalamus. As BMI increased, activation in the hypothalamus decreased. This negative association tended to strengthen as BDI scores increased. These findings warrant further investigation to better understand the relationship between depressive symptoms and adiposity and its effect on neural responses during hedonic evaluation.

F120

HOW AUTOMATION BIAS INFLUENCES HUMAN-HUMAN AND HUMAN-AUTOMATION TRUST: AN FMRI STUDY Kimberly Goodyear[1], Allison Bowman[1], Sergey Chernyak[1], Ewart De Visser[1], Raja Parasuraman[1], Frank Krueger[1]; [1]George Mason University — People often encounter situations in their everyday lives when they must rely on trustworthy advice. With new technological advances, such advice often comes from automated devices, such as GPS navigation systems, other "cognitive agents," etc. People initially tend to trust automation more highly than humans because of an existing automation bias (i.e., perfect automation schema). Previous behavioral studies have investigated the influence of automation bias on human-human and human-automation trust; however, the underlying neural mechanisms involved during these interactions are still unexplored. In this study, we combined fMRI with an X-ray screening task, where healthy participants were asked to search for knives hidden in cluttered X-ray images of luggage. Participants decided whether to search or clear the luggage after receiving advice (presence or absence of a knife) from a human or automated luggage inspector with a reliability of 90% (unknown to the participants). Our results showed that trust, which was measured by the acceptance rate of advice, was initially lower for human advice compared to automation advice. This may be due to preconceived notions that automated systems are perfect. However, trust differences between human and automation disappeared over time because of higher confidence in the human agent to provide correct advice based on the received feedback. The reinforcement learning process was mirrored by activations in reward-sensitive brain regions, including the caudate head and ventromedial prefrontal cortex. The findings provide neural evidence for how automation bias mediates human-human and human-automation trust, leading to behavioral differences in the context of advice taking.

F121

FUNCTIONAL BRAIN ATLAS OBTAINED BASED ON HIGH RESOLUTION FMRI RESTING-STATE DATA Xilin Shen[1], Emily Finn[1], Dustin Scheinost[1], Fuyuze Tokoglu[1], Xenophon Papademetris[1], Robert Constable[1]; [1]Yale University — Network based analysis has been applied to fMRI studies to explore the functional organization of the brain. Such analyses require a set of pre-defined nodes, where it is crucial that time courses within a node are temporally consistent. In our recently published work, we presented a group-wise parcellation algorithm that divides the whole brain into a number of subunits with optimized functional homogeneity and spatial coherence using fMRI BOLD data. The algorithm is aimed at maximizing the similarity within each subunit, and simultaneously minimizing the similarity between different subunits, where the similarity is measured by the temporal synchronization from each gray matter voxel. Follow-up analyses compared our functional parcellations with anatomical atlas defined based on Broadmann areas, and showed that fMRI signal variation within a subunit is significantly smaller using our function-based atlas. Therefore such functional parcellation provides the optimal node definition for subsequent network analyses. We have recently applied the parcellation algorithm to a high resolution resting-state fMRI data-set collected from 100 healthy subjects. This data-set was acquired at a spatial resolution of 2.5mm isotropic and a temporal resolution of 956ms, using a multiband sequence with multiplicity factor of 6. We obtained a series of functional atlases at a number of scales (100, 200, 300, 400 and 500 subunits for the entire brain) with reasonable across subject reproducibility. These atlases can be applied directly to examine the network level contrast in rest vs task studies, in patients vs control studies, in drug studies, etc.

F122

THE MAGIC NUMBER 57 PLUS OR MINUS 3%: WHY IS MULTI-VOXEL PATTERN CLASSIFICATION SUCCESS SO LOW IN THE LATERAL PREFRONTAL CORTEX? Christopher Gagne[1], Apoorva Bhandari[1], Patricia Shih[1], Christopher Chatham[1], David Badre[1]; [1]Brown University — Multi-voxel pattern analysis (MVPA) of the lateral prefrontal cortex (PFC) has yielded potentially important insights in recent years. However, among published studies, decoding performance in lateral PFC is consistently low, usually less than 60% for binary classification. This classification performance is consistently lower that other areas of the brain and typically amounts to only a handful of successful classifications above what would be expected by chance. Moreover, it is unclear whether these small effects would withstand attempts to control for known confounds, such as reaction time (Todd et al. 2013), as most studies have not done so. Here, we sought to investigate the reasons for consistently low classification success in the lateral PFC. We presented stimuli composed of three dimensions (i.e. color, shape, orientation), one of which was always relevant to responding. We then classified lateral PFC activity based on this relevant dimension in order to test three hypothetical accounts of low classification success in PFC. Specifically, we systematically tested (1) whether common choices regarding the implementation of the classification itself are suboptimal, (2) whether PFC voxels are too homogenous in their neural coding (i.e., the spatial frequency of contextual coding is too high for standard fMRI), and (3) whether PFC representations are non-linear and/or multiclass. We will discuss the impact of each of these investigations on classification success and consider these results with regard to the nature of lateral PFC representations for flexible behavior.

PERCEPTION & ACTION: Motor control

F123

CLASSIFICATION OF PERCEPTION-BASED MOTOR IMAGERY WITH SINGLE TRIAL EEG ANALYSIS Yi-Hung Liu[1], Hao-Ling Chen[2], Wei-Chun Hsu[3], Po-Ming Chen[1], Yu-Tsung Hsiao[1], Chun-Fu Yeh[2], Ya-Ting Chen[2], Chein-Te Wu[2]; [1]Department of Mechanical Engineering, Chung Yuan Christian University, [2]School of Occupational Therapy, National Taiwan University, [3]Graduate Institute of Biomedical Engineering, National Taiwan University of Science and Technology — Mental practice through Motor Imagery (MI) has been a contemporary intervention for motor rehabilitation. However, the quality of MI is difficult to evaluate, which limits the effectiveness of the MI-based intervention. The current study therefore aimed to develop a single-trial EEG-based paradigm to evaluate the effectiveness of motor imagery during functional motor training (e.g. goal-directed arm movement). In two experiments, participants (N=13) performed four conditions (15 trials each) of perception-based MI tasks (Condition1 & 2: inserting coins into slots of different sizes, small [3.5 × 0.4 cm] v.s. big [8 × 7 cm]; Condition 3 & 4: insert-

ing peg sticks into slots of different shapes, round v.s. star). Spectral powers of EEG and principal component analysis were adopted to extract features from the EEG signals between condition1 and 2 (SIZE), and those between condtion3 and 4 (SHAPE), and k-nearest neighbor algorithm was used to classify the extracted features. Results showed that the mean classification accuracy was 62.93% for SIZE and 61.72% for SHAPE, indicating that object-based difference during MI can be differentiated using single-trial EEG analysis. Interestingly for both types of classification, the temporal scalp region (SIZE: 65.80%, SHAPE: 62.11%) and the prefrontal scalp region (SIZE: 64.57%, SHAPE: 63.35%) show significantly higher classification accuracy than other scalp regions, which may reflect the characteristics of object-based perception in the ventral visual pathway and motor planning in the prefrontal cortices. The current findings therefore demonstrate that single-trial EEG signals can be used as neurophysiological indices to evaluate the quality of perception-based MI.

F124

SENSORIMOTOR CORTEX RHYTHMS EXPRESS ANGULAR SEPARATION BETWEEN ALTERNATIVE MOVEMENT OPTIONS

Tineke Grent-'t-Jong[1,2], Robert Oostenveld[1], Ole Jensen[1], W.Pieter Medendorp[1], Peter Praamstra[1,2]; [1]Radboud University Nijmegen, Donders Institute for Cognition, Brain, and Behavior, [2]Radboud University Nijmegen Medical Center, Department of Neurology — Movement direction is coded by groups of neurons that share directional preference. Monkey neurophysiology and computational modeling have suggested that cooperative and competitive interactions between cell groups encoding alternative response options are shaped by the task context. The goal of the present study was to investigate whether a particular contextual factor - angular separation between alternative movement targets - would be expressed in power and spectral properties of sensorimotor cortex rhythms. Besides this explorative goal, previous behavioral work informed the hypothesis that spatial separation may have a non-monotonous effect on motor cortical activity. I.e. at angular separations smaller than ~35 degrees, speeded hand and eye movements to a target frequently land between targets ("spatial averaging"), whereas beyond this separation the endpoint distribution is bimodal. MEG data were recorded while participants were precued to two possible movement targets at different angles of separation (30°, 60° or 90°), with one of the locations subsequently cued as the target for a joystick pointing movement. Time-frequency analyses did not identify effects in high frequency bands likely to represent interactions between competing cell groups. However, as predicted, the results showed a convergent pattern, across ERFs, theta, beta and low gamma power, for stronger delay-period motor preparatory activity in the 30º separation condition compared to the 60º and 90º separation conditions. We propose that the stronger motor activation early in the delay, represented in theta activity, is a possible substrate of spatial averaging in reaching.

F125

DYNAMIC VISUAL ACUITY AND EYE HAND COORDINATION IN TABLE TENNIS PLAYERS WITH DIFFERENT LEVEL OF PERFORMANCE

Yi-Jia Lin[1], Hao-Ling Chen[2], Kuang-Tsan Hung[3], Yi-Hung Liu[4], Yi-Chan Li[1], You-Cai Jhong[1], Li-Wen Tseng[1], Chun-Fu Yeh[2], Wei-Chun Hsu[1]; [1]Graduate Institute of Biomedical Engineering National Taiwan University of Science and Technology, [2]School of Occupational Therapy, National Taiwan University, [3]De-Ling Institute of Technology, [4]Mechanical Engineering, Chun Yuan Christian University — Dynamic visual acuity (DVA), the ability to perceive subtle changes of a moving object and has been suggested to be associated with saccadic performance of eye, and eye hand coordination (EHC), involving the processing of visual input and the mutual guidance with hand proprioception and motion, both play crucial role in sports performance. The aim of the study was to evaluate the two abilities through a visual stimuli moving at a speed close to those experienced by table tennis players. Twenty male elite table tennis athletes were recruited. DVA was measured in four directions including left-to-right, right-to-left, up-to-down, and down-to-up by a software. EHC was evaluated by quantifying the reaction time (RT) between a Landolt C rings moving at a set of speed as the visual stimuli and the time at which the player tell its direction through a controller manipulated by player's hand. Measured variables were compared between two groups of table tennis players with different levels. For the comparison between two disciplines, better EHC (RT: 0.48 ±0.03 vs. 0.61 ±0.12 sec) were found in elite group while no significant finding were found in DVA (400 ±69 vs. 600 ±82 pixels/frame). Difference in sports-specific level can be explained that, for the table tennis, EHC ability was more critical than DVA around the upper limit of performance. Table tennis requires both superior DVA and EHC with anticipatory and reactional psychomotor process when dealing with balls traveling around the limit of eye motion.

F126

EFFECTS OF SHORT AND LONG TERM MOTOR LEARNING ON CORTICAL STRUCTURE

Aaron Trefler[1], Cibu Thomas[2,3], Elizabeth Aguila[1]; [1]National Institute of Mental Health, [2]National Institute of Child Health and Human Development, [3]Center for Neuroscience and Regenerative Medicine at USUHS — Previous studies have reported changes in cortical structure over short-term (hours) and long-term (weeks) training using an array of different tasks (e.g. juggling). However, the robustness of these prior results is under question. Here, we employ a carefully controlled paradigm to investigate the topography of any learning based structural changes, the reliability of these changes, and whether they correlate with performance in a lateralized motor sequence-learning task. The task involved learning a specific sequence of eight speeded button presses. Each participant was scanned before and after short-term (90 minutes) or long-term (1 hour/day for one week) training. In addition, equivalent control scans were conducted in the absence of any training within the same participants. Further, multiple scans were collected in each session to test the reliability of any apparent changes. To investigate potential structural plasticity, we compared any changes in measures of cortical structure before-and-after training with any changes occurring in the absence of training. While measures of cortical thickness revealed some greater differences over training compared to equivalent control conditions, these effects were widely spread, not always consistent between replication scans, and not always consistent between short- and long-term training. Additionally, cortical areas of change did not exclusively include motor areas and were found in both the contralateral and ipsilateral hemispheres. We conclude that although measures of cortical structure appear to reveal some plasticity, the results do not appear robust.

F127

COGNITIVE BRAIN FUNCTION AND BALANCE IMPAIRMENTS FOLLOWING MILD TBI

Elizabeth Woytowicz[1], Chandler Sours[1], Joseph Rosenberg[1], Rao Gullapalli[1], Kelly Westlake[1]; [1]University of Maryland Baltimore School of Medicine — Introduction: Traumatic brain injury (TBI) results in both cognitive and physical impairments, with approximately 30% of patients reporting impaired balance, even in mild TBI. Investigations of the effect of divided attention on balance have revealed important links between delayed postural responses, risk of falling, and cognitive function. To date, no observations have been made regarding the relationship between neural changes in cognitive network function and impaired balance following TBI. We aimed to investigate the neural shift from a resting to an attentionally demanding state in relation to balance performance in subjects with mild TBI. Methods: Using functional magnetic resonance imaging (fMRI), we used a general linear analysis to compare default mode network (DMN) suppression and fronto-parietal activation during a 2-back working memory task in subjects with mild TBI and balance impairments (BI) (n = 7, age 47 ±15yrs) or no balance impairments (NB) (n=7, age 47 ±15yrs). Results: BI subjects showed a decreased ability to suppress the DMN compared to NB subjects during the working memory task. In contrast, an increased activation of the fronto-parietal executive regions was found in BI compared to NB subjects. Results were cluster corrected at $p<0.05$. Conclusions: Our results provide the first evidence of a direct relationship between altered neural network suppression and impaired balance. This mechanism may underlie an ineffective attention shifting ability towards important sensory information related to balance. Ongoing research using data-driven fMRI analysis will extend our findings to the role of anticorrelated whole brain functional networks in balance control and executive cognitive function.

PERCEPTION & ACTION: Other

F128

NEURAL CIRCUITRY AND TEMPORAL DYNAMICS OF ACTION AND ANIMAL CATEGORIZATION

Maddalena Fabbri-Destro[1], Pietro Avanzini[2], Carlos Cevallos[2], Giacomo Rizzolatti[1,2]; [1]Italian Institute of Technology, [2]University of Parma — The aim of the present study was to evaluate the neural circuitry underlying animal and action categorization. To this purpose, we recorded high-density EEG in 18 healthy volunteers who were presented with two categories of static stimuli. The first consisted of exemplars of birds and mammals, while the second comprised two types of hand-object interactions, namely precision grip and whole hand grasping. Participants were required to press one of two keys, according to the stimulus category. ERPs were computed for each condition (Animals and Actions), microstate analysis was carried out, and LAURA algorithm was used for source localization. For both conditions, following an initial activation of visual areas, bilaterally, there was an activation of the left inferotemporal cortex. The next microstate, occurring approximately between 200 and 270ms following image onset, was characterized by disappearance of the temporal activation and reactivation of the extrastriate visual areas. The most salient aspect of the next microstate (270-320ms) was the bilateral activation of the temporal pole. These results suggest that inferotemporal cortex is the core area for the "basic level" perception of different categories. The subsequent top-down activation of extrastriate areas is most likely the neural correlate of "subordinate level", while the final temporal pole activation could represent the neural substrate for"superordinate level" perception. Note that, in spite of the differences in the two tasks, the processing involved the same regions and followed the same temporal dynamics, suggesting an automaticity in the categorization processing steps.

F129

HUMAN MIRROR NEURON SYSTEM ACTIVITY IS CONSERVED IN MIDDLE CEREBRAL ARTERY STROKE PATIENTS

Panthea Heydari[1,3,4], Julie M. Werner[1,2,4], Mona Sobhani[5], Lisa Aziz-Zadeh[1,2,3,4]; [1]Brain and Creativity Institute, [2]Division of Occupational Science and Occupational Therapy, [3]Neuroscience Graduate Program, [4]University of Southern California, [5]Vanderbilt University — Stroke is a leading cause of disability among adults, often requiring intensive rehabilitative therapy. Recent studies indicate that standard therapies may be enhanced by priming motor execution via action observation. The neural basis of this result is the mirror neuron system (MNS), which is active during the observation, execution, and imitation of actions. In our study, we aim to understand the properties of the MNS post-stroke, and what task conditions activate it the most. The study will also aim to address effects of lesion location and effector used. Methods/Participants: Functional MRI (fMRI) was used to test the hypothesis that MNS function is preserved in adults with chronic left middle cerebral artery (MCA) stroke (n=8) with mild-to-moderate motor impairments. During scanning, stroke participants and age- and gender-matched control participants (n=8) observed, executed, or imitated button-pressing actions. Results: As expected, in non-disabled participants, activity increased from observation to execution to imitation in several regions, including the inferior frontal gyrus, a major component of the MNS. Interestingly, stroke participants also followed a similar trajectory in brain activity. Conclusions: Our results suggest that stroke participants follow a similar pattern of brain activity as non-disabled controls in motor related brain regions: imitation of actions results in the most activity, followed by execution, and, lastly, action observation. The clinical implications of this preserved functioning suggest that imitation may be the most effective motor practice condition, though action observation may also show improvements. Further analyses are needed to understand effects of lesion location and effector used.

F130

FUNCTIONAL AND SPATIAL DISSOCIATION IN THE BRAIN SYSTEMS ENCODING OBJECT SHAPE AND DIRECTION

Moira Dillon[1], Daniel Hyde[2], Elizabeth Spelke[1]; [1]Harvard University, [2]University of Illinois Urbana-Champaign — Recognizing objects is essential to interacting with the world. Behavioral research has identified certain geometric properties of objects that are essential to their recognition: angle and length information differentiate object shape; directional (i.e., sense) information, however, does not and is both difficult to detect and easy to ignore. Previous behavioral and neuroscientific research has evaluated how object recognition is affected by shape properties that either vary or do not vary according to rotation in depth. The present study investigates how the specific geometric information that underlies object shape and direction may be encoded in the brain. We recorded the ongoing electroencephalogram from 128 scalp sites while participants passively viewed instances of the same shape in varying positions and sizes on a computer screen. Event-related potentials (ERPs) were derived from occasional test images presenting either the same shape again (no-change), a different shape varying in angle, length, or both (shape-change), or the same shape's mirror reversal (sense-change). Preliminary results (N = 16) suggest that, relative to a no-change baseline, shape changes produce a larger-amplitude mid-latency positivity over the central parietal electrode sites compared to sense changes ($t(15) = -2.30$, $p = .036$). During roughly the same time window, sense changes produce a larger-amplitude positivity over central occipital-parietal scalp sites compared to shape changes ($t(15) = 2.52$, $p = .024$). This functional and spatial dissociation provides evidence for distinct brain systems encoding object shape and direction.

F131

PREDICTIVE CODING IN BRAIN REGIONS ASSOCIATED WITH ACTION OBSERVATION

Lieke Heil[1], Stan van Pelt[1], Sasha Ondobaka[1], Johan Kwisthout[1], Iris van Rooij[1], Harold Bekkering[1]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, the Netherlands — In the predictive coding framework, the neural signal is assumed to consist of signals reflecting predicted states of the world and signals reflecting deviations of these predictions from actual observations (i.e. prediction errors). Although this framework has repeatedly been shown to successfully describe sensory processing, few studies have focused on its validity in the more abstract domain of action observation. It has, however, been suggested that neural responses to biological motion and other people's beliefs and desires are modulated by the predictability of an event, in compliance with the features of predictive coding. In the current study, subjects watched animations of bowling actions in which information about the agent and his movements allowed them to predict kinematics and action outcome. Using functional magnetic resonance imaging (fMRI) and multivariate pattern analysis (MVPA) techniques, we examined whether predicted events result in reduced activation and a sharpening of representations in areas associated with the predicted aspect of the event, as would be expected if the prediction improves and the error is reduced. Our results show that the activation patterns in superior temporal sulcus (STS) and temporoparietal junction (TPJ) do indeed comply with the characteristics of predictive coding. Therefore, this study shows that the predictive coding framework seems to be promising not only for sensory processing, but also for more abstract cognitive functions, such as action observation.

F132

IMPACT OF TASK ON THE CORTICAL REPRESENTATIONS OF REAL-WORLD SCENES

Marcie King[1], Assaf Harel[1], Dwight Kravitz[1,2], Christopher Baker[1]; [1]National Institute of Mental Health, [2]The George Washington University — The Parahippocampal Place Area (PPA) is a key region representing visual scenes, particularly their high-level spatial properties. However, it remains unclear how independent these representations are of top-down, observer-based factors, such as task demands. To determine how task demands impact scene representations, we performed an event-related functional magnetic resonance imaging (fMRI) experiment manipulating both higher-level visual scene properties and task context. Scanned on a 7T fMRI scanner, participants viewed a diverse set of real-world scenes, spanning three dimensions (open/closed, manmade/natural, near/far) and were asked to perform either a spatial task (determining whether a scene was open or closed) or a semantic task (determining whether a scene was manmade or natural). Importantly, participants performed the two tasks while viewing the same scene images, ruling out potential stimulus effects. Task context played a key role in constraining the nature of scene representations in PPA. First, in response magnitude there was an interaction between task and scene properties. Second, while multivariate pattern analyses revealed similarities in the representations of scenes across task with a separation of open and closed scenes, the strength of this distinction

varied with task. Together, these findings suggest that the nature of scene representation is determined not only by image properties but also by high-level cognitive factors, such as task context.

PERCEPTION & ACTION: Vision

F133

ARE LETTERS AND FREQUENT LINE CONFIGURATIONS ENCODED IN EARLY VISUAL CORTEX?

Hui-Chuan Chang[1], Kimihiro Nakamura[2,3,4,5], Antoinette Jobert[2,3,5], Christophe Pallier[2,3,6,5], Stanislas Dehaene[2,3,4,5]; [1]Institute of neuroscience, National Yang-Ming University, Taipei, Taiwan, [2]Cognitive Neuroimaging Unit, INSERM, Gif-sur-Yvette, France, [3]CEA, DSV, I2BM, NeuroSpin Center, Paris, France, [4]Collège de France, Paris, France, [5]University Paris-Sud, Paris, France, [6]Centre National de la Recherche Scientifique, Paris, France — It has been reported that letter strings provoked stronger activations than non-letter controls in the visual cortex, including early areas. There can be two, non-necessarily incompatible hypotheses about these activations. They could reflect letter learning or a more general sensitivity to line configurations in visual scene (Changizi et al., 2006, "The structures of letters and symbols throughout human history are selected to match those found in objects in natural scenes" in The American naturalist).The current experiment was designed to disentangle letter status and line configuration frequency. We selected 8 letters and created 8 corresponding non-letter stimuli by rotation or symmetry. The stimuli were repeated either along the horizontal or the vertical meridian. We expected that letter-status might have larger effects in the cortical region corresponding to the horizontal meridian, because words are usually presented horizontally. fMRI data obtained in 18 participants showed that, in early retinotopic area (V1/V2), letters elicited stronger activations than non-letters. This effect was reversed in higher-level retinotopic areas, which can be tentatively explained by supposing that non-letters are recognized as rotated letters, increasing the processing load in higher visual areas. Both in low-level and high levels areas, these effects were mainly found in the horizontal meridian. Moreover, activation correlated with letter frequency but not with configuration frequency, conforming to the existence of experience-dependent plasticity resulting from reading acquisition.

F134

THE EFFECT OF FEEDBACK ON 3D MULTIPLE OBJECT TRACKING PERFORMANCE AND ITS TRANSFERABILITY TO OTHER ATTENTIONAL TASKS

Chiara Perico[1,2], Domenico Tullo[1,2], Krista Perotti[1], Jocelyn Faubert[3,4], Armando Bertone[1,2]; [1]Perceptual Neuroscience Laboratory for Autism and Development, [2]McGill University, [3]Visual Psychophysics and Perception Laboratory, [4]Université de Montréal — Attentional processes play an integral role in learning, affecting performance on most cognitive tasks. In addition, feedback - instant information delivered to the individual that guides their subsequent behavior in relevant situations - plays a critical role in the efficiency and quality of learning. However, its effects are not often empirically assessed. The goal of this study was to assess whether performance on attentional capacities acquired during training on a 3D Multiple Object Tracking (MOT) task are transferrable to other measures of attention. The role of feedback was also investigated to determine whether performance, and its subsequent transferability to other measures, is affected by feedback. Forty typically developing adults participated in 4 testing sessions on consecutive days. On day 1, intellectual and attentional abilities were assessed along with a baseline measure of MOT without feedback. Participants were split into 2 experimental groups and assessed for three subsequent days (days 2 through 4): one group received feedback during the MOT task trials; the other group received no feedback. On day 4, all participants were re-assessed on the same attentional measures as well as the MOT to determine improvements from day 1. MOT performance resulted significantly higher for the feedback group, as defined by an increased speed threshold for tracking 4 out of 8 items. The feedback group also revealed better transferability to other cognitive tasks. The results indicate that feedback is an important component during a learning regiment and that it may affect transferability of cognitive abilities.

F135

ELECTROPHYSIOLOGICAL CORRELATES OF PARIETAL PHOSPHENE PERCEPTION

Chiara Bagattini[1], Chiara Mazzi[1], Silvia Savazzi[1]; [1]University of Verona and National Institute of Neuroscience, Italy — Transcranial magnetic stimulation (TMS) of the occipital cortex is known to induce visual sensations, i.e. phosphenes, which appear as flashes of light without light actually entering the eyes. Recent studies have shown that TMS can produce phosphenes also when parietal cortex is stimulated. As the neural bases involved in parietal phosphenes perception still remain unknown, the main question is whether these percepts are generated directly by local mechanisms or emerge through indirect activation of other visual areas. Specifically, the aim of this study was to investigate the electrophysiological correlates of phosphenes evoked by parietal stimulation in a sample of healthy participants and in a hemianopic patient who suffered from the complete destruction of early visual cortex. We recorded EEG signals while stimulating left parietal cortex, and we compared trials in which the TMS pulse was followed by a phosphene perception with trials in which no visual sensation was reported. Analyzing the pre-TMS Î± power, i.e. an index of cortical excitability, we found that phosphene perception was associated with reduced Î± power, indicating that a higher cortical excitability correlated with phosphene perception. Analyzing TMS-evoked potential, we found that phosphene perception modulated brain activity at different latencies after the TMS pulse, with enhanced components' amplitude when phosphenes were perceived. Given that the same pattern of results was obtained for both healthy participants and the hemianopic patient, the role of V1 in parietal phosphenes can be ruled out. These findings thus support the idea that parietal cortex is an independent generator of phosphenes.

F136

IS BLINDSIGHT REALLY BLIND? HOW DIFFERENT MEASURES OF SUBJECTIVE EXPERIENCE CAN MODULATE AWARENESS IN THE BLIND FIELD

Silvia Savazzi[1], Chiara Bagattini[1], Chiara Mazzi[1]; [1]University of Verona and National Institute of Neuroscience, Italy — Blindsight is classically defined as the ability shown by some hemianopic patients to detect, localize and discriminate visual stimuli in their blind field, without consciously experiencing any visual percepts. In spite of the definition, the literature documents cases of blindsight patients who demonstrated a preserved degree of awareness in their blind field. The aim of this study was to investigate the correlation between discrimination ability and awareness in the blind field of a hemianopic patient. A 45-years old right-handed woman (SL), with a right homonymous hemianopia caused by a complete destruction of the left primary visual cortex, was tested. The patient was asked to discriminate a feature (orientation, color, contrast, motion) of different stimuli presented in her blind field in a two alternative forced-choice task. Subsequently, the patient had to report her subjective experience: in the first experiment as "seen" or "guessed", whereas in the second experiment as the degree of clearness of her experience according to the Perception Awareness Scale (PAS). The first experiments showed that SL demonstrated a performance above chance level in the contrast discrimination task for"guessed" trials, thus showing blindsight when the classic binary methodology (seen/guessed) was applied. The second experiment, however, showed that PAS ratings correlated with discrimination accuracy, thus revealing that SL's above chance performance was due to a certain degree of awareness. In conclusion, patient's preserved discrimination ability seemed to rely on conscious, although degraded, vision rather than unconscious vision.

F137

REAL EFFECTS OF ILLUSORY EFFECTS: THE INFLUENCE OF PERCEIVED LUMINANCE ON BEHAVIOR

Ramisha Knight[1], Chiara Mazzi[1], Silvia Savazzi[1]; [1]University of Verona and National Institute of Neuroscience, Italy — Simple reaction times (RT) are inversely related to the luminance/contrast of a visual stimulus, with RT increasing as luminance/contrast decreases. In the present experiment, we tested whether an illusory luminance/contrast yields a similar effect on RT by using the well-known simultaneous brightness contrast (SBC) illusion: a stimulus appears darker when viewed over a light background than when viewed over a dark background. In Experiment 1, participants were asked to respond as quickly as possible to visual stimuli (light- or dark-gray) presented over backgrounds

with an actual difference in luminance (control condition) or inducing the SBC (illusory condition). The results showed that RTs were modulated both in the control and illusory conditions, thus indicating that the perceived and not the actual luminance/contrast influences behavior. In Experiment 2, we test the hypothesis that SBC illusion could also modulate the frequency and/or RTs to artificially induced visual percepts. Using the same two types of backgrounds as Experiment 1, we applied TMS over the primary visual cortex in order to induce sensations of light (phosphenes) and darkness (scotomas) and participants were asked to react as quickly as possible to the percepts and to report their luminance on a gray-scale bar. The results showed that for both the control and illusory conditions, frequency of and speed in responding to percepts were modulated by the background. These data reinforce our conclusion that the perceived rather than the actual luminance/contrast influences behavior and, more importantly, that this effect can be found also for artificially induced percepts.

F138

DIRECT EVIDENCE FOR DEPENDENCE OF SCENE CATEGORY JUDGMENTS ON NEURAL ACTIVITY IN LATERAL OCCIPITAL COMPLEX AND PARAHIPPOCAMPAL PLACE AREA Drew Linsley[1], Sean MacEvoy[1]; [1]Department of Psychology, Boston College, Chestnut Hill, Massachusetts, USA. — Behavioral studies indicate that scene categorization draws heavily upon analysis of scenes' spatial properties, such as three-dimensional layout (Greene & Oliva, 2009) as well as the kinds of objects scenes contain (Davenport & Potter, 2004; Joubert et al., 2007; MacEvoy & Epstein, 2011). fMRI studies have identified regions of ventral-temporal (VT) cortex sensitive to these resources, notably the parahippocampal place area (PPA) for scenes' spatial properties and the lateral occipital complex (LOC) for their object contents. Although activity patterns in these regions correspond to the identities of viewed scenes (Walther et al. 2009, MacEvoy & Epstein, 2011), their contribution to perceived category has remained unclear. To directly measure the influence of VT areas on behavior, we used fMRI to record patterns of brain activity while observers categorized computer-generated scenes as bathrooms or kitchens; each was either unambiguously a member of one category in terms of spatial properties and object contents, or configured to be completely category-ambiguous. Observers were periodically instructed to base their decisions on either scenes' spatial properties or object contents. A classifier trained on responses to unambiguous scenes successfully predicted observers' categorical judgments of ambiguous scenes from their activity patterns evoked in both LOC and PPA. Critically, predictions by LOC patterns were more accurate when observers attended to objects, while those by PPA were more accurate during attention to scenes' properties. These differentials are inconsistent with LOC and PPA patterns simply following observers' judgments, and instead indicate a significant dependence of judgments on neural activity in these regions.

F139

THE TIME COURSE OF SCENE PROCESSING: EVIDENCE FROM EVENT-RELATED POTENTIALS Assaf Harel[1], Dwight Kravitz[2], Leon Deouell[3], Chris Baker[1]; [1]National Institutes of Health, [2]George Washington University, [3]Hebrew University of Jerusalem — Humans are extremely adept at recognizing complex real-world scenes, an ability supported by a network of scene-selective cortical regions. In spite of growing knowledge about the functional properties of these regions, much less is known about the temporal dynamics underlying scene perception. To address this question, we recorded event-related potentials (ERPs) while participants viewed images of scenes, faces, and objects. Focusing on posterior sites, we found that the first ERP component to distinguish between scenes and faces and objects was the P2 component peaking around 200 ms post-stimulus onset, with highest amplitude to scenes relative to the other two categories. In comparison, the sensory-driven P1 component was equal in amplitude to all categories, and the N1/N170 showed the expected face selectivity. We then asked how sensitive are these early ERP components to different scene-diagnostic dimensions. We presented the same participants with a diverse set of real-world scenes, which spanned three stimulus dimensions: spatial boundary (open/closed), relative distance (near/far), and semantic content (manmade/natural). Consistent with its putative scene selectivity, P2 amplitude was sensitive to the spatial boundary of the scene, with higher amplitude to closed than open scenes. P2 amplitude was also modulated by the semantic content of the scene, a distinction that appeared earlier, at the N1/N170 level, arguably reflecting low-level stimulus properties. In sum, our findings highlight the existence of an ERP marker indexing high-level scene processing, which peaks 200 ms after stimulus presentation and represents complex scene-diagnostic information.

F140

SUBJECTIVE ONSET AND REPETITION IN HIGH-LEVEL VISUAL PERCEPTION Javid Sadr[1]; [1]University of Lethbridge — There are a number of important and timely questions in cognitive neuroscience surrounding the mechanisms of high-level visual perception. In the present study, we explore the neural correlates of the onset of subjective visual perception and of perceptual hysteresis for both face and object stimuli. We do so in a manner that allows for direct comparisons of neural activity that are both categorical (contrasting successful versus unsuccessful high-level perception) and parametric (across graded levels of carefully controlled image degradation); further, with this paradigm all comparisons involve images or image classes that are normalized on a number of stimulus dimensions known to influence both perceptual and neural measures. Using magnetoencephalography, we specifically ask, for faces and for objects, whether the M100 and M170 components exhibit modulation coincident with perceptual onset and/or as a function of repeated viewings -- of the identical image seen at a later time (particularly when an item is successfully perceived on the second but not the first viewing) and of the same object/face depicted in other images parametrically differing in their level of degradation. With this approach, for both faces and objects we find significant modulation of the M100 and M170 corresponding to the onset of perception and as a function of repeated viewings. Further, for the M170 the results indicate an enhancement effect for repeated viewings of face images and a suppression effect for repeated object images.

THINKING: Decision making

F141

FITTING DIFFUSION MODELS TO VALUE BASED DECISIONS Doris Voina[1], Samuel F. Feng[1], Amitai Shenhav[1], Jonathan D. Cohen[1]; [1]Princeton University — Researchers have taken an increased interest in modeling value-based decisions (e.g., choices between consumer goods) as processes of evidence accumulation. The drift diffusion model (DDM) has become one of the most commonly leveraged models in this endeavor. Yet questions remain regarding (a) how to design one's value-based decision task to best exploit the DDM and (b) what analytic methods are most appropriate to then use when fitting the DDM to their data? Here we explore both questions and propose best practices for design and analysis of value-based decision tasks that seek to utilize the DDM. We systematically test a variety of possible experimental designs by simulating data-sets of varying trial numbers and distributions of values across trials. We then analyze each data-set with DDMs with varying numbers of free parameters and using two common approaches to fitting DDM predictions to choices and response times (RTs): maximum likelihood estimation (MLE) and the least-squares method (LSM). We first find that testing more value levels allows an experimenter to improve accuracy and precision of DDM parameter estimates (e.g., given 50 trials per subject, better fits are obtained by sampling 5 trials at 10 value levels as opposed to 50 trials at a single level). Second, we find that MLE always outperforms LSM, but is biased for fits with fewer than 50 trials. However, LSM fits improve with fewer parameters and are always completed faster than MLE. We also discuss fitting performance as sample size, parameter breadth, and trial distribution vary.

F142

STRIATAL HYPERSENSITIVITY TO IMMEDIATE REWARD DRIVES SELF-CONTROL DEFICITS IN PSYCHOPATHY Erik Kastman[1], Hayley Dorfman[2], Arielle Baskin-Sommers[3], Kent Kiehl[4], Joseph Newman[5], Joshua Buckholtz[6]; [1]Harvard — Psychopaths exhibit severe self-control in many contexts, as evidence by the high rate of antisocial behavior, sensation seeking, and substance abuse in the population. Prior work in community volunteers with psychopathic traits suggests that reward-related striatal hyper-reactivity may drive impaired self-control in these individuals(Buckholtz 2010); however, the specific mechanisms by which striatal hypersensitivity contributes to poor decision-making in psychopaths remain unclear. Given

the role of this region in calculating subjective value, we hypothesized that exaggerated striatal reactivity leads to an immediacy bias in subjective value assignment during decision-making, predisposing impulsive choice behavior. To test this hypothesis, 49 male inmates at two state prisons performed an intertemporal monetary choice paradigm, and each individual's hyperbolic discounting factor k was calculated; this was used to compute trial-wise estimates of subjective value for each option. A subjective value difference measure (SVDiff = SVsooner - SVlater) was calculated and entered as a parametric modulator in a random-effects general linear model analysis within SPM8. For each subject, we calculated correlations between their PCL-R score and SVDiff fMRI betas, with age and substance abuse Hx as covariates. Across participants, neural signals encoding subjective value were observed in ventral striatum and medial prefrontal cortex (pFDR < 0.05). Consistent with our hypothesis, PCL-R total scores were positively correlated with these striatal subjective value signals. On the whole, these data support the notion that striatal hyper-reactivity in psychopaths may impair self-control by biasing the assignment of subjective value to immediate reward options during decision-making.

F143

CORTICOSTRIATAL STRUCTURAL DIFFERENCES DISSOCIATE IMPULSIVE-ANTISOCIAL BEHAVIOR FROM PSYCHOPATHY

Hayley Dorfman[1], Erik Kastman[2], Arielle Baskin-Sommers[3], Kent Kiehl[4], Joseph Newman[5], Joshua Buckholtz[6]; [1]Harvard University, [2]Harvard University, [3]McLean Hospital, [4]University of New Mexico, [5]University of Wisconsin - Madison, [6]Harvard University — Antisocial behavior refers to a pervasive pattern of disregard for widespread norms of acceptable conduct. However, individuals can arrive at a common endpoint (e.g. crime, aggression, rule-breaking) via multiple causal pathways. Two antisocial subtypes are especially well characterized clinically - an impulsive-reactive variant ("impulsive-antisocial;" IA) and a callous/instrumental form (Psychopathy; PS) - but our understanding of the neurobiological basis of this distinction is poor. Here, we used morphometric analyses in a sample of incarcerated male offenders to uncover common and subtype-specific associations to antisocial behavior. Given that features related to reward and motivation are common to both (e.g. substance abuse), we predicted IA and PS would show a common pattern of striatal volumetric aberration. By contrast, executive function is impaired in IA but relatively preserved in PS, suggesting that that IA individuals - but not PS - would show significant reductions in prefrontal cortical thickness. To test this hypothesis, we recruited 48 inmates at two medium-security state prisons; they received extensive clinical assessments and T1 structural scans via mobile 1.5T MR. Estimates of cortical thickness and subcortical volume were obtained using Freesurfer. Consistent with our prediction, higher levels of IA were associated with higher gray striatal gray matter volume. However, while we observed lower lateral prefrontal cortical thickness in IA individuals, prefrontal structural deficits were not observed in PS. These data suggest that clinically distinct trajectories for antisocial behavior may both arise from a common deficit in reward and motivation, but are differentiated by subtype-specific preservation of prefrontal executive control.

F144

CRAVINGS IN A VIRTUAL REALITY ENVIRONMENT PREDICTED BY EATING DISORDER RISK

Alexandra Palmisano[1], Andrew Carew[1], Rachel Niezrecki[1], Bonnie Deaton[1], Franchesca Kuhney[1], Melissa Santos[2], Robert Astur[1]; [1]University of Connecticut, [2]Connecticut Childrens Medical Center — It is essential to examine what factors influence conditioned place preference (CPP) in order to predict potential attitudes toward food and to establish treatment for those with eating disorders. Despite ample nonhuman studies, there has been limited human research aimed at elucidating the underlying factors of environmental or contextual cues that impact eating attitudes. Within rodent research, these cues are often studied using a conditioned place preference paradigm, whereby a specific environment is paired with a reinforcement like a drug, sex, or food, and via classical conditioning, a preference emerges for an environment in the absence of the reinforcement. In an attempt to extend this paradigm to humans, we created a virtual reality CPP task with real-life M&M rewards. Previous studies by our lab have demonstrated that participants display a CPP by spending significantly more time in the room previously paired with M&Ms ($p<0.01$). With reliable preferences established, we invited participants to complete the Eating Attitudes Test (EAT-26) and using their responses examined the correlation between self-reported attitudes toward eating and a preference for the M&M-paired room. We observed a strong negative correlation between a participant's risk for bulimia and their preference for the M&M room ($r = -0.562$, $p < 0.05$) that was strengthened when examining female participants only ($r = -0.825$, $p < 0.01$). We believe this to be the first time that factors affecting CPP have been measured in an attempt to examine the extent to which CPP may be used as a food attitude predictor.

F145

USING KNOWLEDGE ABOUT PERCEPTUAL PERFORMANCE TO MAKE VALUE-BASED DECISIONS

Ming-Jen Yeh[1], Shih-Wei Wu[2]; [1]National Yang-Ming University, [2]National Yang-Ming University — In many situations, we often have to make economic, value-based decisions by taking into account our performance in various tasks. Little is known, however, about how and how well subjects estimate their perceptual performance under different contexts and use it to make value-based decisions. Method: There were two sessions in the experiment. First, in a random-dot motion (RDM) task, subjects were trained to make judgments on motion direction when there were two possible correct directions (2AFC task) or 8 possible correct directions (8AFC task). In the second session, we asked the subjects to choose between two different RDM stimuli, one with two alternatives and the other with 8 alternatives. Subjects were instructed to choose the one they preferred. Subjects received a reward if making a correct direction judgment and otherwise nothing. We specifically designed the RDM stimuli such that they would differ in motion coherence levels but would have the same probability of making a correct judgment based on performance in the first session. In other words, the objective stimulus value between the two options was the same. Results: Six subjects participated in the experiment. Preliminary results suggested that, when making value-based decisions in the second session, all subjects took into account knowledge about their own perceptual performance in the first session. We also found that when the value of the competing options was equal, subjects exhibited a slight bias toward the 8-alternative option. This suggested that subjects might systematically overestimate performance in the 8AFC task when making value-based choices.

F146

LOW TEMPORAL DISCOUNTING IN ANOREXIA NERVOSA NORMALIZES WITH WEIGHT RESTORATION

Johannes Decker[1], Bernd Figner[2], Tim Walsh[2], BJ Casey[1], Joanna Steinglass[2]; [1]Weill Cornell Medical College, [2]Columbia University — Anorexia nervosa (AN) has the highest mortality rate of any psychiatric illness, as individuals engage in persistent caloric restriction resulting in pathologically low body weight. AN patients seemingly forgo immediate rewards (food) in favor of a possible future reward (weight loss). Steinglass et al. (2012) recently showed that AN patients have a stronger preference for delayed monetary rewards than healthy controls (HC), suggesting that excessive self-restriction in AN may extend beyond the realm of food. Using a temporal discounting task - offering a series of binary choices between a smaller sooner (SS) and larger later (LL) reward - we explored whether discounting rates, a measure of delay preference, change with weight restoration. AN patients (n=63) were tested within one week of admittance and retested (n=50) after 2 consecutive weeks of weight restoration. A healthy comparison group was tested twice 1-3 months part (HC:n=39,n=32). A subset successfully performed the task during an fMRI scan (AN:n=24,n=19 and HC:n=22,n=16). There was a Diagnosis X Session interaction ($F(1,69.2)=14, p<.0005$ full sample; $F(1,33.5)=6.0, p<.01$ scan sample) with AN patients showing a lower discount rate (LL preference) than HC at session 1, ($t(94)=-2.37, p<.02$ full set, $p=.34$ scan set) and an increase in their discounting rate at session 2 ($t(100)=-3.37, p<.005$ full set, $t(41)=-2.60, p<.05$ scan set). HC showed no change across sessions. A choice (SS/LL) X diagnosis (AN/HC) X session (T1/T2)interaction was observed in the striatum, anterior cingulate cortex, R-parietal cortex (whole-brain corrected $p<.05$,). These differences in reward-related processing suggest an abnormal neural mechanism in temporal discounting in AN.

F147

REWARD-RELATED MODULATION OF CONDITIONED STIMULUS PERCEPTION AFTER ASSOCIATIVE LEARNING James Howard[1], Thorsten Kahnt[2], Jay Gottfried[1]; [1]Northwestern University, [2]University of Zürich — Research on the behavioral and neural underpinnings of reward-related associative learning typically overlooks the role of sensory processing. In order to more closely examine the interaction between sensation and reward we conducted an experiment in which human participants (N=8) underwent a Pavlovian associative learning paradigm involving four olfactory cues as conditioned stimuli (CS) and monetary reward as unconditioned stimuli (US). Before and after learning subjects provided ratings of odor pleasantness and perceptual similarity between each possible odor pair. During the learning phase two of the odors (CS+) were paired with $1.00 rewards with 100% contingency and the remaining two (CS-) were never paired with reward. Analysis of the pleasantness ratings revealed that the CS+ were rated as significantly more pleasant than CS- after learning. Moreover, the two CS+ were rated as significantly more similar to each other after learning compared to the similarity of the CS- pair. By applying multidimensional scaling to the similarity ratings, we observed the emergence of a reorganized perceptual space occupied by these odors such that associated reward value constituted a principal dimension after learning. The magnitude of this perceptual reorganization was directly related to the change in pleasantness rating across subjects. Taken together, these findings suggest that sensory and reward processing of conditioned stimuli are closely linked, and that the representation of associative structures in the brain may extend from higher order associative areas to include primary sensory regions.

THINKING: Development & aging

F148

PATH COMPLEXITY IN VIRTUAL WATER MAZE NAVIGATION: DIFFERENTIAL ASSOCIATIONS WITH AGE, SEX, AND REGIONAL BRAIN VOLUME Ana Daugherty[1], Peng Yuan[1], Cheryl Dahle[1], Andrew Bender[1], Yiqin Yang[1], Naftali Raz[1]; [1]Wayne State University, Detroit, MI — Studies of human navigation in virtual maze environments have consistently linked advanced age with greater distance traveled between the start and the goal and longer duration of the search. Observations of the search path geometry suggests that the routes taken by older adults may be unnecessarily complex, and that excessive path complexity may be an indicator of cognitive difficulties experienced by older navigators. To quantify search path complexity in a virtual Morris water maze, we developed a novel method based on fractal dimensionality. We applied the method to a sample of healthy adults (N=139, mean age 48.52 + 15.85, 66% women). In a two level hierarchical linear model, we estimated improvement in navigation performance across trials by a decline in route length, shortening of search time, and reduction in fractal dimensionality of the path. While replicating commonly reported age and sex differences in time and distance indices of performance, we observed that reduction in fractal dimension of the path accounted for improvement across trials, independent of age or sex. The volumes of brain regions associated with planning (prefrontal cortex), timing (cerebellum) and establishment of cognitive maps (parahippocampal gyrus) were negatively related to path dimensionality, but not to the total distance and time. Thus, fractal dimensionality of a navigational path may present a useful complementary method of quantifying performance in water maze navigation.

F149

ORIGINS OF NUMERICAL THINKING: RELATING BRAIN SIGNATURES TO BEHAVIORAL DEVELOPMENT USING AN INDIVIDUAL DIFFERENCES APPROACH WITH PRESCHOOLERS Daniel Hyde[1], Manuela Piazza[2], Pierre Pica[3], Stan Dehaene[2], Elizabeth Spelke[4]; [1]University of Illinois Urbana-Champaign, [2]INSERM-CEA, France, [3]CRNS, France, [4]Harvard University — Research with infants, adults, and many non-human animals suggests two pre-verbal cognitive systems for representing number: a system for tracking a small number of individual objects and a system for approximating the numerical magnitude of larger sets of objects. The role of these systems in the initial development of symbolic number concepts, as demonstrated by counting ability, remains unclear and highly debated. Here we used an individual differences approach to test for a relationship between counting proficiency and the brain correlates (event-related potentials) of spontaneous object individuation and numerical approximation. We tested a 3- to 4- year old preschool children on a battery of numerical and non-numerical tasks using both behavioral and brain measures. We observed that individual differences in early visual-attentional processing of a small number of objects (N1), a marker of object individuation, correlated with differences in counting proficiency ($n = 40$; give-a-number task: $r = -.47$, $p < .005$). This correlation held after accounting for the effects of age, verbal IQ, and working memory ($ps < .05$). Individual differences in spontaneous, mid-latency processing (P2p) of large approximate numerical differences correlated with active behavioral numerical comparison abilities ($n = 32$, $r = .45$, $p < .01$), but not with counting proficiency in preschoolers ($p > .75$). These results provide further evidence for a distinction between the representation of a small and large number of items. Furthermore, these results suggest that individual differences in basic, spontaneous, attentional processing of objects may influence the development of higher-level conceptual numerical abilities.

F150

ACCEPTANCE OF TELEOLOGICAL AND MECHANICAL EXPLANATIONS AMONG STUDENTS Hamilton Haddad[1], Vivian MC El Dash[1], Ingrid MC El Dash[1]; [1]University of São Paulo — The teleological tendency to assume that objects and events exist for a particular purpose or goal is a crucial element of the biological reasoning, although modern science tends to reject this kind of explanation in favor of a mechanical-causal view of the world. The present study investigated differences in the acceptance of teleological and mechanical explanations among undergraduate students in Biological Sciences at the University of São Paulo. It was presented a set of short statements to 115 students, who were divided in two groups. To the first one, the sentences were presented for 3.5 seconds. The second group had the time they considered necessary to analyze the statements (adapted from Keleman & Rosset, Cognition 2009). Under time restriction, the results showed 51.2% of answers endorsing scientifically unwarranted teleological statements, such as Trees produce oxygen so that animals can breathe . Without this time pressure, this percentage was reduced to 26.3% (statistically different, $p < 0.5$). This pattern was not observed for the mechanical-causal statements, which showed over 90% of correct answers in both groups. These results suggest that the teleological view of natural phenomena is deeply rooted in the conceptual schema of students throughout development and schooling. The role of the prefrontal cortex in this process is discussed. Instead of being supplanted by a more scientific worldview, this tenacious bias can be inhibited but possibly never entirely replaced.

Poster Session G

ATTENTION: Development & aging

G1

DOES THE AGE-RELATED "ANTERIOR SHIFT" OF THE P3 REFLECT AN INABILITY TO HABITUATE THE NOVELTY RESPONSE? Brittany Alperin[1], Katherine Mott[1], Eliza Ryan[1], Philip Holcomb[2], Kirk Daffner[1]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — Older adults generate larger anterior neural responses than young adults when carrying out task requirements. A common finding in the ERP literature is an "anterior shift" of the P3b to targets. Utilizing principal component analysis (PCA), we recently demonstrated that rather than the P3b moving anteriorly, older adults generate a large P3a that temporally overlaps with their P3b. A dominant hypothesis explaining the age-related increase in anterior P3 is the failure to habituate the brain's novelty response to rare targets. We tested this hypothesis in young and old adults by comparing the amplitude of the PCA factor representing P3a to targets presented in the first versus last of eight blocks. If, unlike young adults, older adults are unable to habituate a novelty response, one would expect 1) the P3a amplitude to decrease between the first and last blocks for young, but not old subjects and 2) the difference in P3a amplitude between young and old subjects to be greater in the last than the first block. Our results indicate the amplitude of the P3a was larger in older adults than younger adults. However, this effect was not modulated by block. Additionally, there was no overall effect of block. These findings argue against the hypothesis that an age-related increase in the P3a to targets reflects an inability of older subjects to habituate a novelty response. An alternative hypothesis is that the augmented P3a indexes the increased utilization of frontal executive functions to provide compensatory scaffolding to carry out a task.

G2

BILINGUAL CHILDREN SHOW GREATER LEFT PREFRONTAL ACTIVATION DURING A NON-VERBAL ATTENTION TASK: AN FNIRS STUDY Maria Arredondo[1], Xiaosu Hu[1], Lourdes Delgado Reyes[2], Stefanie Younce[1], Jaime Muñoz Velazquez[3], Teresa Satterfield[1], Ioulia Kovelman[1]; [1]University of Michigan, [2]University of Iowa, [3]California State University, Fullerton — How does early bilingual exposure change the language and cognitive processes in the developing brain? Theories of bilingual development suggest that the necessity to pay selective attention to two competing linguistic inputs fosters an overall improvement of attention in young bilinguals, improvement likely supported by the prefrontal cortex (Bialystok, 2000). Nevertheless, while some previous studies have found better cognitive functioning in bilinguals relative to monolinguals, the degree to which these differences are related to language experience and sociocultural circumstances unique to bilingual upbringing remain unclear. Moreover, little is known about the brain basis of attention processing in child bilinguals. Thus, in the present study we used functional Near Infrared Spectroscopy (fNIRS) to investigate the brain basis of selective attention in Spanish-English bilingual and English-monolingual children using the Attentional Network Task (ANT; n=11 per group, ages 7 to 12). The incongruent condition (minus congruent condition) elicited greater left hemisphere prefrontal activation in young bilinguals relative to monolinguals, including inferior, middle and superior frontal regions ($p < 0.01$). The greater recruitment of the left hemisphere language and verbal working memory regions in bilingual children suggests that early dual language exposure indeed increases the extent to which the language hemisphere responds to domain-general tasks of attention and possibly working memory. The findings carry important implications for understanding the development of the prefrontal cortex and how early life experience, especially bilingualism, may impact the neurodevelopmental basis of higher cognition.

G3

PAYING (FOR) ATTENTION: EFFECTS OF DISTRACTION, TIME-ON-TASK, AND MONETARY INCENTIVE IN YOUNGER AND OLDER ADULTS Ziyong Lin[1], Leanne Lasecki[2], Cindy Lustig[1]; [1]University of Michigan, [2]University of North Carolina at Wilmington — Adult aging is heuristically associated with reductions in attentional control, but performance may be influenced by a number of factors including the type of attention assessed (e.g. sustaining attention vs resisting distraction) and participants' motivation. We used the Continuous Temporal Expectancy Task (O'Connell et al., 2009), a duration-discrimination task that shows rapid time-on-task performance declines, to assess young (n = 32, M age = 18.63 yrs) and older (n =32; M age = 70.37 yrs) adults' ability to sustain attention, and manipulated whether a nearby laptop was silent or playing videos to assess distractor vulnerability. Older adults performed better than young adults overall and had less severe time-on-task declines. Debriefing questionnaires suggested that boredom and lack of engagement by young adults drove this paradoxical age difference. To test this directly, we added an incentive condition in which participants could earn up to $10, with $.05 deducted for every error. (Data collection ongoing; n = 18 young adults, M age = 18.71 yrs; n = 32 older adults, M age = 72.03 yrs.) Preliminary results suggest this incentive improves young adults' performance so that they now perform as well as older adults in the non-incentivized condition, but has no or even detrimental effects on the performance of older adults. Distraction did not increase as a function of time-on-task and was not influenced by incentive condition for either age group. Results suggest that different aspects of attentional control differ in their sensitivity to age differences in ability and motivation.

G4

REMEDIATION OF ABNORMAL VISUAL MOTION PROCESSING SIGNIFICANTLY IMPROVES ATTENTION, READING FLUENCY, AND WORKING MEMORY IN DYSLEXIA Teri Lawton[1,2], Jordan Conway[1], Steven Edland[3]; [1]Department of Computer Science and Engineering, UCSD, La Jolla, California, [2]Perception Dynamics Institute, Del Mar, CA, [3]Department of Neurosciences and Division of Biostatistics and Bioinformatics, Department of Family and Preventive Medicine, UCSD, La Jolla, California — Temporal processing deficits resulting from sluggish magnocellular pathways in dorsal stream cortical areas have been shown to be a key factor limiting reading performance in dyslexics. To investigate the efficacy of reading interventions designed to improve temporal processing speed, we performed a randomized trial on 75 dyslexic second graders in six public elementary schools, comparing interventions targeting the temporal dynamics of either the auditory and/or visual pathways with the school's regular reading intervention (control group). Standardized tests of reading fluency, attention, and working memory were used to evaluate improvements in cognitive function using ANCOVAs. Most dyslexics in this study had abnormal visual motion processing, having elevated contrast thresholds for movement-discrimination on a stationary, textured background. Visual movement-discrimination training to remediate abnormal motion processing significantly improved reading fluency (both speed and comprehension), attention, phonological processing, and auditory working memory, whereas auditory training to improve phonological processing did not significantly improve these skills. The significant improvements in phonological processing, and both sequential and nonsequential auditory working memory demonstrate that visual movement-discrimination training improves auditory skills even though it is training visual motion discrimination, suggesting that training early in the visual dorsal stream improved higher levels of processing in the dorsal stream, where convergence of both auditory and visual inputs in the parietal cortex have been found, suggesting that improving the timing and sensitivity of movement discrimination improves endogenous attention networks. These results implicate sluggish magnocellular pathways in dyslexia, and argue against the assumption that reading deficiencies in dyslexia are only phonologically-based.

G5

AN AGE-RELATED INCREASE IN ANTERIOR NEURAL ACTIVITY IS FOUND THROUGHOUT THE INFORMATION PROCESSING STREAM Eliza Ryan[1], Brittany Alperin[1], Katherine Mott[1], Phillip Holcomb[2], Kirk Daffner[1]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — Functional imaging and ERP studies often demonstrate age-related increases in anterior neural activity to carry out task demands. It remains unclear whether this anterior shift is limited to late cognitive operations like those indexed by the P3 component, or are evident throughout the information processing stream. The temporal resolution of ERPs provided an opportunity to address this issue. Temporospatial principal component analysis (PCA) allowed for the identification of underlying components that may be obscured by overlapping ERP waveforms. ERPs were measured during a visual oddball task in 26 young and 29 old subjects who were well-matched in terms of accuracy, intelligence, and education. PCA identified an anterior positivity in response to target stimuli suggestive of a P3a component, peaking at 507 ms, which was larger for old than young subjects. PCA also differentiated three earlier positive anterior factors peaking at 155 ms, 214 ms, and 312 ms, whose amplitudes were larger in old than young subjects. In old subjects, the size of the 214 ms and 312 ms factors correlated with accuracy, such that the larger the anterior response, the higher the accuracy. In contrast, no relationship was observed between these factors and accuracy in young subjects. Our findings suggest that compared to their younger counterparts, older adults not only recruit anterior resources during late processing, but also rely more on anterior neural activity during earlier stages of information processing. Augmentation of these early anteriorly-mediated operations appears to contribute to better task performance in old adults.

G6

ENHANCED EARLY SENSORY PROCESSING IN HEALTHY AGING: EVIDENCE FOR A FRONTAL GATING DEFICIT? Cierra M. Keith[1], David A.S. Kaufman[1], William M. Perlstein[2,3]; [1]Saint Louis University, St. Louis, MO, [2]University of Florida, Gainesville, FL, [3]Malcom Randall VAMC, Gainesville, FL — Event-related potential (ERP) oddball studies examining the performance of healthy older adults have consistently found decreased amplitudes of P3 potentials to target and distractor stimuli. Scalp topographies of both P3a and P3b components show frontal shifts with age, suggesting an increased need for compensatory frontal activity to assist with age-related disruptions of inhibition and working memory. Compromised frontal lobe function has also been associated with deficits in sensory gating, which can be explored using ERPs. However, aging effects on early sensory ERP components are poorly understood. In this study, 20 young (mean: 22 years) and 10 older (mean: 71 years) adults completed a three-stimulus visual oddball task while high-density ERPs were acquired. Colorful, novel distracters were used to evoke enhanced early sensory processing. Relative to young controls, older participants exhibited elevations in occipital early posterior positivity (EPP) to the colorful distracters. These elevations in EPP were negatively correlated with the number of categories completed on the Wisconsin Card Sorting Test, indicating that elevations in EPP may be associated with age-related frontal dysfunction. In particular, enhancements in EPP may reflect deficits in sensory gating regulated by frontal lobe networks. Despite their enhanced EPP activity, older adults showed typical age-related frontal shifts and amplitude reductions in P3 potentials to targets and distracters. Taken together, these results suggest that healthy aging may be associated with weakened frontal gating of sensory processes. Deficits in sensory gating may be indicative of broader dysfunction in frontal lobe structures that regulate working memory and guide attention.

ATTENTION: Spatial

G7

DOPAMINE SYSTEM GENES ARE ASSOCIATED WITH ORIENTING BIAS AMONG HEALTHY INDIVIDUALS Polina Zozulinsky[1], Lior Greenbaum[2], Noa Eilat[1], Yair Braun[1], Idan Shalev[3], Rachel Tomer[1]; [1]University of Haifa, Haifa, Israel, [2]Chaim Sheba Medical Center, Tel Hashomer, Israel, [3]The Pennsylvania State University, United States — Healthy individuals display subtle orienting bias, manifested as a tendency to direct greater attention toward one hemispace, and evidence suggests that this bias reflects an individual trait. Orienting bias has been shown to reflect asymmetric dopamine signaling in animals and in patients with Parkinson's disease, and among healthy humans, the preferred direction of orienting attention in space has been recently shown to reflect asymmetric dopamine D2 receptor binding in striatal and frontal regions. Polymorphic genes coding for elements of DA neurotransmission partially regulate the available amount of neurotransmitter and receptor number. We therefore examined the hypothesis that polymorphisms of the dopamine D2 receptor TaqIA/ANKK1 gene contribute to individual differences in orienting bias, as measured by the greyscales paradigm, in a sample of 197 young healthy Israeli Jewish participants. As predicted, homozygous carriers of the A2 allele displayed increased leftward orienting bias compared to the carriers of the A1 allele. Additionally, and as previously reported by others, we found that bias towards leftward orienting of attention was significantly greater among carriers of the 9-repeat allele of the DAT1 3′ VNTR as compared to the individuals who were homozygous for the 10-repeat allele. These findings support the suggestion that individual differences in asymmetries in orienting bias that are associated with asymmetries within dopaminergic system, are influenced by genetic factors.

G9

THE PRECUNEUS AND NEGLECT: A TRANSCRANIAL MAGNETIC STIMULATION STUDY Indra Mahayana[1], Daisy Hung[1,2], Ovid Tzeng[1,2,3], Chi-Hung Juan[1,2], Neil Muggleton[1,2,4,5]; [1]National Central University, [2]National Yang-Ming University, [3]Academia Sinica Taiwan, [4]University College London, [5]Goldsmiths University of London — Parietal cortex lesions provide a large body of evidence for the involvement of this region in orientation and navigation in space. This has been supplemented by investigation of the contribution of a number of subregions using transcranial magnetic stimulation. However, the role of the precuneus area, located in the medial plane of posterior parietal cortex (PPC), in control of visuospatial attention is not well understood. We investigated the contribution of this area using the landmark task. Participants were asked to do forced-choice judgments of which side of prebisected lines were longer for near and far viewing distances (70 and 180 cm, respectively). Online 10 Hz, repetitive transcranial magnetic stimulation (rTMS) was delivered for 500 ms over the right precuneus, rPPC (Talairach coordinates: 15/-68/37 and 42/-58/52, respectively) and vertex (control), in separate blocks of trials. The rPPC stimulation was used as a positive control, having previously resulted in "neglect like" spatial bias effects in a number of studies. A no-TMS condition showed a leftward spatial bias (pseudoneglect) for near space judgments but not for far space which used as the baseline midpoint. Precuneus stimulation resulted in rightward spatial bias from the midpoint in near space similar to the rPPC neglect-like effect. No significant effects were seen with vertex stimulation. This study shows that precuneus, like other parietal areas, is involved in visuospatial attention control. Further work is required to clarify how the contribution of this area differs from other parietal regions.

G10

IMPROVING MULTIPLE OBJECT TRACKING PERFORMANCE BY STIMULATING THE ANTERIOR INTRAPARIETAL SULCUS Eric Blumberg[1,2], Brian Kidwell[1,2], Matthew Peterson[1,2], Raja Parasuraman[1,2]; [1]George Mason University, [2]Center of Excellence in Neuroergonomics, Technology, and Cognition (CENTEC) — The anterior intraparietal sulcus (AIPS) is known to be associated with performance of the multiple object tracking (MOT) task (Howe et al., 2009). Stimulating this brain region with transcranial Direct Current Stimulation (tDCS) provides a unique method to establish the causal role of the AIPS and of evaluating the plasticity of MOT performance. Participants in the present study were randomly assigned to one of three groups while they performed the MOT under two loads: anodal stimulation at 2mA of the right AIPS, a stimulation control condition (2 mA of left dorsolateral prefrontal cortex, DLPFC), and a sham control condition (2 mA ramp-up and immediate ramp-down of left DLPFC). Stimulation for each group lasted 30 minutes. Each participant completed 132 trials (66 trials tracking at each load of 2 and 4 moving circles) during both the pre- and post- (stimulation) time intervals. There was a significant improvement in MOT performance from pre- to post-stimulation periods for tracking four-objects with right AIPS stimulation, compared to the two DLPFC con-

ditions. No stimulation effects were found for the two-object load trials. The results are consistent with the view that the right AIPS plays a critical role in multiple object tracking.

G11

NEURAL MECHANISMS BY WHICH ATTENTION MODULATES THE COMPARISON OF REMEMBERED AND PERCEPTUAL REPRESENTATIONS

Bo-Cheng Kuo[1], Duncan Astle[2]; [1]National Taiwan University, [2]MRC Cognition and Brain Science Unit — Attention is important for effectively comparing incoming perceptual information with the contents of visual short-term memory (VSTM), such that any differences can be detected. However, how attentional mechanisms operate upon these comparison processes remains largely unknown. Here we investigate the underlying neural mechanisms by which attention modulates the comparisons between VSTM and perceptual representations using functional magnetic resonance imaging (fMRI). Participants (N = 13) performed a cued change detection task. Spatial cues were presented to orient their attention either to the location of an item in VSTM prior to its comparison (retro-cues), or simultaneously (simultaneous-cues) with the probe array. A no-cue condition was also included. When attention cannot be effectively deployed in advance (i.e. following the simultaneous-cues), we observed a distributed and extensive activation pattern in the prefrontal and parietal cortices in support of successful change detection. This was not the case when participants can deploy their attention in advance (i.e. following the retro-cues). The region-of-interest analyses confirmed that neural responses for successful change detection versus correct rejection in the visual and parietal regions were significantly different for simultaneous-cues compared to retro-cues. Importantly, we found enhanced functional connectivity between prefrontal and parietal cortices when detecting changes on the simultaneous-cue trials. Moreover, we demonstrated a close relationship between this functional connectivity and d' scores. Together, our findings elucidate the attentional and neural mechanisms by which items held in VSTM are compared with incoming perceptual information.

G12

INTERACTIONS BETWEEN EXOGENOUS AND ENDOGENOUS ATTENTION ACROSS LEVELS OF SALIENCE AND PREDICTABILITY.

Prerna Bholah[1], Jonathan Parsons[1], Joseph Hopfinger[1]; [1]University of North Carolina, Chapel Hill — Previous research has suggested that endogenous and exogenous attention have distinct yet interacting mechanisms (Berger, Henik & Rafal, 2005; Hopfinger & West, 2006). It is unknown, however, if the interactions are fixed or malleable, since previous studies have used only a single level of salience for the exogenous cue and a single level of predictability for the endogenous cue. In this study, event-related potentials were used to investigate the interactions between exogenous orienting and sustained endogenous attention when the degree of engagement is varied. Participants sustained attention to a specified visual field throughout a block, while performing a discrimination task in a within-subjects design in two conditions: (1) strong endogenous-weak exogenous condition (high target predictability and dim cue) and (2) weak endogenous-strong exogenous condition (low target predictability and bright cue). Whereas behavioral results showed interactions between endogenous and exogenous attention that did not interact with condition, the ERP results revealed that at earlier levels of processing these interactions differed across condition. Specifically, the P1 component was generally dominated by exogenous attention, and endogenous attention interacted with exogenous attention only in the "strong endogenous/weak exogenous" condition. These data provide new electrophysiological evidence that the interaction between endogenous and exogenous attention depends on the degree of engagement of each system, at least at early visual processing levels. In contrast, the later P3 component was mainly influenced by sustained endogenous attention, and the interaction between endogenous and exogenous attention at this stage of processing was not dependent on the strength of engagement.

G13

VISUAL ATTENTIONAL DEPLOYMENT IS MODULATED BY RESPONSE REQUIREMENT AND VISUAL SKILL LEARNING

Yulong Ding[1], Yuling Su[1], Yan Song[2], Zhe Qu[1]; [1]Sun Yat-Sen University, [2]Beijing Normal University — By using N2pc and Pd components as the neural markers of attentional allocation and attentional suppression respectively, this study investigated how attentional deployment is affected by response requirement and visual skill learning. To dissociate the factor of response requirement from perceptual relevancy, a homogeneous array search paradigm was designed in experiment 1 and 2, in which participants were required to explicitly respond to the homogenous arrays and not to the heterogeneous arrays containing a shape or orientation singleton. Each subject performed three training sessions over consecutive days. The task-relevant but no-response-requiring shape/orientation singleton did not elicit any visible N2pc or Pd component in the first session, but induced an apparent Pd component (220-270ms) after long-term training over several days. In experiment 3, we adopted a traditional singleton detection task in which the stimulus set was identical to that in experiment 2, but participants were required to explicitly respond only to the heterogeneous arrays containing an orientation singleton. In this control experiment, the orientation singleton elicited a typical N2pc component (220-270ms) within a single session. Taken together, our results indicate important roles of response requirement and visual skill learning in attentional deployment on singletons in visual search arrays.

G14

A COMPENSATION ROLE OF TOP-DOWN ATTENTIONAL CONTROL IN THE GENERALIZATION OF VISUAL SKILL LEARNING

Zhe Qu[1], You Wang[1], Yanfeng Zhen[1], Yan Song[2], Yulong Ding[1]; [1]Sun Yat-Sen University, [2]Beijing Normal University — Specificity and generalization of visual skill learning have been extensively studied with behavioral measurements, but the mechanisms remain unclear. The present study used high-density event-related potentials (ERPs) to investigate the brain mechanisms underlying behavioral specificity and generalization of short-term learning of texture discrimination task (TDT). Human adults were trained with TDT for a single session and their ERPs were measured on the following day. Behavioral performance showed that learning effects were specific to the trained background orientation but generalized across target locations. ERP data, however, revealed both target-location and background-orientation specific changes. While the behavioral background-orientation specificity mainly involved amplitude enhancement of early N2pc over occipital cortex, behavioral target-location generalization was associated with modulation of tempo-spatial configurations of the N2pc component (early-occipital vs. late-parietal/temporal pattern) and decrease of frontal P2 amplitudes for the trained relative to the untrained condition. The earliest visual component C1 did not show specific effects for either background orientation or target location. These results indicated different brain mechanisms underlying the behavioral specificity and generalization of TDT learning. Based on the present findings and literatures, we propose that visual skill learning may induce not only enhancement of relatively early visual selection of the trained target among distractors but also decreases of top-down attention originating from high-level brain centre. The reactivation of top-down attention control in some conditions (e.g., the untrained target-location condition) may compensate for the specific effect induced by the early visual selective attention mechanism, leading to generalization or less specificity of learning in behavioral performance.

G15

SOCIAL ATTENTION IS MODULATED BY EMOTIONS: THE INFLUENCE OF FACIAL EXPRESSION ON THE SPATIAL SPECIFICITY OF GAZE CUEING

Eva Wiese[1,2], Agnieszka Wykowska[1,3], Hermann J. Mueller[1]; [1]LMU Munich, Germany, [2]George-Mason University, USA, [3]TU Munich, Germany — When interacting with other people, information about their internal states is communicated explicitly by speech but also implicitly by social cues, such as gaze direction and facial expression. While gaze direction signals the current focus of attention, facial expression conveys information about the social significance of the attended events/objects. In two experiments, we investigated whether facial expression (neutral, happy, fearful) modulates the spatial specificity with which attention is allocated when being triggered by changes in gaze direction. Gaze cues were followed by a target stimulus which participants had to localize and/or discriminate. The allocation of attention was determined by comparing reaction times (RTs) as a function of the distance between cued position and target position. Spatially specific cueing effects were found for fearful faces, whereas neutral and happy faces induced equally strong cueing effects for all positions in the cued hemifield. However, the modulatory effect of fearful faces on

the spatial specificity of gaze cueing depended on the stimulus-onset asynchrony (SOA) between cue and target presentation: specific cueing effects for fearful faces were present only at longer SOAs indicating that the modulatory effect of facial expression on gaze cueing is not just a mere alertness effect (which would be present already at short SOAs), but rather seems to succeed the classification of emotions which takes place at later stages of information processing.

G16

RAPID EXTRACTION OF CATEGORY-SPECIFIC SHAPE STATISTICS: EVIDENCE FROM EVENT-RELATED POTENTIALS

Bria L. Long[1], Viola S. Störmer[1], George A. Alvarez[1]; [1]Harvard University — During visual search, observers analyze target-distractor similarity rapidly, allocating attention to the most informative part of the display. The difficulty of target selection is indexed by the N2pc, an early, lateralized event-related potential (ERP) component (Luck & Hillyard, 1994). Here, we examined how target selection is modulated by distractor similarity of real-world categories. Observers searched for an object that was presented either among five distractors of the same category (uniform displays) or of a different category (mixed displays). Stimuli were either animals or inanimate objects; these categories were equalized across factors already known to influence visual search for simple stimuli, including low-level properties (e.g., luminance, contrast, power at different spatial frequencies and orientations, size, etc.) in addition to familiarity and typicality. Observers' accuracy was higher on mixed vs. uniform trials, indicating a more efficient search process on mixed displays. To investigate the neural underpinnings of this performance difference, ERPs were recorded from posterior electrode sites (PO7/PO8), where an enlarged negativity contralateral to target location was found from 180 to 300ms after display onset the N2pc. The N2pc amplitude was greater for uniform vs. mixed displays ($F(1, 8) = 5.89$, $p < .05$), suggesting that more attentional resources were allocated on uniform relative to mixed trials, presumably to resolve the increased similarity between same-category targets and distractors. As we controlled stimuli for a wide range of low-level feature dimensions, these results suggest that differences in mid-level shape features between animals and inanimate objects can modulate rapid attentional allocation during search.

EMOTION & SOCIAL: Development & aging

G17

DEVELOPMENT AND NEURAL BASES OF HAPPY FACE PROCESSING IN INFANTS: A STUDY IN FNIRS AND TEMPERAMENT

Miranda Ravicz[1], Katherine Perdue[1,2], Alissa Westerlund[1], Charles A. Nelson[1,2]; [1]Labs of Cognitive Neuroscience, Division of Developmental Medicine, Boston Children's Hospital, Boston MA, [2]Harvard Medical School, Boston MA — Accurate decoding of facial expressions is critical for human communication, particularly during infancy before formal language has developed. Differentiation of brain responses to different emotional faces develops within the first months of life. However, there are broad individual differences in such responses. In the current project we seek to examine such differences by studying the relation between neural response and temperament. We do so using functional near-infrared spectroscopy (fNIRS) to measure oxyHb responses to happy face stimuli. Seven-month-old infants (n=11, study in progress) were shown images of happy faces, and neural activity was recorded using fNIRS, which measures hemoglobin concentrations in response to stimulus events. Greater oxyHb response is associated with greater local brain activation. Temperament data were collected using the Revised Infant Behavior Questionnaire (Gartstein & Rothbart, 2003), which assesses three temperament factors: Surgency/Extraversion, Negative Emotionality, and Orienting/Regulation. Across several channels over the prefrontal cortex, we found that oxyHb response was correlated with temperament. For three channels over the left prefrontal cortex, there was a positive correlation between Surgency/Extraversion and oxyHb response ($r=.739$, $p=.009$; $r=.705$, $p=.015$; $r=.736$, $p=.015$). Over the right prefrontal cortex, three channels showed negative correlations between Negative Emotionality and oxyHb activity ($r=-.741$, $p=.009$; $r=-.715$, $p=.013$; $r=-.709$, $p=.015$). This second effect was driven by negative deflections in oxyHb concentrations. These results suggest that individual temperament differences are associated with differential oxyHb responses to happy faces, putatively subserved by the orbitofrontal cortex. Infants with higher Surgency/Extraversion and lower Negative Emotionality characteristics show greater brain responses to happy faces.

G18

HOW CHILDHOOD PEER ACCEPTANCE AND REJECTION RELATE TO NEURAL RESPONSES TO SOCIAL EXCLUSION DURING ADOLESCENCE

Geert-Jan Will[1,2], Pol van Lier[3], Eveline A. Crone[1,2,4], Berna Gürolu[1,2]; [1]Leiden University, the Netherlands, [2]Leiden Institute for Brain and Cognition (LIBC), the Netherlands, [3]VU University, the Netherlands, [4]University of Amsterdam, the Netherlands — This functional Magnetic Resonance Imaging (fMRI) study investigated neural responses to social exclusion in adolescents (age 12-15) who either experienced chronic acceptance (n = 27) or rejection (n = 19) by their peers during childhood. After first being included and then excluded in a virtual ball-tossing game (Cyberball) by two unknown peers, participants reported a rise in emotional distress; independent of experienced acceptance or rejection during childhood. Neuroimaging results showed that across the sample social exclusion was associated with increased activity in brain regions associated with processing affect and emotion regulation, such as ventral anterior cingulate cortex (ACC), subgenual anterior cingulate cortex/striatum and ventrolateral prefrontal cortex (PFC). Chronically rejected adolescents showed: 1) increased activation in the pre-supplementary motor area/dorsal ACC and anterior PFC when they did not receive the ball during the inclusion game, suggesting a hypersensitivity to minimal cues of rejection; and 2) decreased activity in the anterior insula during the exclusion game, suggesting blunted emotional processing during extended periods of social exclusion. Taken together, our results show that brief episode of social exclusion is highly distressing for adolescents and that childhood peer relations are associated with differential neural processing of social exclusion in adolescence.

G19

DEVELOPMENT OF EMOTIONAL FACE PROCESSING IN INFANTS AS MEASURED WITH NEAR-INFRARED SPECTROSCOPY

Katherine Perdue[1,2], Alissa Westerlund[1], Miranda Ravicz[1], Charles A. Nelson[1,2]; [1]Boston Children's Hospital, [2]Harvard Medical School — The goal of this work is to elucidate the neural basis of the development of emotional face processing in infants over the first year of life. Prior work has shown that infants after but not before 7 months of age show enhanced attention to fearful faces as opposed to happy faces. Event-related potentials have shown an increased neural response to fearful faces also for older infants, however the poor spatial localization capability of EEG has left unanswered questions. In this study, near-infrared spectroscopy (NIRS) was used to measure infants' brain activity during the presentation of happy, angry and fearful faces. Separate groups of 5- (n = 8), 7- (n = 11), and 12- (n = 7) month-old infants were tested with a 46 channel NIRS system that recorded brain activity over the frontal, temporal, and parietal cortex. The oxyhemoglobin responses to each emotional condition were calculated. Heart rate was calculated from the NIRS signals as a measure of attention. Preliminary analysis indicates that significant differences in oxyhemoglobin responses were found in the right superior temporal cortex for 5-month-olds (Anger > Fear, $F[2, 14]=8.196$, $p < 0.01$), the left parietal cortex for 7-month-olds (Happy > Anger, $F[2, 20]=3.516$, $p < 0.05$), and in the left parietal cortex for 12-month-olds (Fear > Anger, $F[2, 12]=4.411$, $p < 0.05$). Heart rate for all ages and conditions decreased with stimulus presentation, indicating orienting to the stimuli. These findings suggest that the neural architecture of facial emotion processing is age-dependent.

G20

AN ERP STUDY OF EMOTIONAL FACE PROCESSING IN ADOLESCENTS

Danielle Mascarelli[1], Elvira Kirilko[1], Kevin Constante[1], Danielle diFilipo[1,2], Amy Medina[1,2], Jill Grose-Fifer[1,2]; [1]John Jay College of Criminal Justice, CUNY, [2]The Graduate Center, CUNY — Previous research indicates that face perception is still developing in adolescents, especially in terms of facial expression identification. In this study we examined developmental differences in the neural correlates of the face inversion effect for happy and fearful face stimuli. We hypothesized that immaturities in magnocellular visual pathways might contribute to less effective face processing in adolescents compared to adults. We recorded event-related potentials (ERPs) in

adolescents (14-17 years old) and adults (25-35 years old) while they looked at a series of gray-scale images of happy faces, fearful faces, and chairs. The images were presented either upright or inverted in order to investigate the face inversion effect on the N170 and P1 components. The images were also presented at three different filter settings: either unfiltered, or high pass or low pass filtered, in order to accentuate the relative contributions of the parvocellular and magnocellular visual pathways. High pass filtered faces did not elicit face inversion-related ERP effects. However, unfiltered and low pass filtered stimuli evoked a disproportionately larger amplitude increase in the N170 and P1 components on face inversion, for the adults compared to the adolescents. The difference in amplitude between groups was most pronounced in the low pass filtered condition. These findings suggest that immaturities in magnocellular pathways may affect configural face processing in adolescents.

G21

ALTERED AMYGDALA FUNCTIONAL CONNECTIVITY RATHER THAN STRUCTURAL DECLINE PREDICTS AGE DIFFERENCES IN SOCIOEMOTIONAL WELLBEING

David Clewett[1], Michiko Sakaki[1], Hyun Joo Yoo[1], Mara Mather[1]; [1]University of Southern California, [2]University of Reading, [3]University of Southern California, [4]University of Southern California — In spite of widespread structural decline in the brain, older adults exhibit a paradoxical increase in socioemotional wellbeing. While this phenomenon has garnered considerable interest in the aging literature, the structural and functional correlates of this change remain controversial. The "aging-brain model" posits that age-related structural decline in the amygdala leads to reduced negative affect. In contrast, the "regulatory" hypothesis posits that altered patterns of amygdala functional connectivity support older adults' continued ability to regulate their emotions. To test these competing theories, we conducted complementary amygdala structural and resting-state functional connectivity analyses across younger adults, middle-aged adults and older adults. A factor analysis was used to identify shared variance between behavioral inventories that assessed negative affect, including depression and anxiety, to produce a socioemotional wellbeing score for each participant. Whereas amygdala volume significantly declined with age, this change did not relate to socioemotional wellbeing. Instead, greater wellbeing in older adults was associated with altered functional connectivity between the amygdala and an area spanning the left middle and inferior frontal gyri. Aging was also characterized by functional decoupling between the amygdala and catecholaminergic regions, such as the locus coeruleus and basal ganglia. These findings suggest that altered amygdala functional connectivity rather than structural decline contributes to greater socioemotional wellbeing in older adults. Given evidence that dorsolateral prefrontal regions down-regulate amygdala responsivity during emotion regulation, this age-related shift may signify more efficient access to cognitive resources at rest and older adults' retained capacity to regulate their wellbeing during emotion processing tasks.

G22

INCREASED ALPHA BAND EEG ACTIVITY DUE TO INTERVENTION IN ASD

Bridget K. Dolan[1], Amy V. Van Hecke[1], Sheryl Stevens[1], Ryan J. McKindles[1]; [1]Marquette University — This study examined whether the Program for the Education and Enrichment of Relational Skills (PEERS: Laugeson et al., 2009) affected neural function via EEG in a randomized control trial of adolescents with Autism Spectrum Disorder (ASD). Delta, theta, alpha, beta, and gamma frequency bands were examined across frontal and temporoparietal regions, which are implicated in the "social brain" (Volkmar, 2011). Literature also suggests there is overgrowth and hyperactivity of local neural networks (Kana et al., 2007; Minshew & Williams, 2007). Fifty-seven adolescents (11 to 16 years-old) with ASD (28 in the experimental group and 29 in the waitlist control group) and 29 typically developing adolescents who received no treatment were studied. EEG during an eyes open, resting condition was taken at pre- and post-intervention for the groups with ASD and on one occasion for the typically developing adolescents. At pre-treatment, there was a significant group by band (alpha) interaction due to the ASD groups being identical and significantly differing from the typically developing group ($F(8, 160) = 2.28$, $p < .05$). At post-treatment, a group by band (alpha) interaction indicated that all three groups differed; however, the experimental ASD group was more similar to the typically developing group while the ASD waitlist group remained unchanged at post-treatment ($F(8, 162) = 2.76$, $p < .05$). Increased alpha band activity is associated with inhibition of unnecessary neural activity (Rippon, 2006). Taken together, these findings suggest that the PEERS program increases alpha band activity, which is conducive for inhibition of excess neural activity.

G23

ATTENTIONAL MODULATION IN RESPONSE TO EMOTIONAL STIMULI AMONG OLDER AND YOUNGER ADULTS

Maryam Ziaei[1], Nathalie Peira[2,3], Jonas Persson[3,4,5]; [1]School of Psychology, University of Queensland, Brisbane, Australia, [2]Department of Psychology, Uppsala University, Sweden, [3]Department of Psychology, Stockholm University, Sweden, [4]Aging Research Center, Karolinska institute and stockholm University, [5]Umeå Center for Functional Brain Imaging (UFBI), Sweden — Previous studies have demonstrated that older adults show a positivity effect in attention and memory, with reduced processing of negative stimuli relative to positive stimuli, compared to young adults. The brain mechanisms involved in age-related differences in attending to relevant emotional information while filtering out irrelevant emotional information are still largely unknown. The main aim of this study was to investigate age-differences in neural mechanisms of attentional modulation in response to emotionally-valenced items. Young and older adults were scanned with fMRI while performing a working memory (WM) task in which they were instructed to attend to positive or negative targets while inhibiting emotional or neutral distractors. We found an overall reduction in WM performance for older adults compared to young adults, although both age groups had enhanced WM performance during instructed attention compare to passive fixation. Moreover, we found that older adults performed better when they were instructed to attend to positive information while ignoring negative information, while younger adults showed the opposite pattern. Brain imaging results revealed increased activity in anterior cingulate and dorsolateral prefrontal cortex (dlPFC), and less activity in the insula during instructed attention conditions, for older adults compared to young adults. Increased DLPFC and anterior cingulate in older adults might reflect increased engagement of dorsal attentional network compared to young adults. These brain and behavioral results show insights into why older adults preferentially attend to positive information, and contributes to current literature on attention and emotion interaction in aging.

G24

HTR1B AND TPH2 GENE EXPRESSION PREDICTS THE CONTINUITY OF BEHAVIORAL DYSREGULATION FROM EARLY CHILDHOOD TO LATE ADOLESCENCE

Sara Levens[1], Daniel Shaw[2]; [1]University of North Carolina at Charlotte, [2]University of Pittsburgh — The ability to delay gratification in favor of long-term goals is an essential component of behavior regulation. Beginning in early childhood, behavior of children during delay of gratification (DoG) tasks appears to assess a stable individual difference in emotional and behavioral control that may be an indicator of cognitive control and (mal)adaptive behaviors in adulthood. In this study 196 males from the Pitt Mother & Child Project (PMCP; Shaw et al., 2003) were observed in a DoG task at the age of 3½ followed by repeated assessments of internalizing and externalizing behavior through age 17. Participants were genotyped for 5-HTT, HTR1A, HTR1B and TPH2 serotonin transporter polymorphisms, which have all been implicated in emotional reactivity and psychopathology. Analyses were conducted to determine whether serotonin gene expression moderated the association between early emotion dysregulation and later adolescent internalizing and externalizing problems. Results reveal that when an individual possesses the recessive CC allele pair of the HTR1B gene, behavioral dysregulation during the DoG task predicts high externalizing behavior in adolescence. Whereas when participants possess the CG allele pair of the HTR1B gene, behavioral dysregulation during the DoG task predicts low externalizing behavior in adolescence. In addition, individuals who possess the rare TT allele pair of the TPH2 gene show a significant relation between anger expression during the DoG task and externalizing and internalizing behavior in adolescence. Variants of the HTR1B and TPH2 genes therefore appear to uniquely moderate the continuity of behavioral and emotional regulation from early childhood to late adolescence.

G25

THE RELATIONSHIP BETWEEN PUBERTAL STATUS AND NEURAL ACTIVITY DURING RISKY DECISION-MAKING IN MALE ADOLESCENTS USING FMRI Anne-Lise Goddings[1], Lara Menzies[1], Iroise Dumontheil[2], Emily Garrett[1], Russell Viner[1], Sarah-Jayne Blakemore[1]; [1]University College London, London, UK, [2]Birkbeck College, University of London, London, UK — During adolescence, risk-taking emerges as an important behaviour. One prominent theory postulates that this increased risk-taking results from a dissociation in maturational timing of the limbic system and the prefrontal cortex. It is hypothesised that the limbic system matures relatively early in adolescence, in tandem with pubertal maturation, while the prefrontal cortex undergoes protracted development throughout adolescence, independent of pubertal change. This goal of this study is to explore how developmental changes in brain function when performing a risk-taking fMRI (functional Magnetic Resonance Imaging) task are related to puberty, independently of chronological age. Fifty-six male participants aged 12-14 years underwent fMRI scanning whilst performing a risk-taking task (BART task, adapted from Lejuez et al., 2002). Participants completed four six-minute runs of the task. Multiple indicators of pubertal development were collected including self-reported pubertal status using Tanner stage diagrams and the Pubertal development scale (Petersen et al., 1988), and salivary hormone levels for testosterone, oestradiol and dehydroepiandrosterone. Participants also completed validated self-report questionnaires of risk-taking, impulsivity and sensation-seeking. The analysis focused on a main effect, across the entire group, of active risky decision-making compared to the control condition in regions including the prefrontal cortex and limbic system, which are known to be involved in risky decision-making. We also investigated whether this activation was differentially related to puberty across regions, using both group-wise and regression analyses. This study adds to our understanding of models of risk-taking during adolescence.

G26

PERSONALITY IN PARKINSON'S DISEASE: RELATION OF HARM AVOIDANCE TO MOOD AND DISEASE SEVERITY Mirella Diaz-Santos[1], Gretchen Reynolds[1], Patrick McNamara[2], Sandy Neargarder[1,3], Alice Cronin-Golomb[1]; [1]Boston University, [2]VA Boston Healthcare System, [3]Bridgewater State University — Parkinson's disease (PD) has been associated with personality traits including elevated harm avoidance (HA). HA is known to co-occur with mood disorders in general, including in PD, raising the question of whether HA is actually a trait or instead a clinical manifestation of PD related to disease severity. We examined HA, mood, and disease severity in 23 non-demented PD patients (12F/11M) using, respectively, Cloninger's Temperament and Character Inventory (TCI); Beck Depression Inventory-II and Beck Anxiety Inventory; and the Unified Parkinson's Disease Rating Scale. HA is one subscale of the TCI and comprises the dimensions of fatigability/asthenia, shyness with strangers, anticipatory worry/pessimism, and fear of uncertainty. Regression analysis revealed that anxiety, depression and disease severity explained 57% of the variance in HA. Examining HA by dimensions, we found significant correlations of disease severity, anxiety and depression with fatigability and shyness with strangers but not with worry or fear of uncertainty. Together with recent research reporting that fatigue in PD is related to reduced serotonergic function in the basal ganglia and limbic structures, our results suggest that HA is not a trait but rather may change with disease progression, current mood, and interpersonal situations (e.g., tremor causing perceived social stigma). Further, fatigability and shyness with strangers are specific dimensions of HA associated with mood. These results suggest that the dimensions of harm avoidance may be uniquely related to mood symptoms at various stages of the disease, which motivates the need for research on the neurobiological mechanisms underlying mood and personality in PD.

G27

EXAMINING THE LINK BETWEEN PARENT PERCEIVED STRESS AND CHILDREN'S MENTAL HEALTH SYMPTOMS Abigail Cyr[1], Allyson Mackey[1], Patricia Saxler[2], John Gabrieli[1]; [1]McGovern Institute for Brain Research, Massachusetts Institute of Technology, [2]Harvard Graduate School of Education — Early life stress has been indicated to have a negative effect on cognitive development and mental health symptoms. Parental stress can increase the negative effect of children's stress. Here, we examined how socioeconomic status and parental perceived stress predict mental health symptoms in a diverse sample of young children. Subjects between the ages of 4 and 7 participating in a larger neuroimaging study completed measures of cognitive ability and executive function, while parents completed questionnaires about socioeconomic status (MacArthur), child mental health symptoms (Child Behavior Checklist [CBCL]), children's stressful life events (Life Events Scale for Children, modified), and parental stress (Perceived Stress Scale). Even after controlling for socioeconomic status (maternal education), parent perceived stress significantly predicted children's externalizing mental health symptoms. All mental health symptoms were on a subclinical level. This finding points to the close relationship between parental stress and mental health and the mental health of children, particularly in the early childhood, and to the important role parents play in the early years of cognitive and emotional development.

EMOTION & SOCIAL: Emotion-cognition interactions

G28

DIFFERENTIAL NEURAL ACTIVITY FOR DEMOCRATS AND REPUBLICANS WHILE VIEWING NEGATIVE CAMPAIGN ADVERTISEMENTS John L. Sullivan[1], Matthew D. Cravens[2], Philip C. Burton[1], Katie L. Galazen[1], Brenton W. McMenamin[3], Chad J. Marsolek[1]; [1]University of Minnesota, [2]Dartmouth College, [3]University of Maryland — In presidential election campaigns, televised advertisements attacking the opposing candidate are routine. Does brain activation differ between Democrat and Republican participants when they view such negative ads? We used functional magnetic resonance imaging to examine partisan Democrats' and partisan Republicans' brain responses to (a) negative ads attacking their own party's candidate and negative ads attacking the opposing party's candidate and (b) "fact-check" videos indicating whether the claims made in the negative ads can be independently corroborated as true or disproved as false. Beta weights for each condition and for contrasts between conditions were derived from a general linear model. Region of interest analyses were conducted with anatomically-defined regions of interest. Within left and right amygdalae, an interaction was observed in which Democrat participants' BOLD response to the negative ads attacking the Republican candidate was larger than their BOLD response to the negative ads attacking the Democratic candidate. The opposite pattern was observed in Republican participants, but this difference was not significant. Additionally, in voxel-level analyses, Democrat participants exhibited a greater BOLD response in right amygdala for fact check videos that corroborated claims made in the anti-Republican ads than for fact check videos that undermined claims in the anti-Republican ads. This difference was not observed in Republican participants for the analogous contrast.

G29

NEUROCOGNITIVE CORRELATES OF TRAUMA MEMORY RECALL Geraldine A. Gvozdanovic[1,2], Erich Seifritz[2], Bjoern Rasch[3]; [1]University of Zuerich, [2]Hospital of Psychiatry, University of Zuerich, [3]University of Fribourg — Posttraumatic stress disorder is an anxiety disorder characterized by intrusive events. The encoding of traumatic events involves brain structures including the amygdala, striatum, thalamus and anterior cingulate cortex. Activity in these regions was associated with later intrusiveness of memories, as revealed by functional magnetic resonance (fMRI) studies using the trauma film paradigm (analogue study for intrusion development) in healthy participants. However, the neural correlates of implicit and explicit recall of traumatic memories remain rather unclear. Therefore we investigated the neurophysiological factors of recall processes of traumatic memories in 50 healthy participants. We recorded brain activity using fMRI and simultaneously measured skin conductance response, heart rate, respiratory rate as well as salivary cortisol. Participants watched either a trauma- or a control-film. Subsequently, all participants performed a Sternberg working memory task with emotional distracters (film, scrambled, negative and neutral pictures) to investigate attention-related biases. Finally, intrusive film memories were directly recalled during a script - driven imagery task. Preliminary analyses reveal that the trauma film group displayed an attention bias with faster reaction times during the Sternberg task than

the control film group. Additionally, the same neutral film pictures that served as emotional distracters were rated significantly more negative and arousing for the trauma group compared to the control group and were associated with altered activity in emotion-related brain regions. Overall, results reveal a trauma-memory related modulation of cognitive processes underlying implicit and explicit memory recall.

G30

EFFECT OF EMOTION ON WORKING MEMORY IN PSYCHOTIC DISORDERS Amri Sabharwal[1], Akos Szekely[1], Roman Kotov[1], Aprajita Mohanty[1]; [1]Stony Brook University — Working memory (WM) dysfunction and deficits in emotional processing are prominent impairments in schizophrenia and their biological correlates have been recommended as viable candidates for biomarker development by cognitive neuroscience treatment research to improve cognition in schizophrenia (CNTRICS) initiative. However, it is unclear whether these potential biomarkers are indicative generally of psychosis, or specifically of schizophrenia, and whether these neuroscience measures can explain illness course and real-world functioning. In the present study we examined neural correlates of goal maintenance in WM in the presence of emotional distractors and its specificity to schizophrenia. Behavioral and functional magnetic resonance imaging data were recorded while patients with schizophrenia (N=19), other psychoses (N=28), and controls (N=29) performed a modified n-back WM task in which threatening and neutral distractors were presented. Preliminary results show that, compared to neutral distractors, threatening distractors decrease accuracy and increase reaction time, more so in patients than controls. There were no significant differences between the two psychoses groups in their decline in performance on threatening trials, suggesting that these deficits are not specific to schizophrenia. For threatening versus neutral distractors, we expect to find greater amygdala recruitment, poorer dorsolateral prefrontal cortex recruitment, decreased amplification of task-relevant stimulus priorities, and increased distractor processing in relevant sensory cortices, effects that will be amplified for patients versus controls, with no difference between patient groups. This research will produce markers that are broadly reflective of psychoses and shed light on specific neural abnormalities underlying some key aspects of cognitive and emotional dysfunction in psychoses.

G31

MAKING DECISIONS WHEN EMOTIONS RUN HIGH: A MODULATORY ROLE FOR TRAIT ANXIETY Caroline J. Charpentier[1], Benedetto De Martino[2], Tali Sharot[1], Jonathan P. Roiser[1]; [1]University College London, UK, [2]Royal Holloway University of London, UK — Emotional states can heavily influence how we choose, judge, or evaluate things around us. However, it is unclear how economic decisions are affected by incidental emotional context. To investigate this question, we developed a novel functional magnetic resonance imaging (fMRI) paradigm in which participants (N=28) completed a decision-making task to assess loss aversion, where each gamble was preceded by emotional (faces) or control (objects) primes. The task was embedded in a memory task to avoid participants suspecting the actual purpose of the study. We found that participants' loss aversion, i.e. their tendency to overestimate monetary losses relative to gains, was modulated by emotional context as a function of trait anxiety (negative correlation:, R=-.5, p=.007): emotional face primes, relative to objects, increased loss aversion in low anxious individuals, and tended to decrease it for high anxious participants (anxiety group * emotion interaction: F(1,26)=7.06, p=.013). This result suggests that individual differences based on trait anxiety may influence whether emotional context, by modulating the impact of potential losses, interferes with or promotes risky decision-making. Functional neuroimaging analyses revealed that trait anxiety modulates amygdala responses to emotional context, as well as emotionally-driven changes in a prefrontal "loss aversion" signal that mirrored the change in behavior. These findings shed light on a novel potential mechanism underlying the modulation of economic decision-making by emotion.

G32

VALENCE BASED HEMISPHERIC SPECIALIZATION FOR EMOTIONAL PROCESSING IN A MODIFIED STROOP TASK Denise Evert[1], Mike Coffel[1], Renee Schapiro[1]; [1]Skidmore College — The right hemisphere hypothesis posits that all emotional stimuli are processed more efficiently within the right hemisphere. The valence hypothesis suggests that each hemisphere is specialized for processing specific emotions, the left hemisphere for positive emotions and the right hemisphere for negative emotions. The present study explored the effects of lateralization for emotional processing using both experimenter- and participant-generated (self-relevant) positive, negative and neutral words in an Emotional Stroop task. In this divided visual-field task, words in red, green or blue ink were presented vertically to the left (LVF) or right visual field (RVF). According to the right hemisphere hypothesis, color identification was expected to be more efficient for stimuli presented to the LVF both for positive and negative words. According to the valence hypothesis color identification was expected to be more efficient for positive stimuli in the left hemisphere and for negative stimuli in the right hemisphere. We expected that effects for self-relevant stimuli would be larger than for experimenter stimuli. The results indicated that response times to negative stimuli presented in the LVF were significantly faster than to the RVF, implicating the right hemisphere in the processing of negative emotional information. Furthermore, significantly faster response times to positive stimuli presented in the RVF than the LVF were observed for males only, regardless of the source of the stimuli. These results support a valence-based model for emotional processing and highlight greater patterns of hemispheric lateralization in males than females.

G33

EARLY CATEGORICAL AND LATER DIMENSIONAL PERCEPTION OF FEAR Wen Li[1], Emily C Forscher[1], Yan Zheng[1]; [1]University of Wisconsin-Madison — How is a fear cue encoded and its intensity evaluated in the brain? Here, we compared visual processing of neutral faces and fearful faces that varied in 6 levels of intensity (in increments of 6% from 15% to 45% on a neutral-to-fearful morph continuum). Participants (N=45) viewed these faces and performed a fear detection task while EEG data were acquired. Fear detection hit rate showed a strong linear trend according to fear intensity, $t(33)=28.42$, $p<.001$, with means of .13, .21, .42, .62, .76, .87 from 15 to 45%. Fitting a sigmoid curve on the group average hit rate, we found 45% intensity to be suprathreshold, 21%-39% perithreshold and 15% subthreshold. The P1 component (85-116 ms) at site Oz showed a strong categorical fear perception effect: 45% fear was significantly elevated above the other fear levels or the neutral condition, $t(33)=-2.56$, $p<.05$; while those lower-intensity levels did not differ from the neutral condition or between each other, $p's>0.12$. However, the late positive potential (LPP; 400-600 ms) at Pz and Cz showed a strong linear trend, parametrically mapping the fear intensity in the faces, $t(33)'s>6.26$, $p's<.001$. Importantly, we found that the LPP amplitude closely tracked the fear hit rates across the six intensity levels, $r=0.46$, $Zr=1.77$, $p<.001$. These findings thus suggest that early visual perception of fear is highly categorical whereas late visual processing is dimensional, parametrically evaluating the intensity of fear.

G34

AFFECTIVE BONDING IN BIOLOGICAL KNOWLEDGE Fabio Gois[1], José Guilherme Brockington[1], Hamilton Haddad[1]; [1]University of São Paulo — In students, misconceptions, or spontaneous conceptions, are comprehensions of natural phenomena forged by daily experience. These non-scientific viewpoints regarding the world are both solid and resistant to change. Some researchers have proposed that conceptual change is not dependent on purely rational processes. Evidence has shown that cognitive processes, such as perception, attention, learning, memory, decision-making, and problem resolution, are all strongly influenced by both rational aspects and emotional factors. Furthermore, the latter are accompanied by somatic markers, namely, corporal (physiological) reactions that act in the construction of emotional perceptive experiences. These markers are extremely important in the decision-making process, and it is hypothesized that before rationalizing a decision in terms of value analysis, they are instrumental in the unconscious reduction in the number of options that occurs. In this study, we recorded the skin conductance responses (SCR) from biologists while responding to a questionnaire with 20 questions about Biology, each one containing one scientifically correct alternative answer and three popular misconceptions. Our results showed that in 12 of these questions, biologists presented a higher SCR when confronted with misconceptions compared to the SCR when confronted with scientific alternatives, even choosing the scientifically correct answer in most of time. These results

suggest that the difficulties in promoting a real and long-lasting conceptual change might be related with the affective bonding of students with their spontaneous interpretations of the world.

G35

MORAL DOMAINS FROM THE BOTTOM UP: CONVERGENT EVIDENCE FROM BRAIN AND BEHAVIOR

Alek Chakroff[1], Michael Gravina[1], Theresa Tharakan[1], Joshua Greene[1]; [1]Harvard University — Are there different "kinds" of morality? Attempts to carve the space of morality have settled on conceptual clusters, such as harm, fairness (Haidt, 2007). However, these distinctions were crafted a priori and supported by confirmatory analysis, but do not naturally emerge in a data-driven analyses of moral judgments (Graham et al., 2011). The present research uses data-driven analyses of neural and behavioral data to discover structure in morality. 150 participants provided moral permissibility judgments for 90 unique moral violations. A principal components analysis on judgments returned a two factor solution. The first factor was associated with universally agreed upon violations, such as murder and theft; the second factor was associated with "conservative" violations, such as homosexuality and obscenity. In a separate fMRI experiment, 18 participants were scanned while viewing the same 90 violations. Item beta images were submitted to a voxel clustering algorithm (Lashkari et al., 2010) to discover brain regions with similar activation profiles across items. We requested two clusters, and found correspondence between these two clusters and the two behavioral factors. Regions associated with the first factor (e.g., murder) included the medial prefrontal cortex, precuneus, and superior temporal gyrus, regions associated with social cognition. In contrast, regions associated with the second factor (e.g., homosexuality) included the supplemental motor area and left inferior parietal lobe, regions implicated in action understanding. In sum, behavioral and brain-based methods suggest that there are two kinds of morality, each supported by distinct sets of brain regions.

G36

AN IMPLICIT MEASURE OF PRO-SOCIAL ATTITUDES: CAN A LIBERAL FEEL EQUANIMITY TOWARD A CONSERVATIVE?

Jessica D. Creery[1], Susan M. Florczak[1], Afsara B. Zaheed[1], James W. Antony[1], Ken A. Paller[1]; [1]Northwestern University — The attitudes people hold toward others are not immutable. Through training, people can learn to increase pro-social attitudes. Progress in such training might be apparent in direct measures of pro-social behavior, in implicit attitudes, and/or in measures of neural function. These three types of measures might provide complementary evidence about different aspects of learning. We developed measures of implicit attitudes for use in assessing benefits of compassion training. We capitalized on the fact that people tend to negatively judge those with opposing political views. A person with strong liberal political ideals, for example, might have difficulty treating two people equally if one holds the same liberal views and the other holds opposing conservative views. To assess degree of implicit equanimity, we administered a novel variant of the implicit attitude test with concurrent recordings of brain potentials. Participants (N=32) viewed positive and negative personal qualities (e.g., intelligent, rude), responding to each word according to valence (positive/negative mapped to left/right hands, counterbalanced). Multiple views of two individuals were intermixed, and participants responded left for one and right for the other. In Match-Blocks, the same response was required for positive words and same-view individuals; in Mismatch-Blocks opposite responses were required. Prior to the test, participants selected two strongly held political issues (e.g., gay rights, healthcare). For each issue, the same and the opposing view were ascribed to otherwise similar faces. Predicted reaction-time differences were found as a function of Match/Mismatch, and these differences declined after a session of compassion training.

G37

INFORMATION PROCESSING STYLES CONTRIBUTE TO RELIGIOUS BELIEFS AND SPECIAL INTERESTS FOR BOTH NEUROTYPICAL AND AUTISM SPECTRUM CONTINUUM INDIVIDUALS

Chloe Jordan[1], Catherine Caldwell-Harris[1]; [1]Boston University — Possession of systemizing traits (tendency to analyze systems) is negatively correlated with strength of belief in God, while mentalizing traits are positively correlated with belief. These correlations explain reduced belief among autism spectrum individuals. We extended these findings via an online survey of neurotypical (N=118) and autism spectrum (N=70) individuals' religious beliefs and interests. Our goal was to investigate whether cognitive processing styles can explain diverse behaviors such as belief in God and special interests (measured using the Cambridge University Obsessions Questionnaire), and whether these associations are similar for neurotypical and autistic spectrum individuals. Scores on Reading the Mind in the Eyes task (measuring mentalizing) correlated positively with active practice of religious beliefs and intensity of belief in a personal God, higher power and moral pattern to the universe. Autism Quotient scores correlated negatively with these belief items. Systemizing Quotient scores were unrelated to beliefs. Large granularity social interests such as food and drink correlated positively with belief in a higher power and moral pattern to the universe. Interests in sports and games, people, and nature (interests which allow systemizing but can also facilitate socializing) correlated positively with spiritual identity. Small granularity special interests (numerical systems, sensory fixations) correlated positively with inner contemplation and private beliefs. Interest in numbers correlated positively with belief in a higher power, moral pattern to the universe, life after death, and literal translation of religious texts. These findings indicate complex relations between information processing styles, special interests and religious beliefs, across the neurotypical/autism spectrum continuum.

G38

HUMOR RATINGS AND SKIN CONDUCTANCE RESPONSES TO NATIVE AND FOREIGN LANGUAGE JOKES

Catherine Caldwell-Harris[1], Ayse Aycicegi-Dinn[2]; [1]Boston University, [2]Istanbul University — Humor ratings for bilinguals reading native language vs. foreign language jokes were compared to test the inverted-U theory of humor appreciation. This theory proposes that jokes are funniest when processing difficulty is at an intermediate level where the ambiguity is resolvable but not too obvious. Jokes using universal humor were selected from Turkish and English websites and translated; none of the jokes were difficult for native speakers to understand. Turks studying to be English teachers or translators in Istanbul rated jokes for funniness while skin conductance was recorded. Processing difficulty was measured using jokes' reading times using different readers. We expected skin conductance amplitudes to be reduced in a foreign language, because joke processing may be more intellectual and less visceral. When jokes were ranked by processing difficulty, the most difficult of the native language jokes were rated as the funniest, presumably because their complexity placed them in the sweet spot of manageable processing difficulty. Conversely, in a foreign language, those jokes with the highest procession difficulty were rated as the least humorous, and the easiest jokes were rated as funniest. Together the results support inverted-U theory, since humor rating depended on manageable difficulty within a language. Skin conductance tracked humor ratings more tightly for native than for foreign language jokes. The implication is that humor in a native language taps bodily response, but in a foreign language, humor ratings are filtered through appraisal mechanisms, including an after-the-fact feeling of achievement at 'getting' a foreign language joke.

G39

THE INFLUENCE OF INTRANASAL OXYTOCIN IN THE PERCEPTION AND MEMORY OF PAIN IN HUMANS

Ivana Brito[1], Jéssica U Silva[1], Gizela AM Zonta[1], Ricardo Galhardoni[1], Daniel C Andrade[1]; [1]University of São Paulo — Several studies have demonstrated the role of oxytocin in promoting social interaction in maternal, sexual, and social behavior, as well as in the processes of memory and learning. Recent papers have also discussed the influence of oxytocin in the modulation of pain perception. The purpose of the present study was to investigate the effect of inhaled oxytocin on the perception and memory of pain in humans. Placebo and experimental groups were subjected to the Quantitative Sensory Testing-QST before and after oxytocin or placebo administration. These two groups received intranasal oxytocin (24 IU) or saline 50 min before the second QST application. They received graduated thermal painful stimuli in order to identify the cold and heat detection thresholds and the pain detection threshold. Although no significant difference was observed for cold and heat detection threshold, both groups showed an increase in heat pain detection threshold in the second QST. This effect was only borderline ($p = 0.5$) for the placebo group but strongly significant for the experimental group ($p < 0.01$). The memory of perceived pain was accessed by using a visual analogical scale.

The results showed that the placebo group overestimated their memory of heat painful stimuli ($p < 0.01$), while the oxytocin group showed no statistical difference. No significant difference between oxytocin and placebo groups was obtained for the memory of cold painful stimuli. These findings suggest that central oxytocin selectively influences the perception and memory of pain in humans.

G40

AUTISM SPECTRUM MEASURES PREDICT RESPONSE TO AFFECTIVE LANGUAGE IN HEALTHY YOUNG ADULTS Lesley Sand[1], Elizabeth Redcay[1], Donald J. Bolger[1]; [1]University of Maryland — Processing others' emotional states is a fundamental component of successful social relationships, and language is a primary means by which emotions are conveyed in daily interactions. The current study examined the relationship between brain regions associated with inferring emotional content from language and individuals' social aptitude measured by scales used to characterize social traits: the Autism Quotient (AQ) and the Social Responsiveness Questionnaire (SRS). Functional MRI data was collected from 22 young adults on an Emotional Inference Task (EIT). Emotionally valent (positive or negative) and neutral (physical state) scenarios (~1100msec) were presented verbally in an event-related fMRI study, and subjects were made a congruency (T/F) judgment. Brain responses were measured to the story context from which the emotional inference was drawn separately from the congruity judgment. Imaging results revealed that when hearing affective scenarios, more "social" individuals (as revealed by AQ and SRS scores) employ brain areas of the "saliency" or "emotion" network, specifically putamen, cingulate and supramarginal gyrus. In contrast, lower social aptitude ratings predicted activations in the superior temporal gyrus in emotional conditions. Further, the relationship is different for the AQ and the SRS with emotional vs. neutral scenarios. These findings may have important implications for autism, a neurobiological condition marked by social deficits (Klin et al., 2002), emotional impairments (Begeer et al., 2008) and pragmatic language weaknesses (Groen et al., 2008). Disentangling the neural mechanisms underlying affective language processing in individuals with autism may be a useful step in understanding the nature of the hallmark social disability.

EMOTION & SOCIAL: Emotional responding

G41

THE NEURAL CORRELATES OF SOCIAL LEARNING FROM FLEETING PAIN: A DYNAMIC CAUSAL MODELING ANALYSIS Yang-Teng Fan[1], Chenyi Chen[2], Yawei Cheng[2,3]; [1]School of Occupational Therapy, College of Medicine, National Taiwan University, Taipei, Taiwan, [2]Institute of Neuroscience and Brain Research Center, National Yang-Ming University, Taipei, Taiwan, [3]Department of Research and Education, National Yang-Ming University Hospital, I-Han, Taiwan — Social learning is a primary way for organisms to adapt and cope with their rapidly changing surroundings. Although the amygdala is central to classic fear conditioning, the neural mechanism of social learning from fleeting experiences remains unclear. This study scanned fMRI before and after first-hand experience (FH) as well as indirect experience through social-observational (SO) and verbal-informed (VI) learning of fleeting pain. Results showed that these three learning groups share common activations in the brain regions implicated in emotional awareness, memory, mentalizing/perspective taking, and emotional regulation. These included the anterior insula cortex (AIC), anterior cingulate cortex, hippocampus, temporparietal junction (TPJ), and superior frontal gyrus (SFG). Importantly, the AIC was recruited across these different ways of learning procedures. Nevertheless, the amygdala activation was only observed within the FH learning. Dynamic causal model (DCM) indicated that SO and VI learning exhibited weaker connectivity strength from the AIC to SFG than FH. These findings might benefit future studies exploring the pathological mechanisms associated with socio-emotional disturbances and help to improve knowledge in the area of socially transmission of emotional learning.

G42

MISMATCHES BETWEEN SOCIAL OUTCOMES AND GOALS ACTIVATE THE DORSAL ANTERIOR CINGULATE CORTEX Lane Beckes[1], Brenton W. McMenamin[2], Chad J. Marsolek[3], Angus W. MacDonald III[3]; [1]Bradley University, [2]University of Maryland, [3]University of Minnesota — When people experience the social pain of social rejection, the dorsal anterior cingulate cortex (dACC) typically is activated. This activation may be specific to social rejection or it more generally may reflect mismatches between the social outcomes of acceptance or rejection and the social goals of desiring to be included or excluded. Here we tested these alternatives using functional magnetic resonance imaging in a dating context. Participants imagined being in a date seeking situation, and they viewed photos of the faces of potential dates. Half of the faces were high in physical attractiveness and half were low in physical attractiveness, enabling a manipulation of the social goal of desiring or not desiring social interaction. Participants also were informed about whether the individual in each photo had accepted or rejected the participant for a date. Results indicated that dACC activity was elicited by rejection from people who are high in attractiveness, confirming previous social rejection results. However, dACC activity also was elicited by acceptance from people who are low in attractiveness, supporting the hypothesis that dACC activity reflects mismatches between social outcomes and goals. This activation in the dACC affected subsequent behavior; it predicted higher attractiveness ratings of the faces in a subsequent task, particularly in the outcome/goal mismatch conditions.

G43

ELECTROENCEPHALOGRAPHY STUDY OF EMPATHY FOR PAIN OF HUMAN AND ROBOT Yutaka Suzuki[1], Lisa Galli[2], Ayaka Ikeda[3], Shoji Itakura[3], Michiteru Kitazaki[1]; [1]Toyohashi University of Technology, [2]Freie Universitaet Berlin, [3]Kyoto University — Early emotional-sharing and late cognitive-evaluation neural mechanisms involved in empathy for pain of human others are revealed by an event-related brain potential study (Fan & Han, Neuropsychologia 2008). We aimed to investigate neural responses to human other's and robot's pain. We measured EEG (10-20 system, right and left earlobe averaged reference, 1kHz sampling, 0.5-30Hz band-pass) of fifteen healthy adults observing either human- or robot-hand pictures in either non-painful or painful situations such as a finger cut by a knife (1s). Luminance of painful and non-painful pictures were controlled to be identical. Participants were asked to judge whether the picture was painful or not though all trials, but their response (mouse-click) was asked only for random 15.2% trials. The responded trials were excluded from the analysis. We found that a late positive potentials (LPP, 500-550ms) was significantly larger in the painful situations than the non-painful situations both for human and robot hands ($F(1,14)=14.335$, $p=0.002$) at Fz, Cz, and Pz. Human painful pictures elicited larger LPP than robot painful pictures at Fz ($F(1,112)=5.515$, $p=0.021$). P300 (300-350ms) was larger in the painful robot pictures than the painful human pictures ($F(1,28)=7.601$, $p=0.010$) at Fz, Cz, Pz and Oz. Amplitude difference (painful - non-painful) of P1 (140-190ms) at Fz positively correlated with participants' empathy scores (EQ-SQ score) only for human hands ($r=0.599$, $p=0.018$). These results suggest that human observers elicit empathic neural responses for robot others as well as human others, and that particularly the late cognitive-evaluation neural mechanisms works differently for human and robots.

G44

CHARACTERIZING VALENCE CODING IN THE AMYGDALA Jingwen Jin[1], Aprajita Mohanty[1], Christina Zelano[2], Jay Gottfried[2]; [1]Stony Brook University, [2]Northwestern University — Although the amygdala is a major locus for hedonic processing, it remains unclear whether it is selectively involved in encoding positive valence, negative valence, or overall saliency. These mixed research findings may be attributed to the use of conventional (univariate) functional magnetic resonance imaging (fMRI) techniques, which may not be sensitive enough to delineate finer-scale differences between pleasant and unpleasant stimuli. Given the hedonic potency of olfactory stimuli and the amygdala's anatomical proximity, the present study combines high-resolution olfactory fMRI with pattern-based (multivariate) techniques to examine whether amygdala encodes an odor's overall saliency (valence-independent) or encodes specific information about an odor's hedonic tone (valence-dependent). Ten subjects smelled 9 odorants

that systematically varied in perceived valence (including 3 pleasant, 3 neutral, and 3 unpleasant odorants) while fMRI data were recorded. Representational similarity analyses (Kriegeskorte et al., 2008) showed a strong correspondence between behavioral valence ratings (pair-wise Euclidian distances across the 9 odors) and the fMRI pattern similarity in the amygdala (pair-wise linear correlations across the 9 odors) ($r = 0.39$, $p < 0.05$). Complementary pattern analyses revealed that the categorical representation of positive valence emerged significantly earlier in amygdala than the categorical representation of negative valence ($p < 0.05$). The present findings underscore the idea that both spatial (pattern) and temporal features uniquely encode pleasant and unpleasant odor valence in the amygdala, and help clarify perceptual mechanisms of affective processing in this brain region.

G45

INTRINSIC CONNECTIVITY IN THE ORBITAL FRONTAL CORTEX PREDICTS IMPROVED CONTROL OF ANXIETY AFTER NEUROFEEDBACK. Dustin Scheinost[1], Teodora Stoica[1], John John[1], Xenophon Papademetris[1], R. Todd Constable[1], Christopher Pittenger[1], Michelle Hampson[1]; [1]Yale University — Anxiety, a basic human emotion, can become pathologically dysregulated. Poorly controlled anxiety reduces the quality of life of many healthy individuals and is a core component of neuropsychiatric conditions. Treatment of anxiety includes both pharmacological and behavioral interventions. However, how best to match an individual to an intervention remains an open question. We used a novel measure of resting-state functional magnetic resonance imaging (rs-fMRI), labeled the intrinsic connectivity distribution (ICD), as a marker to predict improved control over non-clinical anxiety from real-time fMRI neurofeedback. Rs-fMRI data was collected from ten subjects before receiving multiple sessions of neurofeedback from the orbital frontal cortex (OFC) and from ten subjects receiving matched sham feedback. For all subjects, a measure of change in control of anxiety was collected after the neurofeedback. Voxel-wise connectivity was estimated using a threshold free approach (ICD) that models the distribution of a voxel' connectivity to the whole brain. To identify which brain regions predict control over anxiety, correlation between ICD connectivity and change in control of anxiety was calculated for each group. Neurofeeback subjects showed a significant increase in control of anxiety. Connectivity in the target OFC region was significantly correlated with these improvements such that subjects with the highest connectivity in the OFC gained the most control. Sham subjects showed neither an improvement in anxiety nor a correlation between connectivity and improvement. These results suggest that rs-fMRI connectivity could be used to aid in the matching of individuals to intervention and maximize individual treatment.

G46

EVOLUTIONARY MECHANISMS OF SENSATION SEEKING Amanda Renfro[1], Adam Lawson[1]; [1]Eastern Kentucky University — Sensation seeking is considered a biological based personality trait, in part because our curiosity and need to seek new environments has been pivotal in the evolution of our species (Zuckerman, 1994). The current study examined the impact of sensation seeking (N=40) on the initial preference and subsequent memory to positive valenced images. For pleasantness ratings, high sensation seekers rated high arousal images as more pleasant than low sensation seekers ($p < .05$). For skin conductance responses (SCR) during the familiarity task, high sensation seekers consistently had higher SCR activation than low sensation seekers ($p < .05$). We also found interactions between SS and low arousal unfamiliar images and high arousal familiar images ($p < .05$). For both image types, high sensation seekers had higher SCR reactivity than low sensation seekers. Both image types are considered moderately unique since they stand out in either arousal (i.e., having high arousal) or in familiarity (being new), but not both. These results are in agreement with prior research showing that high sensation seekers like moderately stimulating items in their environment. Our research furthers this knowledge by showing moderate intensity stimulation is more advantageous than low or high intensity at differentiating low and high sensation seekers. These results may reflect a useful adaptation in human evolution, in which certain individuals (high sensation seekers) are drawn toward moderately stimulating, beneficial resources. Individuals exhibiting such preferences would have been instrumental in searching for and securing important resources for survival, while avoiding highly dangerous situations.

EMOTION & SOCIAL: Other

G47

FACIAL EMOTION RECOGNITION IN PARKINSON DISEASE AND MULTIPLE SCLEROSIS Marilena Aiello[1], Cinzia Cecchetto[1], Roberto Eleopra[2], Daniela Cargnelutti[2], Raffaella Ida Rumiati[1]; [1]SISSA, [2]AOU "Santa Maria della Misericordia" — The grounded theory of emotion assumes that the mechanism by which emotions of others are recognized critically depends on the one individuals rely on when they experience and express their own emotions. It follows that the inability to express or experience emotions and to be aware of them, could determine a failure in recognizing emotions experienced by others. This prediction was tested in two neuropsychological studies. In the first study, twelve patients with Parkinson disease (PD), a neurodegenerative disorder that causes major motor impairments and a reduction of facial expressivity (amimia), performed a facial emotional recognition and discrimination task before and after deep brain stimulation of the subthalamic nucleus (DBS-STN), a surgery which improve significantly PD motor symptoms. In the second study, the same tasks were administered to thirty patients with multiple sclerosis (MS), a neurological disorder frequently associated to high levels of alexithymia, an inability to describe and identify one owns feelings, and to distinguish feelings from bodily sensations. In the first study, PD patients were found to be impaired both at discriminate and recognize facial emotional expressions, in particular disgust. However, such deficit was not associated to the ability to imitate facial expressions or to amimia. Moreover after surgery PD patients showed a reduction of motor symptoms, but did not show an improvement of emotion recognition. In the second study, we observed that alexithymia did not explain emotion recognition deficit observed in MS patients. In conclusion, our results cannot be easily explained within the grounded theory of emotion.

G48

EFFECT OF TARGETED COGNITIVE TRAINING ON FACIAL EMOTION PROCESSING IN INDIVIDUALS AT HIGH RISK FOR PSYCHOSIS Hong Yin[1], Emily Carol[1], David Dodell-Feder[1], Sarah Hope Lincoln[1], Laura Tully[1], Matcheri Keshavan[2], Larry Seidman[2], Christine Hooker[1]; [1]Harvard University, [2]Beth Israel Deaconess Medical Center/Harvard Medical School — It has been reported that individuals at clinical high risk (CHR) for psychosis display impaired functioning in emotion processing. Such impairment may affect social interaction and contribute to functional disability associated with schizophrenia-spectrum illness. Currently there is no effective intervention that prevents functional deterioration or reverses the deficit in CHR individuals. In this study, we investigated the effects of a targeted cognitive training (TCT) intervention that targeted both cognition and social cognition on facial emotion processing in CHR group. Fourteen CHR participants went through cognitive and behavioral evaluations and functional MRI (fMRI) imaging before and after completing 40 hours of computer aided TCT in 8 weeks. The TCT program was designed to target specific neural functions, including face identification and emotion recognition, with gradual increase in difficulty that optimizes brain plasticity. Effects of TCT were assessed for neural activity, cognitive performance and global functioning. Compared to healthy controls (n=14, demographically matched), CHR participants before TCT showed task related neural deficits in face processing regions. After training, CHR group demonstrated improved cognition and altered neural activity in fusiform, supramarginal and precentral gyri. The observed changes also correlated with improvements in cognition and global functioning in CHR group. Psychophysiological interaction (PPI) analysis indicated that TCT increased neural connectivity between face processing network and executive control regions among CHR participants. Overall, our study confirmed the feasibility of computer aided TCT and the initial evidence that it improved emotion processing related neural activity, cognition and functional outcome in CHR individuals.

G49

EFFECTS OF MAO-A POLYMORPHISM ON BRAIN STRUCTURE: A VOXEL-BASED MORPHOMETRY ANALYSIS IN HEALTHY SUBJECTS Imis Dogan[1,2,3], Bianca Voß[4], Martin Klasen[4], Jessica Freiherr[5], Klaus Mathiak[2,4], Ingo Vernaleken[3,4], Florian Zepf[2,3,6], Ute Habel[3,4], Kathrin Reetz[1,2,3];

[1]Department of Neurology, RWTH Aachen University, Aachen, Germany, [2]Institute of Neuroscience and Medicine, Research Center Jülich, Jülich, Germany, [3]JARA - Translational Brain Medicine, Germany, [4]Department of Psychiatry, Psychotherapy and Psychosomatic, RWTH Aachen University, Aachen, Germany, [5]Diagnostic and Interventional Neuroradiology, RWTH Aachen University, Aachen, Germany, [6]Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, RWTH Aachen University, Aachen, Germany — Introduction: The neurobiological correlates of aggressive behavior and impulsivity are not entirely understood. In addition to complex environmental and social circumstances, genetic risk factors have also been linked to the emergence of impulsive aggression. In particular, the low expression variant of the X-linked monoamine-oxidase-A (MAO-A) coding gene was shown to be associated with an increased risk for violent behavior. In the current analysis, we aimed to investigate the impact of functional polymorphism in the MAO-A gene on brain structure in healthy subjects. Methods: Anatomical 3 Tesla MRI scans were acquired in 141 healthy volunteers (84 male; 19-62 years). Based on the allelic variants of the MAO-A polymorphism subjects were genotyped as hemizygous/homozygous carriers of high enzyme-expression activity (MAOA-H: males=52; females=27), low activity (MAOA-L: males=32; females=10) or as heterozygous females with high/low activity (MAOA-L/H: 20). Voxel-based morphometry was used to assess the effect of MAO-A genotype on regional gray matter volumes. Results: In MAOA-L males compared to MAOA-H males, we found volume reductions in the middle temporal gyrus, putamen and posterior cerebellum. In heterozygous females, gray matter volumes in the orbitofrontal, medial prefrontal and inferior parietal cortex were increased. Post-hoc correlations with aggression questionnaires showed negative associations with orbitofrontal volumes in MAOA-L individuals, whereas we found positive associations in heterozygous females. Conclusion: Increased orbitofrontal volumes in heterozygous MAOA-L/H females indicate a regulatory role of the orbitofrontal cortex in emotional control and social adaptation particularly in heterozygous women, for which an intermediate neurobehavioral response pattern between MAO-A homozygotes has been suggested.

G50

MATERNAL TRAUMATIC STRESS AND INFANT FACIAL EMOTION PROCESSING: AN ERP STUDY

Michelle Bosquet Enlow[1,2], Alissa Westerlund[1], Charles A. Nelson[1,2], Rosalind J. Wright[3]; [1]Boston Children's Hospital, [2]Harvard Medical School, [3]Icahn School of Medicine at Mount Sinai — Maternal traumatic stress may impact early child development, although underlying mechanisms are poorly understood. The influences of maternal traumatic stress on child brain development may contribute, albeit research is sparse. The purpose of the current study was to examine associations of maternal trauma exposure and symptoms of posttraumatic stress disorder (PTSD) and depression with the neural correlates of facial emotion processing in infants. Participants included 20 sociodemographically diverse mother-infant dyads participating in a longitudinal examination of maternal stress and infant development. At age 13 months, infants viewed alternating pictures of neutral, fearful, and happy faces while event-related potentials (ERPs) were recorded using 62 scalp electrodes. Mean amplitude of the P1 (low level differences in stimuli), N290 (face processing, encoding), P250 (orienting), P400 (face processing), and NC (attention) components were examined in relation to maternal lifetime exposures to traumatic events and symptoms of PTSD and depression when the infants were 6 months of age. Results indicated that greater maternal trauma exposure was associated with larger N290 amplitudes to all emotions and larger P250 amplitudes to neutral and fearful faces. Greater maternal PTSD and depression symptoms were associated with larger P400 amplitudes to neutral and happy faces. Greater maternal PTSD symptoms were also associated with larger NC amplitudes to happy faces. There were no consistent effects for the P1 component. These findings suggest that maternal lifetime trauma exposures and related psychiatric symptoms are associated with infant ERP components related to early face processing and may represent one pathway for intergenerational stress effects.

G51

CHARACTERIZATION OF HUMAN DEFENSIVE BEHAVIORS FROM THREAT DESCRIPTIONS

Curie Ahn[1], Laura Harrison[1], Ralph Adolphs[1]; [1]California Institute of Technology — Human defensive reactions to physically threatening scenarios strongly parallel evolved rodent defensive behavior (Blanchard, 2001). These defensive behaviors depend upon situational factors: for example, in highly dangerous scenarios, given the presence of an escape route, rodents will choose flight over other defensive behaviors. The aims of this present study were twofold. First, we sought to determine whether human defensive behavior is predicted by situational factors in situations of social threat, e.g., blackmail. We also sought to test prior findings in cases of animal and natural threats in which one cannot communicate with the source of threat. Second, we aimed to construct a decision tree characterizing how situational factors determine defensive behaviors. In an online survey, 110 male and female subjects selected and ranked up to three defensive behaviors to 29 threatening scenarios. Scenarios differed with respect to: dangerousness, escapability, ambiguity, distance, and immediacy of threat; the presence of a hiding place; the ability to communicate with, mitigate, or harm the source of the threat; and the ability of others to help. Pearson product-moment correlations between external ratings and defensive behaviors confirmed that situational factors predict defensive behavior; these predictive patterns mostly generalize between social and physical threat. A data-driven decision tree successfully organized these patterns to predict the most common choice for each scenario. Serving as a general model for the decision processes involved in human defensive behavior, these results may also serve as a tool for assessing individuals impaired in detecting threat.

G52

REDUCED MEDIAL PREFRONTAL CORTICAL VOLUMES ASSOCIATED WITH DEPRESSIVE TRAITS IN HEALTHY INDIVIDUALS

Emily DePetro[1], Joshua Maxwell[1], Joshua M. Carlson[1]; [1]Northern Michigan University — Research has shown that patients diagnosed with Major Depressive Disorder have reduced gray matter volume in a variety of brain regions including the hippocampus, basal ganglia, and medial prefrontal cortex. In particular, a number of recent meta-analyses have consistently observed reduced medial prefrontal cortical volumes in major depression, which has been hypothesized to be linked to stress-initiated hypercortisolemic glucocorticoid-mediated cell death. In healthy individuals, stress is associated with lower levels of gray matter volume in the medial prefrontal cortex. However, it remains unclear as to whether variability in normative levels of non-clinical depression is related to variability in medial prefrontal cortex gray matter volume. Therefore, the aim of this study was to examine whether non-clinical levels of depression were related to medial prefrontal cortical volumes. In a sample of 42 normative individuals, we used T1-weighted magnetic resonance imaging to measure brain volume and assessed participants' level of depression via a self-report questionnaire. Voxel-based morphometry was used to identify voxels which correlated with depressive symptoms. We found a cluster within the medial prefrontal cortex where greater levels of depression were associated with lower gray matter volumes. This relationship with the medial prefrontal cortex was not observed for measures of anxiety and stress - suggesting a unique association between medial prefrontal gray matter volume and depression. The results of this experiment support the hypothesis, that even within a non-clinical sample, individuals who have higher levels of depressive traits tend to have lower levels of gray matter volume in the medial prefrontal cortex.

G53

WHEN WHITE BEARS AND MONEY INFLUENCE SELF-CONTROL: NEURAL CORRELATES OF EGO-DEPLETION AND MOTIVATIONAL COUNTERACTION

Matthias Luethi[1], Julia Binder[1], Malte Friese[2], Peter Boesiger[3], Roger Luechinger[3], Bjoern Rasch[1,4]; [1]University of Zurich, Switzerland, [2]Saarlandes University, Germany, [3]Swiss Federal Institue of Technology, Switzerland, [4]University of Fribourg, Switzerland — The strength model of self-control postulates that the ability to control oneself depends on a limited resource. Repeated acts of self-control can lead to impairments in performance and associated reductions in prefrontal brain activity. Motivational incentives counteract the ego-depletion effect, while the neural correlates of this counteraction are still unknown. Here, we used functional magnetic resonance imaging to identify the neural correlates of motivation-induced benefits on self-control depletion effects. To manipulate self-control resources, half of the participants initially suppressed thoughts of white bears (depletion group), whereas the other half did a similar task without thought suppression (control group). In a subsequent Stroop task,

participants either received a monetary reward for good performance (high-motivation group) or did not (low-motivation group). In accordance with the strength model of self-control, participants in the low-motivation group performed worse in the Stroop task after prior self-control depletion as compared to non-depleted controls. In contrast, in the high-motivation group, the depletion effect was abolished, i.e., highly motivated and depleted participants performed as well as non-depleted participants. On the neural level, self-control depletion reduced activity in the dorsolateral prefrontal cortex independent of motivation, whereas boosting motivation after depletion resulted in activity increases in additional brain areas (secondary visual areas, anterior prefrontal cortex). Our data suggest that motivation-induced benefits after ego-depletion might be due to the recruitment of additional brain areas for task processing, with depletion-induced decreases in prefrontal brain activity still being present, thereby providing a first hint that depletion and motivation might be two distinct processes.

EXECUTIVE PROCESSES: Development & aging

G54

THE DEPLETION OF SEX STEROID HORMONES DURING THE MENOPAUSAL TRANSITION IS RELATED TO ALTERED PREFRONTAL CORTEX SIGNALING DURING WORKING MEMORY

Emily Jacobs[1,2], Sue Whitfield-Gabrieli[3,4], Blair Weiss[1], Anne Klibanski[4], Jill Goldstein[1,2,4]; [1]Brigham & Women's Hospital, [2]Harvard Medical School, [3]Massachusetts Institute of Technology, [4]Massachusetts General Hospital — Historically, basic neuroscience research on sex steroids focused on their role in reproduction, but a rapidly growing body of work from nonhuman primates has established estradiol's influence on synaptic organization within the dorsolateral prefrontal cortex (DLPFC). Consistent with these findings, recent work from our group demonstrated significant estradiol-dependent effects on DLPFC fMRI BOLD and working memory performance in young women. Given estradiol's regulation of memory circuitry, the loss of ovarian estrogens during menopause likely plays a significant role in shaping age-related neural changes in mid-life. To investigate this, healthy mid-life men and women (N=114; age range 46-53) who were part of a larger prospective birth cohort were enrolled in a follow-up fMRI study. Detailed menstrual cycle histories in conjunction with fasting serum samples collected on the morning of the scan day were used to determine pre/peri/post-menopausal status of women. Participants performed a visual working memory task during fMRI scanning. Results show robust changes in DLPFC function over the menopausal transition, despite minimal variance in chronological age. Women exhibited exaggerated DLPFC activity as estradiol levels declined and FSH levels increased. These results are consistent with our previous work in young women, showing exaggerated DLPFC activity under low versus high estradiol conditions (despite comparable performance), a putative marker of neural efficiency. We see the same inefficient DLPFC response in mid-life as women lose ovarian estrogens. These data underscore the importance of studying adults early in the aging process in order to understand sex-specific mechanisms that shape cognitive aging trajectories and, ultimately, disease-risk.

G55

HOW HARD IS IT GOING TO BE? ERP EVIDENCE FOR THE ADJUSTMENT OF COGNITIVE CONTROL DURING A FLANKER TASK IN YOUNG ADULTS, BUT NOT CHILDREN

Daniela Czernochowski[1,2], Lydia Schiffmann[2]; [1]Technical University Kaiserslautern, [2]Heinrich Heine University Düsseldorf — According to the conflict monitoring account, cognitive control is up-regulated upon the detection of response conflict. Hence, interference costs are particularly high when incongruent stimuli are unexpected. Given well-established difficulties in interference control in children, little is known about the developmental trajectory of regulating cognitive control according to task context. Specifically, it is unclear if children are unaware of increased conflict and/or unable to recruit cognitive control. Here, we focus on the ability to inhibit irrelevant information (flanker stimuli) or responses (NoGo-Trials). Task context was manipulated by using frequent or rare incongruent trials and by reversing response rules. Young adults, older children (aged 10 years) and younger children (aged 7 years) completed a flanker task while event-related potentials (ERPs) were recorded. The results confirmed children's behavioral difficulties, in particular with inhibiting No-Go responses. RT-interference costs were age invariant. By contrast, accuracy-interference costs were smaller for non-reversed rules and frequent incongruent trials for adults only; this pattern was absent for older children and reversed for younger children. ERPs suggest that conflict detection is functionally mature even in young children; shorter latencies of the error-related negativity for children compared to adults suggest the delayed execution of a motor response after decision-making. Together, these results indicate that all age groups were able to detect response conflict and respond more slowly to incongruent flankers. However, increased conflict did not lead to increased cognitive control on the next trial for children, as younger children in particular were unable to translate conflict into correct response selection.

G56

THE ROLE OF SLEEP ON NEXT DAY COGNITION

Gillian Cooke[1], Jim Monti[1], Chelsea Wong[1], Neal Cohen[1], Arthur Kramer[1]; [1]University of Illinois Urbana-Champaign — Sleep spindles have been associated with grey matter volume in regions of the brain that are involved in cognition, the hippocampus, basal forebrain and orbital frontal cortex. Additionally, sleep spindles have been associated with self-reported measures of sleep. The present study aimed to investigate the influence of self-reported measures of sleep on next day cognitive performance. Furthermore, we wanted to examine the impact that age has on this relationship as aspects of both cognition and sleep physiology change with age. D-prime scores from a relational memory task (face-scene) and a cognitive control task (AX continuous performance task (AX-CPT)) of 99 middle aged and older adults (40-81 years) were used to examine the impact of sleep on next day cognition. Shorter time to fall asleep and younger age was associated with better relational memory performance. Furthermore, younger people had less difficulty falling asleep. Controlling for gender and education, time to fall asleep explained 5% of the variance in relational memory performance. Adding age increased this to 11%, and significantly predicted relational memory performance. In contrast, although AX trial accuracy was associated with younger age, there was no relationship between AX accuracy or AX-CPT d-prime and time to fall asleep. These data suggest dissociation between the types of cognition that are influenced by sleep; this is likely due to influence of sleep on the hippocampus. Since disruptions to sleep physiology and relational memory performance are evident with aging, interventions designed to improve age-associated sleep disruptions may positively influence relational memory performance.

G57

RESTING-STATE MRI IN ADOLESCENTS FROM SOCIOECONOMICALLY DIVERSE BACKGROUNDS: RELATION OF FUNCTIONAL CONNECTIVITY TO COGNITIVE ABILITIES AND EDUCATIONAL OUTCOMES.

Julia Leonard[1], Amy S. Finn[1], Allyson P. Mackey[1], Carlo de los Angeles[1], John Salvatore[1], Calvin A. Goetz[1], John D.E. Gabrieli[1], Susan Whitefield-Gabrieli[1]; [1]Massachusetts Institute of Technology — A fundamental question in developmental cognitive neuroscience is how brain maturation supports the development of cognitive abilities and how the environment shapes this relationship. The present study explored this question with resting-state functional MRI in a socioeconomically diverse sample of teenagers. Seventy-six students (mean age = 14.5), from whom we collected standardized test data, participated in a resting state scan and completed working memory, and math tests outside of the scanner. Greater negative correlations between time-series data in the medial prefrontal cortex (MPFC, a key node of the default mode network) and left dorsolateral prefrontal cortex (DLPFC, key node of the fronto-parietal network) were related to superior performance on a working memory test ($r(72)=-.224$ $p=.039$), a standardized math test (collected in schools, $r(76) = -.227$, $p = .049$) and a separate math test (collected in the lab; $r(71)=-.271$, $p=.022$). Breaking the sample into low-socioeconomic status (SES) and high-SES groups based on receiving free or reduced lunch from the public school system, revealed further insights. The groups did not differ on their average correlation between the MPFC and DLPFC. However, the brain-behavior relationships listed above were observed only in the high-SES group.

These findings suggest that while we have a good neural index of cognition and achievement in high-SES populations, these relationships have yet to be fully elucidated in low-SES populations.

G58

PROACTIVE CONTROL CAN BE ENCOURAGED DURING CHILDHOOD Nicolas Chevalier[1], Shaina Martis[2], Tim Curran[2], Yuko Munakata[2]; [1]University of Edinburgh, [2]University of Colorado Boulder — Young children engage cognitive control reactively only after events requiring control have occurred, even when they could have anticipated and proactively prepared for upcoming events. The present study examined whether proactive control can be encouraged in children showing this reactive control bias. To this end, reaction times, EEG and pupil dilation were collected while 36 5- and 28 10-year-old children completed three conditions of a task-switching paradigm, varying in the possibility to process task cues before or after stimulus onset. Specifically, in the "Impossible" condition, the cue and target were simultaneously presented, preventing proactive preparation based on the cue. In the "Possible" condition, the cue was presented early, allowing proactive preparation, but remained visible after stimulus onset, hence also allowing reactive control. Finally, early cue presentation was terminated on target onset in the "Encouraged" condition, hence providing a stronger incentive to prepare proactively. Ten-year-olds engaged in proactive preparation whenever it was possible, as shown by shorter reaction times, increased cue-related pupil dilation (reflecting greater mental effort) and more pronounced late posterior positivity (an ERP associated with proactive task preparation) during the cue-stimulus interval in both the "Possible" and "Encouraged" condition, relative to the "Impossible" condition. In contrast, 5-year-olds showed faster RTs, greater pupil dilation and a more pronounced posterior positivity only in the "Encouraged" condition. These findings suggest that 5-year-olds overreliance on reactive control results from a meta-cognitive failure to determine which control mode is most adaptive for the task at hand.

G59

EXECUTIVE FUNCTIONING AND ALZHEIMER'S DISEASE: FAMILY HISTORY PREDICTS PERFORMANCE ON THE WISCONSIN CARD SORTING TEST Kathleen Hazlett[1], Christina Figueroa[1], Kristy Nielson[1,2]; [1]Marquette University, [2]Medical College of Wisconsin — Alzheimer's disease (AD) research typically focuses on memory; however, executive functioning (EF) deficits are also common among AD patients and are associated with decreased functionality in activities of daily living, an important criterion in diagnosing AD. Using modified Wisconsin Card Sorting Tests (WCST), previous research indicates that the number of categories achieved (CA) and perseverative errors (PE) distinguish AD groups based on disease severity; that CA, unique errors, and total errors (TE) differentiate patients with AD, vascular dementia, and controls; and that patients with AD and MCI exhibit more perseveration than controls. Results based on the traditional WCST corroborate these findings. Given the sensitivity of the WCST in the context of AD, examining differences in performance among at-risk cognitively intact individuals (i.e., those with positive family history (FH) of AD) would provide valuable insight into preclinical cognitive changes. The current study examined WCST performance in 24 FH- and 17 FH+ older adults. Results revealed significant group differences for TE, PE, non-perseverative errors (NPE), CA, and conceptual level responses, with the FH+ group consistently exhibiting poorer performance. Moreover, hierarchical regression analyses indicated that, after accounting for demographic variables, FH significantly predicted TE, PE, NPE, and CA. These results speak to the potential role of EF in bolstering our understanding of early cognitive markers of future decline. Expanding our understanding of the relationship between additional domains of cognitive functioning (i.e., EF) and AD may allow for better prediction of cognitive functioning and potential progression to AD.

G60

INTERACTIVE MENTAL AND PHYSICAL EXERCISE FOR OLDER ADULTS: EXECUTIVE FUNCTION BENEFITS Cay Anderson-Hanley[1], Nikita Shah[1], Katherine Cohen[1], Michael Hogan[2], Paul Arciero[3]; [1]Union College (NY), [2]National University of Ireland, Galway, [3]Skidmore College — Dementia is on the rise around the world and while a "cure" is elusive, research has shown that exercise can play a significant role in prevention or amelioration of decline (Colcombe et al., 2003). Less is known about the combination of mental and physical exercise, particularly when intertwined in interactive exergaming, but one study has reported a greater cognitive benefit among exergaming older adults than those engaged in traditional exercise (Anderson-Hanley et al., 2012). This study examined the impact of three months of interactive mental and physical exercise for older adults. Twenty-eight older adults (mean = 85.1 years old; SD = 5.9) were trained to pedal a stationary bike with an interactive virtual-reality display. Executive function was measured pre- and post-exercise (Color Trails 2, Stroop C, and Digit Span Backwards). Twenty-two participants completed the study; of those, ten participated regularly and vigorously consistent with the ACSM standard and thus were considered to have received an adequate "dose" of interactive mental and physical exercise. Exercisers meeting criteria for mild cognitive impairment (MCI) made significantly greater gains on two of the three tests (Stroop C, $p = .02$; Digit Span Backwards, $p = .05$) when compared with normative older adults. Results suggest interactive mental and physical exercise can be particularly effective among those older adults already experiencing some cognitive decline. Future research could further explore benefits for MCI of various types if interactive mental and physical exercise.

EXECUTIVE PROCESSES: Other

G61

MOBILE COGNITIVE TRAINING REGIME IS BEST TAILORED BY AGE GROUP Conny Lin[1], Catharine H. Rankin[1], Paul D. Nussbaum[2]; [1]University of British Columbia, [2]University of Pittsburgh School of Medicine — Consistent cognitive training tasks can potentially produce transferrable cognitive improvement; mobile cognitive training applications such as Fit Brains enable more frequent access to short cognitive training sessions (3-5mins). To understand how mobile training regimes influence performance for different age groups, we investigated score performance from twelve cognitive tasks each targeting 1 of 5 categories, logic, memory, concentration, visual and speed. From 20,660,413 game scores generated by 727,390 unique Fit Brains users from 20-79 years old, we analyzed the effect of age on the initial performance, performance improvement over repeated training, and performance decay as a factor of lower training frequency. Initial performance declined significantly with age, except for logic tasks, for which 30-40 years old initially performed better than 20 years olds. Performance improvement for memory, concentration and speed significantly interact with age, and, not surprisingly, performance improvement in memory is the most negatively affected by age, and logic the least affected. Analysis for performance decay related to lower training frequency showed that, for all ages, speed and concentration suffers the most from less frequent training, and visual suffers the least. As age increases, maintenance of concentration and memory performance requires the most frequent training compared to other tasks. In conclusion, this study showed that all age groups would benefit from daily concentration and speed training, and that a mobile cognitive training regime is best tailored by age group.

G62

WHITE MATTER INTEGRITY FROM OPENNESS TO PSYCHOSIS: SUPPORT FOR A DIMENSIONAL MODEL OF PSYCHOTIC SPECTRUM ILLNESS Rachael Grazioplene[1], Robert S. Chavez[2], Colin G. DeYoung[1]; [1]University of Minnesota, [2]Dartmouth University — Diffusion imaging investigations of psychotic-spectrum illnesses have revealed specific changes in frontal and limbic white matter regions that are associated with cognitive disregulation; however, similar neural markers appear in both unaffected relatives and in psychologically healthy individuals with high levels of personality traits related to psychosis (e.g. Openness to Experience; Nelson et al., 2013 & Jung et al., 2010). Absorption, a trait measured by the Multidimensional Personality Questionnaire (MPQ), is closely linked to Openness, and measures individual differences in proneness to altered states of cognition; Absorption has also been linked to aspects of psychosis liability, such as perceptual dysregulation and magical thoughts (DeYoung et al., 2012). We sought to replicate and extend research by Jung et al. (2010) by examining white matter correlates of MPQ Absorption in a large nonclinical adult sample (N=229; 109 female) using high quality diffusion weighted imaging data. Based on previous findings, we hypothesized that Absorption would be inversely associated with fractional anisotropy in the

Uncinate Fasciculus and the Anterior Thalamic Radiation. These hypotheses were supported: Results of a whole brain regression of fractional anisotropy against MPQ Absorption (controlling for age, sex, and IQ) indicate an inverse association between FA and trait Absorption in the anterior portions of the left Anterior Thalamic Radiation, the left Uncinate Fasciculus, and the left Forceps Minor. These findings support the notion that liability to psychosis is distributed across the population, is evident in brain structure, and manifests as normal personality variation at subclinical levels.

G63

NEURAL CORRELATES OF SENTENCE COMPREHENSION: EFFECTS OF THE POSITION OF EVENT-STRUCTURE CUES. Josefine Karlsson[12], Anne Helder[12], Paul van den Broek[12], Linda Van Leijenhorst[12]; [1]Leiden University, the Netherlands, [2]Leiden Institute for Brain and Cognition, the Netherlands — Human language can present consecutive events in non-chronological order. Linguistic cues, such as "before" and "after" function as event structure cues (ES-cues), signaling temporal order. Comprehension of non-chronological sentences has been shown to involve increased activation of prefrontal regions associated with cognitive control. However, previous studies only examined sentence-initial ES-cues, and recent behavioral findings from our lab suggest that readers use different reading strategies for sentence-initial and sentence-medial ES-cues. The present study examined the effects of chronology as well as ES-cue position in young adults (ages 19-27, N=21). We collected fMRI data while participants read 84 sentences in which chronology and ES-cue position were manipulated. Sentence reading times did not differ as a function of sentence chronology, and were significantly slower for sentence-initial compared to sentence-medial ES-cues. Preliminary fMRI analyses show that the contrast of Non-chronological > Chronological sentences resulted in activation in the right Anterior Insula, left Lingual Gyrus and left Frontal Pole. The contrast of Medial > Initial ES-cue sentences resulted in activation of a large bilateral cluster in the Occipital Cortex, as well as activation in the right Postcentral-, left Precentral-, left Superior Temporal-, and right Inferior Frontal Gyri. Even though these data confirm that comprehension of non-chronological sentences requires additional processing, they reveal the importance of ES-cue position for sentence comprehension. Sentences with initial- and medial ES-cues result in differences at both the behavioral and neural level. These results suggest that ES-cue position is an important factor which could influence readers' comprehension strategies.

G64

NEURAL CORRELATES OF INDIVIDUAL DIFFERENCES IN COHERENCE MONITORING DURING READING. Anne Helder[1,2], Josefine Karlsson[1,2], Paul van den Broek[1,2], Linda Van Leijenhorst[1,2]; [1]Leiden University, the Netherlands, [2]Leiden Institute for Brain and Cognition, the Netherlands — Successful comprehension of texts is a key complex cognitive ability. It requires the construction of a coherent mental representation of a text by a reader, which involves continuous coherence monitoring. Individual differences in reading comprehension ability are related to differences in the ability to notice when coherence is disrupted. This study examined the neural correlates of individual differences in coherence monitoring during reading. We collected fMRI data while young adults (N = 31, ages 19-27) read 32 six-sentence narratives that were presented sentence-by-sentence in a slow self-paced event-related design. Half of the narratives contained a break in coherence. Behavioral results show increased reading times for inconsistent compared to consistent target sentences ($p = .002$). The contrast of Inconsistent > Consistent target sentences resulted in a network of significantly active clusters ($p < .05$, cluster corrected) in the bilateral Angular Gyri and Temporal Poles, Dorsolateral Prefrontal Cortex (DLPFC), Dorsomedial Prefrontal Cortex (dmPFC), and left Anterior Cingulate Cortex (ACC). Whole brain regression analyses on this contrast revealed that activation in DLPFC and ACC was positively correlated with reading ability measured outside of the scanner: better comprehenders recruited these regions more when reading an inconsistent target sentence. These results suggest that individual differences in activation patterns in cognitive control regions such as the DLPFC and ACC during reading are related to individual difference in reading comprehension abilities. These results help us to gain more insight in the brain regions involved in coherence building processes that are crucial for successful comprehension of texts.

G65

FRACTIONATING EXECUTIVE CONTROL IN THE HUMAN BRAIN Sabrina Lemire-Rodger[1], Nathan Spreng[2], Dhawal Selarka[1], Gary Turner[1]; [1]York University, [2]Cornell University — Executive control processes have been found to cluster around three factors: updating, inhibition and task switching. Few neuroimaging studies have directly contrasted two of these processes. To date, none have examined convergent and divergent patterns of neural activity for all three using matched tasks to investigate brain activity during updating, inhibition and task switching in a single scanning protocol. Here, we used a novel paradigm that directly manipulated executive control demands while keeping all other demands constant to assess the neural correlates of these three executive processes. Participants underwent fMRI scanning while performing updating, inhibition and control tasks. A multivariate analysis of the neuroimaging data revealed two significant patterns of brain activity dissociating (i) task switching from updating and inhibition, and (ii) executive function from control tasks. The first pattern included laterality differences in inferior frontal brain regions (Left hemisphere = task switching; right hemisphere = inhibition & working memory). The second significant pattern of brain activity dissociated executive control tasks, mediated by the extended frontoparietal control network from the baseline control task, which showed greater engagement of the midline structures associated with the default network. This study represents the first investigation of the fractionation of executive processes in the human brain examining the full range of executive control processes. These data suggest a hybrid architecture of executive control representation - lateralized differences in frontal brain regions associated with specific control processes as well as common recruitment of frontal-parietal brain regions, common to all executive control demands.

G66

OUTCOME ANTICIPATION AND THE ONLINE CONTROL OF STIMULUS-BASED ACTION - AN FMRI STUDY Steffi Frimmel[1], Uta Wolfensteller[1], Hannes Ruge[1]; [1]Technische Universität Dresden, Dresden, Germany — A fundamental prerequisite of goal-oriented action is to correctly recognize contingencies between a response (R) that produces a specific outcome (O) in a specific stimulus situation (S). Previous studies have shown that such triple S-R-O associations can be linked up very fast. The present study investigated the brain activation dynamics linked to the initial incremental strengthening of S-R-O associations during a short period of incidental learning using functional magnetic resonance imaging. In order to determine the specific contribution of the full triple S-R-O contingency, we also realized two control conditions in which the triple contingency was reduced to R-O contingency and S-R contingency, respectively. We found that learning the triple S-R-O association was specifically linked to enhanced activation in the supplementary motor area (SMA), the anterior caudate and the central orbitofrontal cortex (OFC). Furthermore, the S-R-O-related caudate activation was associated with relative response time differences between the S-R-O condition and the S-R condition. Together, these results suggest that contingent outcomes are only integrated into action selection when they can be anticipated based a contingently preceding stimulus. This integration seems to rely on an interplay between brain areas involved in basic voluntary motor control processes (SMA) and brain areas involved in a diverse range of outcome-related processes (caudate, OFC).

G67

DAYTIME SLEEPINESS IS ASSOCIATED WITH DECREASED INTEGRATION OF REMOTE OUTCOMES ON THE IGT Elizabeth Olson[1,2], Mareen Weber[1,2], Olga Tkachenko[1], William D. S. Killgore[1,2]; [1]McLean Hospital, [2]Harvard Medical School — Sleep loss is associated with deficits in basic aspects of attentional control such as processing speed and vigilance, in both healthy and clinical populations. Recently, deficits in higher-level aspects of executive functioning and decision-making also have been described. For instance, multiple research groups have reported impairment in Iowa Gambling Task (IGT) performance, both in healthy controls experiencing acute sleep deprivation and in individuals with sleep disorders. Traditional metrics of assessing IGT performance such as subtracting good minus bad deck choices do not discriminate between multiple underlying features that may contribute to changes in task performance. By using the expectancy valence model, it is possible to fit parameters to describe attention to gains versus losses, emphasis on recent versus remote

outcomes, and behavioral randomness. In the current study, 32 participants ages 18 to 45 completed the IGT as well as questionnaires concerning sleep patterns and fatigue. Individuals who reported greater daytime sleepiness on the Epworth Sleepiness Scale (ESS) had higher values of the updating parameter, reflecting decreased integration of remote versus recent outcomes in decision-making, Spearman's r (30) = 0.390, p = 0.027. Results suggest that sleep loss affects IGT performance by shortening the time horizon over which decisions are integrated. This finding has important implications for healthy individuals experiencing sleep loss, as well as for clinical populations with sleep disorders.

G68

HOT OR NOT? PERCEIVED ATTRACTIVENESS ACTIVATES REWARD PROCESSES WITHIN MEDIAL-FRONTAL CORTEX Scott Whittaker[1], Laura MacKenzie[1], Cameron Hassall[1], Natalie Rosen[1], Olave Krigolson[1]; [1]Department of Psychology and Neuroscience, Dalhousie University — Utilitarian theory posits that we are driven by an inherent desire to maximize reward. Not to be superficial - but given this logic when one views an attractive face the face should be desired and processed as a reward whereas when one views an unattractive face it should be processed as a punishment. Indeed, research using functional magnetic resonance imaging supports this hypothesis - in a seminal study Aharon and colleagues (2001) showed that the viewing of attractive faces activated neural reward circuitry relative to the viewing of unattractive faces. Here, we sought to provide electroencephalographic (EEG) support for this hypothesis. Specifically, we recorded electroencephalographic data while participants viewed and rated faces on a Likert scale for attractiveness. Following data collection we used the participants' ratings to code faces as either being attractive or unattractive. Based on these codings, an analysis of our electroencephalographic data revealed that a contrast of "attractive" and "unattractive" faces revealed an event-related brain potential component with a timing and scalp topography consistent with the feedback error-related negativity (fERN) - a component previously shown to be sensitive to reward feedback. Further, localization of the fERN we observed revealed a source within the anterior cingulate cortex - a result also consistent with previous accounts of the fERN. Importantly, our results provide further support for the hypothesis that perceived attractiveness activates reward-processing circuitry within the medial-frontal cortex.

EXECUTIVE PROCESSES: Working memory

G69

TESTING A DYNAMIC NEURAL FIELD MODEL OF VISUAL WORKING MEMORY WITH FMRI John Spencer[1], Aaron Buss[1], Vincent Magnotta[1]; [1]University of Iowa — Visual working memory (VWM) plays a key role in visual cognition, comparing percepts that cannot be simultaneously foveated and identifying changes in the world when they occur. Functional magnetic resonance imaging (fMRI) has identified frontal, parietal, and temporal cortical areas that are selectively activated in VWM tasks; less is known about how these neural regions work together to encode, maintain, and compare items in working memory. Here, we push accounts of brain processes to a new level by using a dynamic neural field (DNF) model to predict what happens in the brain when people correctly and incorrectly detect visual changes. We generated a real-time local field potential (LFP) measure from each component of the DNF model. When convolved with an impulse response function, the LFPs yielded predicted hemodynamics from each model component and each trial type. We then simulated predicted hemodynamics from an fMRI paradigm designed to yield above-chance responding, but many correct and incorrect responses for analysis. Finally, we tested these predictions with 20 adult participants. Results show a strong correspondence between the model-based neural predictions and cortical activation measured with fMRI on both correct and incorrect trials, including a "flip" in the neural signal on incorrect trials across set sizes. This highlights how model-based fMRI can explain subtle and often surprising differences across conditions that are difficult to explain otherwise. The model identifies the working memory and comparison processes that underlie change detection and explains how frontal, parietal, and temporal regions work together as an integrated network.

G70

SUCCESSFUL NAVIGATION IN THE ABSENCE OR PRESENCE OF AN ORIENTING LANDMARK Katherine Sherrill[1,2], Ugar M Erdem[1], Thackery Brown[1,2], Robert Ross[1,2], Michael Hasselmo[1], Chantal Stern[1,2]; [1]Center for Memory and Brain, Boston University, Boston, MA, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA — fMRI was used to examine brain mechanisms related to successful navigation. Navigation took place in an open field environment with or without an orienting landmark. Each trial included map presentation (2 sec), delay (4 sec), and navigation (8 sec) components. In the map presentation phase, participants were shown a survey representation of their start location, heading direction, and goal location. On half the trials, a single distinguishing landmark was included on the map and in the environment, which participants could use as an orientation cue. Following the delay, participants actively navigated to the encoded goal location. Critically, the goal location marker was only visible during the map encoding phase, but the landmark was visible in both map and navigation phases. Navigation occurred in either first person perspective (FPP) or Survey perspective. We contrasted FPP navigation without a landmark against FPP navigation with a landmark. During successful FPP navigation in the no-landmark condition compared to the landmark condition, we found increased activation in brain areas known to be important for spatial navigation including the parahippocampal cortex, striatum, superior parietal lobule, precuneus, and orbitofrontal cortex. No areas showed greater activation for the landmark condition compared to the no-landmark condition. Survey navigation showed the opposite effect: greater activation was observed in retrosplenial cortex, dorsal striatum, and orbitofrontal cortex when an orienting landmark was present in the environment. Taken together, the results indicate recruitment of differential brain regions for successful FPP and Survey perspective navigation in the presence or absence of an orienting landmark.

G71

WORKING MEMORY TRAINING: AN UPDATED META-ANALYSIS OF TRANSFER TO FLUID INTELLIGENCE MEASURES Samantha Wootan[1], Paul Reber[1], Dan Mroczek[1]; [1]Northwestern University — Working memory (WM) training research has sparked both excitement and skepticism, particularly around the claim that these interventions can result in improved fluid intelligence. Robust far-transfer effects following training would have significant implications for theories of working memory, neuroplasticity, and fluid intelligence in addition to applications of these theories in education, training, and cognitive rehabilitation. Among the challenges to addressing the reliability of effects is the fact that many interventions studies are underpowered to detect potentially subtle far-transfer effects. Melby-Lervåg and Hulme (2012; MLH) reported a meta-analysis of WM training effects that only included studies with substantial training and a comparison control group. Their analysis suggested that these WM training paradigms have not produced consistent fluid intelligence gains across studies. Here we report an updated meta-analysis in which additional recent studies are included. Critically, the addition of new findings allows for separate examination of participant populations that were combined in the MLH report: young healthy adults, older adults and children (some with learning or other disabilities). In 13 studies with young healthy adults, the meta-analytic effect size of working memory training interventions was d=0.238, p<.001, indicating consistent gains in measures of fluid intelligence and cross-study reliable far transfer. Thus it appears that for adults, working memory training does produce consistent increases in performance on tests of fluid intelligence and research efforts should be directed to better understanding of the interventions and conditions that lead to the most effective gains.

G72

ENCODING OBJECTS AS A CONFIGURAL REPRESENTATION INCREASES SPATIAL WORKING MEMORY CAPACITY Laura R. Rabbitt[1], Craig G. McDonald[1], Matthew S. Peterson[1]; [1]George Mason University — Spatial working memory capacity is limited in the number of items that can be maintained over time. However, similar to verbal working memory, previous research has demonstrated that spatial working memory capacity can be increased when stimuli are organized into familiar patterns. The current study examined whether manipulating the strategy used for

encoding could increase the capacity of spatial working memory. In the current study, participants performed a spatial working memory change detection task, where various set sizes of squares were to be encoded and the location of one square could change during recognition testing. Participants were given one of two instruction types: to remember the location of the squares or to remember the squares as a constellation. Results of this study demonstrated that for larger set sizes, instruction type made a significant difference in the number of items that participants recalled. Specifically, participants that were instructed to remember the constellation of squares, remembered more items than participants that were instructed to remember the location of squares for larger set sizes. Thus, the configural representation of the stimulus array significantly impacts spatial working memory capacity. Ongoing research will further examine the neurophysiological underpinnings of spatial working memory capacity by recording EEG and investigating the contralateral delay activity (CDA) in this task.

G73

THE EFFECT OF STRESS ON VISUO-SPATIAL WORKING MEMORY

Sarah Cebulski[1], Rob Gabrys[1], Hymie Anisman[1], Chris Herdman[1]; [1]Carleton University — Stressful events affect a range of cognitive functions, such as attention, memory formation and memory recall. With regard to working memory, the relationship is particularly complex. In part, this complexity arises from a tendency to erroneously conflate tasks that actually rely on separate subcomponents of the working memory system, subcomponents that are themselves differentially affected by stressors. The aim of the present study was to address this issue by investigating the relationship of cortisol, a stress hormone, to working memory in tasks that independently reflect visual storage and visual processing. The study also aimed to explore how workload affects performance on these tasks. The Trier Social Stress Test, a task known to induce social-evaluative stress, was administered to half of the 24 participants studied. Performance on low and high workload versions of a visuo-spatial storage task (delayed pattern matching) and a visual processing task (mental rotation) were compared between the stressor and control groups. Results reveal a differential stress influence on working memory tasks, such that performance on the storage task was significantly impaired in the stressor relative to control condition at both workloads, while performance on the processing task was significantly enhanced. These results suggest that different mechanisms influence delayed pattern matching and mental rotation. Genetic analysis of polymorphisms known to be correlated with individual differences in executive functioning, such as brain derived neurotrophic factor (BDNF), especially during stressful events, may provide further insight into these differences.

LANGUAGE: Development & aging

G74

CEREBELLAR CONTRIBUTIONS TO LANGUAGE RECOVERY FOLLOWING PRE- OR PERINATAL STROKE

Carolina Vias[1], Alexarae Bryon[1], Arnaldo Morales[1], Anna De Feria[1], Jessica Medina[1], Anthony Steven Dick[1], Ana Solodkin[2], Steven L. Small[2]; [1]Florida International University, [2]University of California, Irvine — This study focuses on the contribution of the cerebellum to language recovery following pre- or perinatal stroke. Language function is resistant to lesions that destroy classical speech areas of the brain, provided these lesions occur early in development. Research suggests that cortical changes in interhemispheric connectivity relate to syntactic, expressive, and receptive language outcome following early stroke. However, less is known regarding the recovery of the broader language network that includes subcortical structures, particularly the cerebellum. Indeed, through its connections with the cortex, the cerebellum is associated with higher cognitive functions, including language. Perinatal stroke is associated with cerebellar atrophy, suggesting early degeneration of cortico-ponto-cerebellar connections, and increased understanding of cerebellar function may clarify how the developing brain recovers language function following early stroke. To gain greater clarification on this issue, we assessed 42 individuals who sustained pre- and perinatal stroke and 28 of their typical siblings using behavioral and neuro-imaging techniques. Structural magnetic resonance imaging (MRI) was used to investigate region-specific atrophy of the cerebellum, while functional MRI was used to investigate cortico-cerebellar connectivity during receptive and expressive language fMRI tasks. These measures were correlated with behavioral measures of syntactic, expressive, and receptive language outcome. We found that greater cerebellar atrophy predicts poorer receptive and expressive language outcomes. We also found that right cerebellar functional connectivity with left frontal and temporal cortical regions predicts receptive language outcomes. These findings enhance our understanding of cerebellar function, which has the potential to inform therapeutic strategies for language recovery following early stroke.

G75

THE DEVELOPMENT OF PHONOLOGICAL PROCESSING FROM THE PRE-READING TO THE BEGINNING-READING STAGE IN CHILDREN WITH AND WITHOUT A FAMILIAL RISK FOR DEVELOPMENTAL DYSLEXIA

Maria R Dauvermann[1,2], Nora M Raschle[1,2], Danielle D Sliva[1], Bryce Becker[1], Ola Ozranov-Palchik[1], Barbara Peysakhovich[1], Sara A Smith[1], Michael Figuccio[1], Jennifer Zuk[1], Nadine Gaab[1,2,3]; [1]Boston Children's Hospital, Laboratories of Cognitive Neuroscience, Developmental Medicine Center, [2]Harvard Medical School, [3]Harvard Graduate School of Education — Developmental Dyslexia (DD) is characterized by difficulties with accurate and/or fluent word/text recognition with a strong genetic basis. Research has suggested that individuals with DD show functional alterations in left-hemispheric inferior frontal and posterior regions during phonological processing (PP), an early key predictor of DD. However, to date no study has examined PP during development from the pre-reading to the beginning-reading stage in children with (FHD+) and without (FHD-) a familial risk for DD. FHD+ and FHD- children were examined three times using psychometric measures and a PP fMRI task: At the pre-school age (42 FHD-/34 FHD+), after one year of reading instruction and again in elementary school. At the pre-school age, FHD+ compared to FHD- children showed reduced behavioral performance in PP, receptive/expressive language and rapid automatized naming. Furthermore, reduced activation in left occipital-temporal and parieto-temporal regions were observed for FHD+ compared to FHD- children. After one year of reading instruction, FHD+ children showed additional deficits in reading fluency and the hypoactivation in left-hemispheric posterior regions persisted. At elementary school, behavioral deficits in FHD+ compared to FHD- children remained unchanged. However, FHD+ now exhibited additional hypoactivation in left inferior frontal regions, one additional key component of the reading network. Our results suggest that the development of the reading network is fundamentally different in the majority of FHD+ compared to FHD- children and that the various components of the reading network seem to follow different developmental trajectories. Our results have important implications for the development of early intervention programs.

G76

INDIVIDUAL DIFFERENCES IN FUNCTIONAL CONNECTIVITY OF THE VENTRAL STREAM DURING CONTINUOUS READING

W. Einar Mencl[1,2], Jason Zevin[1], Stephen Frost[1], Peter Molfese[1], Laura Mesite[3,1], Daniel Sharoh[1], Jay Rueckl[4,1], Kenneth Pugh[1,2,4]; [1]Haskins Laboratories, [2]Yale University, [3]Harvard University, [4]University of Connecticut — The putative "Visual Word Form Area", or VWFA, is important in skilled reading, although its precise function is not understood. Using fMRI, we investigated functional connectivity, operationalized as time-course correlations, among the VWFA and other brain regions in subjects who vary on reading skill. 31 healthy young adult subjects were scanned in two protocols. First, a localizer task employing real printed words and false font stimuli was used to functionally define the VWFA in each subject. Second, a continuous stimulation paradigm was run, where subjects read and listened to sections of a continuous story in long blocks. For each subject, we computed a brain-wide connectivity map to the independently-defined VWFA during continuous reading. Finally, we used a measure of subjects' reading skill as a predictor to these connectivity maps (TOWRE Sight Word Efficiency raw score). Initial results indicate that in general, subjects with higher reading skill showed reduced connectivity between the VWFA and other brain regions, including early bilateral visual areas. One interpretation of this finding is that in more skilled readers, the VWFA has reduced connections to ancillary brain regions outside the primary language system. Further analyses will investigate connectivity of other primary regions in the reading circuit, and verify these initial results.

G77

NEURAL CORRELATES OF SENTENCE REPETITION IN THE LOGOPENIC VARIANT OF PRIMARY PROGRESSIVE APHASIA Anna Lisette Isenberg[1], Drew Goldberg[1], Murray Grossman[1]; [1]University of Pennsylvania — The logopenic variant of Primary Progressive Aphasia (lvPPA) is typified by progressive impairment in two core behavioral deficits: word retrieval and sentence repetition. It has been hypothesized that reduced repetition accuracy in lvPPA is due to degradation in the phonological working memory network, prompting a heavier reliance on lexical/semantic representations for repetition tasks (Gorno-Tempini et al, 2008). However, characterization of sentence level repetition has been primarily qualitative to date. Here we quantitatively examine error types in lvPPA sentence repetition and relate these to regions of grey matter (GM) atrophy. Patients (N=12) were diagnosed using current published criteria. Senior controls were demographically comparable. Participants performed a five item sentence repetition task. Changes in lvPPA cortical GM were quantified relative to seniors using aMRI and regression analyses related atrophy to repetition performance. Patients were significantly impaired in repetition accuracy, word substitutions, insertions and omissions ($p<.05$). Regions of atrophy were observed throughout left pSTG, IPL, and middle and posterior temporal cortex. Atrophy in pSTG and neighboring temporal regions correlated with accuracy measures of overall sentence repetition, omitted words and substituted words. Together, results suggest deficits in sentence repetition may stem, in part, from impairments in auditory verbal short term working memory as well as lexical retrieval. Additional work is needed to tease apart the specific contribution of working memory and lexical retrieval to the types of errors observed. Results suggest some contribution of temporal regions, beyond the pSTG/inferior parietal network traditionally associated with phonological working memory, to the repetition deficit observed in lvPPA.

G78

STRUCTURAL NEUROBIOLOGICAL DIFFERENCES IN CHILDREN WITH DYSLEXIA AND SPECIFIC READING COMPREHENSION DEFICITS Katherine Swett[1], Stephen Bailey[1], Fumiko Hoeft[2], Angela Sefcik[1], Scott Burns[1], Laurie Cutting[1]; [1]Peabody College of Education and Human Development, Vanderbilt University, [2]Department of Psychiatry, University of California San Francisco — Specific reading comprehension deficits (S-RCD), characterized by adequate word-level decoding skills but below-average reading comprehension, is a behaviorally distinct condition from developmental dyslexia (DYS). Recently, neurofunctional differences between S-RCD and DYS were described for the first time in fMRI (Cutting et al., Brain Connectivity 2013). The goal of this study was to examine neuroanatomical differences between S-RCD, DYS and typically developing (TD) readers using multivariate pattern analysis. Specifically, we applied a linear support vector machine (SVM) algorithm to gray matter volumes generated by voxel-based morphometry (VBM). The resulting classifiers achieved significant accuracy, and their validity was tested using leave-one-out cross-validation. First, and as expected from the previous literature of dyslexia, DYS was best differentiated from TD by negative weights in occipito-temporal regions, including left fusiform gyrus, as well as left precentral, supramarginal gyri and bilateral thalamus (classification accuracy: 80%). Similar differences were found when classifying DYS compared to S-RCD (accuracy: 88%; $p<0.05$ permutation based correction). Second, and more importantly, subjects with S-RCD were best classified using negative weights in bilateral prefrontal cortex when compared to TD (accuracy: 93%) and DYS (accuracy: 88%; $p<0.05$ permutation based correction). The weighting was most prominent in the right dorsolateral prefrontal cortex, an area associated with executive processes like monitoring and manipulating mental representations (Barbey et al., Cortex 2013). Taken altogether, these findings provide further evidence for distinct neurobiological differences between S-RCD and DYS adolescents.

G79

THE IMPACT OF SEMANTIC CATEGORIES AND IMAGEABILITY ON LANGUAGE PROCESSING IN ALZHEIMER'S DISEASE AND HEALTHY AGING Jet M.J. Vonk[1], Roel Jonkers[2], Loraine K. Obler[1]; [1]The Graduate Center of the City University of New York, [2]University of Groningen — Conflicting results have been reported regarding noun and verb processing, both with respect to the role of semantic categories and the influence of imageability in healthy aging and Alzheimer's disease (AD). In this study we addressed the relation of these categories to neuroanatomical regions that could account for the inconsistent results. We hypothesized that specific semantic features/categories (e.g., animacy, motion, but not furniture) would be impaired due to their association with frontal and temporal regions linked to AD. In addition, we tested nouns and verbs with varying degrees of imageability to determine how these would impact word processing. We tested 13 Dutch-speaking individuals with AD and 16 matched healthy controls on a semantic-similarity judgment task, measuring both accuracy and response time. Results show significant differences among both the semantic categories and the imageability ones. For example, the AD group responded significantly slower on animal nouns than furniture nouns, consistent with previous studies that propose the involvement of the posterior superior temporal sulcus in processing animal nouns. As well, both groups showed a significant progressive improvement in accuracy and in response time from very low-imageable nouns and verbs to high-imageable ones. In sum, the results support an anatomical-behavioral correlation between language deficits in AD and brain regions most vulnerable to the disease. In addition, the feature of imageability is differently processed along a continuum. These findings argue that semantic subcategories and imageability must be taken into account in future neurolinguistic studies.

LANGUAGE: Lexicon

G80

A NEUROCOGNITIVE INVESTIGATION OF INHIBITORY PROCESSES DURING SPEECH PLANNING Rhonda McClain[1], Eleonora Rossi[1], Judith Kroll[1]; [1]Penn State University — Recent event-related potential (ERP) studies have shown that bilinguals inhibit their native language (L1) when they produce their second language (L2) (Misra et al., 2012; Strijkers et al., 2013). It is not clear whether inhibition of the L1 is a general consequence of bilingualism, occurring whenever bilinguals are required to speak their L1, or restricted to contexts in which they must speak both languages. It is not known whether only bilinguals who are highly proficient in two languages inhibit their L1. In the present study, we examined consequences of bilingualism for L2 learners. Two groups of L2 Spanish learners and English monolinguals performed a blocked picture naming task, in which a series of pictures were initially named and then later repeated. One group of Spanish learners named pictures in an L1-L2-L1 order. Another group of learners and English monolinguals named in an L1-L1-L1 order. We expected repetition priming for learners performing the L1-L1-L1 order, but evidence of inhibition in the L1-L2-L1 group. Learners' and monolinguals' ERPs diverged in the first block, in which only the L1 was produced. This early difference occurred within the N400 window (300-600 ms post picture onset). ERPs also revealed that learners were more sensitive to item repetition than the monolinguals, as indexed by the late positive component (LPC). This pattern suggests facilitation rather than inhibition of the L1. The results suggest that there are general consequences of L2 use that differentiate learners from monolinguals even when L2 speakers are only moderately proficient in the L2.

G81

TEMPORAL DYNAMICS OF SEMANTIC AND LANGUAGE MEMBERSHIP INFORMATION DURING BILINGUAL WORD RECOGNITION Liv J. Hoversten[1], Trevor Brothers[1], Tamara Y. Swaab[1], Matthew J. Traxler[1]; [1]University of California, Davis — Previous research has suggested that bilingual comprehenders access lexical representations of words in both languages non-selectively. Results from other studies suggest that, under certain conditions, bilinguals may be able to selectively access a single target language. To help clarify the issue, the present study examined the relative timing of activation of language membership and word meaning. Spanish-English bilinguals performed simultaneous semantic and language membership classification tasks on single words during event-related potential (ERP) recording. In one half of the experiment, participants performed a Go/No-Go animacy judgment on each word and differentiated Spanish and English words with a Left/Right response hand decision. These tasks were reversed in the other half of the experiment and counterbalanced across participants. Lateralized readiness potential (LRP) and Go/No-Go ERP latencies were examined to assess the timing of access

of the two types of information. N400 frequency effects were also analyzed to determine the degree of semantic processing in target and nontarget categories. We found behavioral and electrophysiological evidence that language membership information was accessed before semantic information. Furthermore, the depth of processing of words in the nontarget language was reduced. This data suggests that the bilingual brain can rapidly identify the language to which a word belongs and use this information to selectively modulate the degree of processing in each language.

G82

LOCATION OF VIOLATION IN THE WORD STRUCTURE IS ASSOCIATED WITH DISTINCT PATTERNS OF GAZE TRAJECTORIES AND OCCIPITAL SOURCE ACTIVATION: COMBINED EEG AND EYE-TRACKING STUDY

Otto Loberg[1], Jarkko Hautala[1], Jarmo A. Hämääinen[1], Paavo H.T. Leppänen[1]; [1]University of Jyväskylä, Finland — In our previous study, we found that the location of the violations in word structure attracts fixational eye movements. These anomalies in the beginning of the word attract the movements earlier than the anomalies in the end during a lexical decision task. This faster orientation to the beginning of the word could indicate serial or serial-like processing of letters during word recognition. In order to investigate the neural basis of this preference for word beginning, we combined EEG and eye-tracking in 16 typical adult readers. We found, as in the previous study, that gaze trajectories at 225-250 ms were oriented towards the anomalies in the beginning of the words, whereas at 400-425 ms they were oriented towards the violations at the stimulus end. The early (0-300ms) fusiform source activation for the anomalies in the beginning of the words showed clearly distinct pattern from the activation exhibited by the normal words. Source localized at the approximate location of the left fusiform gyrus displayed long lasting (100 ms) attenuation of activity centered around 200 ms, whereas the source localized at the approximate location of the right fusiform gyrus displayed enhanced activity at the same time window. In comparison, the stimuli with the anomalies in the end showed enhanced activity in the left fusiform source centered at 200 ms lasting 50 ms with no distinct response from the right fusiform source. The location of violations in the word structure generates clearly distinct activation patterns in the left and right fusiform gyri.

G83

IMPLICIT SEMANTIC PRIMING ON SENTENCE LEVEL IN YOUNG AND ELDERLY ADULTS: AN EEG PILOT STUDY

Katrin Wrede[1], Christopher Gundlach[2], Anika Stockert[1], Till Nierhaus[2], Dorothee Saur[1]; [1]Language and Aphasia Laboratory, Department of Neurology, University Hospital, Leipzig, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Department of Neurology — We are planning a simultaneous EEG-fMRI study to investigate language reorganisation in aphasic stroke patients. Here we present the results of an EEG pilot study in young (n=13, 24 years) and elderly adults (n=12, 66,8 years) on auditory semantic priming on sentence level. We implemented three conditions: 1.COR_Expected ("[The cook oversalts] the soup"), 2.INC_Semantic incorrect (" [&] the school , 3.PSEU_ Pseudoword ([&] the pause"). Subjects were instructed to focus on the sentence final word to perform a lexical decision task. We hypothesized that increasing demands in lexical access will result in increasing reaction times (RTs) and N400 amplitudes in the EEG. Results showed a larger N400 for INC vs. COR and PSEU vs. COR over all electrodes ($p < .001$) and longer RTs for INC and PSEU ($p > .001$) irrespective of age. Both groups showed larger N400 amplitudes for INC versus PSEU (young: left posterior electrodes ($p=.033$); elderly: central electrodes ($p= .021$)). However the younger group didn´t differentiate between INC and PSEU in respect to RTs ($p=.769$) whereas elderly subjects showed longer RTs for PSEU in contrast to a smaller amplitude in the EEG ($p= .026$). In summary, implicit semantic priming on sentence level can be described through the N400 effect in both age groups. The N400 component has been seen in almost every single subject. This demonstrates the robustness of the N400 effect in our paradigm even in elderly subjects as prerequisite for application in stroke patients with aphasia. Furthermore it will be possible to use individual performance for EEG-fMRI informed analysis.

G84

CROSS-LANGUAGE PHONOLOGICAL PRIMING IN ONE LANGUAGE ALONE THROUGH TRANSLATION

Susan C. Bobb[1], Julien Mayor[2], Katie Von Holzen[3], Nivedita Mani[3], Manuel Carreiras[4]; [1]Northwestern University, [2]University of Geneva, [3]University of Göttingen, [4]Basque Center on Cognition, Brain and Language — Several studies have shown that unbalanced bilinguals activate both of their languages simultaneously during language processing (e.g., Spivey & Marian, 1999; Wu & Thierry, 2009). However, they were tested either in their non-dominant language environment or were required to use both languages, potentially artificially increasing co-activation. We tested balanced Spanish-Basque bilinguals on an ERP picture prime task where only Spanish was overtly presented without ever presenting Basque. Participants saw a picture in silence and then heard a word in Spanish under five conditions (SPANISH/BASQUE picture prime labels respectively presented in capital letters; Spanish auditory words/Basque translations in lower case): 1) the Spanish label of the picture was identical to the auditory target, (CASA/ETXE-casa/etxe) 2) the Spanish label of the picture rhymed with the Basque translation of the auditory target, (MANO/ESKU-aguila/arrano) 3) the Basque label of the picture rhymed with the auditory target, (GAVIOTA/KAIO-rayo/tximista) 4) the Basque label of the picture rhymed with the Basque translation of the auditory target, (AGUJA/ORRATZ-lápiz/arkatz) or 5) there was no relationship between the label in either language and the target (CAMA/OHE-guante/eskularru). We recorded ERPs to the onset of Spanish auditory targets. To evaluate priming effects, we compared conditions 1 through 4 with condition 5. Our results suggest that participants activated prime picture labels in both Spanish and Basque, activating Basque translations of Spanish auditory targets even though the experimental environment was Spanish and did not require activation of Basque. We therefore provide the strongest evidence yet for the non-selectivity of bilingual lexical access.

G85

HOW PROPERTIES OF THE WRITING SYSTEM DETERMINE THE CONVERGENCE OF THE SPEECH AND READING SYSTEMS IN THE BRAIN

Jay Rueckl[1,2], Stephen J. Frost[1], Peter J. Molfese[1], Pedro M. Paz-Alonso[3], Wen-Jui Kuo[4], Atira Bick[5], W. Einar Mencl[1], Denise H. Wu[4], Ovid J. Tzeng[4], Ram Frost[1,3,5], Manuel Carreiras[2], Kenneth R. Pugh[1,2]; [1]Haskins Laboratories, USA, [2]University of Connecticut, USA, [3]Basque Center on Cognition, Brain and Language (BCBL), Spain, [4]National Central University, Taiwan, [5]Hebrew University, Israel — Reading involves mapping between visual forms and the speech sounds of the language that they represent. Indeed, studies in English have shown that reading skill can be indexed by the degree of convergence between the reading and speech systems in both emergent readers (Frost et al. 2009) and adults (Shankweiler et al. 2008). In this fMRI experiment, we examined whether reading-speech convergence in skilled adult readers depends on the properties of the writing system. Native speakers of Spanish, English, Hebrew, and Mandarin Chinese (N = 70 in total) made animacy judgments about printed and spoken words. These languages vary in orthographic depth: the ambiguity of the mapping from spelling to phonology. This mapping is largely unambiguous in Spanish and highly ambiguous in Chinese, with English and Hebrew falling in between. The results revealed that (a) reading (considered independently of speech) engages a largely similar cortical network in each language, including fusiform, temporal-parietal and inferior frontal regions; (b) the neural convergence of speech and reading is substantial and largely similar across languages; although (c) there is somewhat less reading-speech convergence in Chinese than in the alphabetic languages, and (d) for the alphabetic writing systems, reading-speech convergence in certain regions of interest (e.g., LH superior temporal gyrus) was modulated by orthographic depth.

G86

DIFFERENTIAL FUNCTIONAL ACTIVATION IN SPEECH/ LANGUAGE AREAS ASSOCIATED WITH AUDITORY LEXICAL LEARNING AS A FUNCTION OF SLEEP CONSOLIDATION

Stephen Frost[1], Nicole Landi[1,2,4], Peter Molfese[1], James Magnuson[1,2], Daniel Sharoh[1], Jay Rueckl[1,2], Jonathan Preston[1,3], W.E. Mencl[1], Kenneth Pugh[1,2,3]; [1]Haskins Laboratories, [2]University of Connecticut, [3]Southern Connecticut State University, [4]Yale University — Previous research has identified both procedural and declara-

tive learning mechanisms at the level of brain and behavior as potentially causal factors in reading and language disorders. We investigated learning with behavioral (extensive phenotypic classification via behavioral testing in multiple linguistic and cognitive domains) and neuroimaging methods (fMRI). 26 Participants (ages 15- 25) completed a behavioral assessment battery of reading, language and general cognitive ability. Participants then learned associations between 24 novel spoken words and pictures (unusual fish or minerals) over the course of ~1.5 hour of training until they met a criterion of 90% correct. On the following day, they returned for a refresher period, seeing all trained stimuli twice, and a second learning period, during which participants learned a new set of novel word-picture pairs to criterion. After the second behavioral learning session, participants were scanned using fMRI. During scanning they heard the trained consolidated words from Day 1, the trained unconsolidated words from Day 2, and a set of completely novel non-words. fMRI results revealed stronger activation of language regions surrounding the perisylvian fissure (inferior, superior and middle temporal), as well as posterior cingulate for consolidated vs. trained unconsolidated and novel non-words; larger and more bilateral differences emerged for comparisons between consolidated and novel non-words. Covariate analyses indicated that reading and language skills modulated these findings, such that skill in reading was associated with greater effects of consolidation above and beyond training.

G87

ACCESSING MEANING OF L2 WORDS IN BEGINNING AND ADVANCED LEARNERS: AN ELECTROPHYSIOLOGICAL AND BEHAVIORAL INVESTIGATION Fengyang Ma[1], Judith F. Kroll[1], Taomei Guo[2], Peiyao Chen[3]; [1]Pennsylvania State University, [2]Beijing Normal University, [3]Northwestern University — According to the Revised Hierarchical Model (Kroll & Stewart, 1994), second language (L2) learners initially access meaning of L2 words via the L1 whereas advanced learners access meaning directly. We tested this hypothesis with English learners of Spanish in a translation recognition task, in which participants were asked to judge whether English words were the correct translations of Spanish words. In each case, we gathered data on behavior and on the earliest time course of processing using ERPs. The critical conditions compared the ability of learners to reject distractors that were related to the translation in form or meaning when a long (750 ms) or short (300 ms) SOA separated the two words. For advanced learners, there were effects for semantic and form distractors in both measures at the long SOA, but at the short SOA, there were behavioral effects but only an N400 effect in the ERP record for semantic distractors. These results replicate Guo et al. (2012), suggesting that relatively proficient L2 speakers access the meaning of L2 words directly. For beginning learners, at the long SOA, there were semantic and form effects in both measures. At the short SOA, behavioral data were sensitive to distractor type, but the ERPs only revealed larger N400 and smaller LPC for translation distractors and no effect for semantic distractors. Overall, these data suggest that at early stages of L2 learning there is reliance on the L1 translation equivalent. Once proficient, they are able to retrieve the meanings of the words directly.

LANGUAGE: Other

G88

REPETITION SUPPRESSION IN THE LEFT INFERIOR FRONTAL GYRUS IS ASSOCIATED WITH NON-NATIVE SOUND LEARNING SUCCESS. Salomi S. Asaridou[1,2], Atsuko Takashima[2,3], Dan Dediu[1], Peter Hagoort[1,2], James M. McQueen[2,3]; [1]Max Planck Institute for Psycholinguistics, [2]Donders Institute for Brain, Cognition and Behaviour, [3]Behavioural Science Institute, Radboud University Nijmegen — Individuals differ greatly in their ability to learn non-native linguistic sounds. However, it is unknown whether this variation stems from individual differences in the acuity of the neural representations of non-native sounds. In this study, we used an fMRI adaptation paradigm to investigate this possibility. Assuming that the magnitude of repetition suppression to a repeated non-native sound will depend on the acuity of its representation, adaptation effects should differ between successful and less successful learners after training. We trained 40 Dutch native speakers in a non-native sound contrast (Mandarin tones) by means of a lexical task. Participants learned to match 24 auditory-presented words to pictures of items over the course of five training sessions. Participants' repetition suppression to Mandarin tones was measured before and after training completion using fMRI. All participants showed significant learning effects with training; however, there was substantial variation in their learning curves. Whole brain fMRI analyses revealed significant repetition suppression to tone in the inferior frontal gyrus (IFG) bilaterally. Furthermore, the size of the repetition suppression effect in the left IFG, before and after training, correlated significantly with learning attainment. Our results demonstrate that individuals who show larger repetition suppression to non-native sounds in the left IFG are also better at learning these sounds. This is true even before training initiation and argues in favor of pre-existing differences at the level of neural encoding of sounds. These findings offer further support for the important role of the left IFG in phonetic learning.

G89

DIFFERENTIAL DYNAMICS OF CORTICAL REORGANIZATION IN THE LANGUAGE NETWORK AFTER LEFT FRONTAL OR TEMPORAL STROKE - A LONGITUDINAL FMRI STUDY Anika Stockert[1], Kümmerer Dorothee[2], Wrede Katrin[1], Hartwigsen Gesa[3], Mader Irina[4], Weiller Cornelius[2], Saur Dorothee[1]; [1]Leipzig University Hospital, Germany, [2]Freiburg University Hospital, Germany, [3]Christian-Albrechts-University Kiel, Germany, [4]Bernstein Center Freiburg, Germany — Language recovery after stroke has been attributed to reorganization processes within a bilateral temporofrontal language network. Previous work in stroke patients with heterogeneous lesion sites demonstrated that functional magnetic resonance imaging (fMRI) blood-oxygenation-level depended (BOLD) response was diminished, increased and subsequently normalized from acute to chronic stages. Yet, it is unknown whether frontal and temporoparietal lesions contribute differently to the described dynamics. We compared fMRI BOLD response to speech (SP) and reversed speech (REV) using an auditory comprehension paradigm administered repeatedly (acute (t1) d" 1 week, subacute (t2) = 1-2 weeks, chronic phase (t3) > 6 months) to patients with stroke affecting left frontal (FC, N = 14) or temporoparietal cortex (TPC, N = 14). A mixed-design ANOVA revealed that BOLD response in left and right inferior frontal gyrus (IFG) and middle temporal gyrus (MTG) was modulated by the factors condition (SP/REV), time (t1-t3) and group (FC/TPC). Language specific response (SP>REV) in TPC patients conforms to the previously described pattern with overall downregulation in the language network (diaschisis , t1), early increase in bifrontal and perilesional tissue (t2) and normalization of right IFG response (t3). Conversely, in FC patients, right temporofrontal response was not modulated by time, however normalization of left MTG and perilesional response (t3) was observed during recovery. These patterns point towards differential involvement of right hemisphere homologues, ipsilesional IFG and MTG in the course of recovery depending on frontal or temporoparietal lesion sites.

G90

SONG FAMILIARITY IN LYRICS PROCESSING: AN ERP STUDY Pei-Ju Chien[1], Shiao-hui Chan[1]; [1]National Taiwan Normal University — This study explores whether song familiarity affects lyrics processing with the ERP technique. Nineteen right-handed Mandarin-speaking subjects first heard a Chinese pop song excerpt, containing 1-2 sentences and lasting 5-18 seconds, followed by a visual target word related or unrelated to the final word of the lyrics. ERPs were synchronized to the onset of the songs to examine the familiarity effect, and to the target word to test if the lyrics were processed semantically. Topographically, the subjects processed familiar and unfamiliar songs differently. A left lateralized negativity lasted throughout the epoch (-200-5000ms) for unfamiliar songs, while for familiar songs, similar pattern was observed first, but about 3 seconds, two negative components at the central electrodes and two positive components at the bilateral temporo-occipital sites appeared. As for the meaning of the lyrics, larger N400 was elicited by the unrelated targets, suggesting that the subjects processed lyrics semantically. Interestingly, the hemispheric distribution of N400 was different regarding song familiarity: N400 was stronger in the midline and the left hemisphere for familiar songs but stronger in the midline and the right hemisphere for unfamiliar songs. For this discrepancy, two processing strategies, prediction and integration (Federmeier et al., 2007), were considered. "Prediction" was in processing familiar lyrics possibly because the subjects had high word expectancy,

while "integration" in processing unfamiliar lyrics was possibly due to the low word expectancy and the obscure tonal feature of the Chinese lyrics in songs, which might force subjects to rely more on the context for word recognition.

G91

WHITE MATTER INTEGRITY PREDICTS ADULT SECOND LANGUAGE LEARNING OUTCOMES Michelle Han[1], Zhenghan Qi[1], Jack Murtagh[1], Keri Garel[1], Ee San Chen[1], John Gabrieli[1]; [1]Massachusetts Institute of Technology — While second language learning becomes increasingly difficult with age, some adult learners find more success than others in this elusive endeavor. In this study, we studied whether measures of white matter integrity in specific white matter pathways would predict Mandarin-learning outcomes in adults. 23 native English-speakers were scanned in an MRI scanner before participating in an intensive 4-week Mandarin course. During the scan, diffusion-weighted images (DWI) with 60 directions were acquired from which individual subjects' white matter tracts were reconstructed. At the end of the Mandarin course, participants' proficiency was assessed using a final exam with both written and oral components. The written component tested vocabulary, grammar, sentence comprehension, and discourse comprehension, while the oral component tested accuracy of pronunciation, vocabulary and grammar in speech production. The particular tract of interest here was the left arcuate fasciculus (AF), which is commonly characterized as an integral element of the dorsal language-processing stream. The average fractional anisotropy, a key measure of white matter integrity, of the left AF were significantly correlated with the participants' final oral exam score ($p=0.015$) as well as the participants' written exam score ($p=0.003$). That white matter structure is closely linked to real-life learning outcomes underscores the link between structure and function while also revealing aspects of adult second language learning mechanisms.

G92

INDIVIDUAL DIFFERENCES IN THE EFFECTS OF REFERENTIAL CONTEXT ON SYNTACTIC AMBIGUITY RESOLUTION Shruti Dave[1], Megan Boudewyn[1], Tamara Swaab[1]; [1]University of California, Davis — Individuals differ in the relative influence of global discourse context and local word meaning information on the processing of incoming words during spoken discourse comprehension (Boudewyn et al, 2013). In the present study, we examined whether individuals differ in sensitivity to referential discourse context during the processing of syntactic ambiguities, as a function of working memory span. Outside of context, syntactically ambiguous phrases such as "cut down the oak with the ___" are more readily attached to the preceding verb phrase (VP; chainsaw) than to a noun phrase (NP; mushroom). This finding has been explained by assuming that the most economic syntactic structure is always attached first, regardless of contextual information. However, previous research suggests that the syntactic processing costs associated with NP-attachment can be modulated by discourse context, such that NP-attachment is facilitated when prior context contains more than one plausible referent (e.g. two oaks). To investigate this, we recorded ERPs as participants listened to short stories in which referential context (one or two plausible referents) and sentence type (VP- or NP-attached) were manipulated. The results show that high-span participants selected a VP-attached parse when supported by referential context, but maintained activation of both syntactic structures when referential context supported NP-attachment. In contrast, low span participants showed evidence of parallel activation of both preferred and non-preferred syntactic structures, regardless of referential context. The results indicate that working memory span affects the relative influence of referential context and syntactic preference during syntactic ambiguity resolution.

G93

MODULATING INHIBITORY CONTROL IN IMMERSED LANGUAGE LEARNERS: AN ERP STUDY Daniel W. Bloodgood[1], Rhonda McClain[1], Eleonora Rossi[1], Judith F. Kroll[1]; [1]The Pennsylvania State University — Previous studies have shown that language learners have increased difficulty speaking their native language (L1) when immersed in their second language (L2) environment (Linck et al., 2009). This suggests that immersion is an effective language learning technique precisely because access to the L1 is gradually lost, at least temporarily. Inhibitory effects have also been seen more generally in picture naming studies in which participants had to switch between naming in L1 and L2 (Misra et al., 2012). Previous studies have been able to capture the neural signature of inhibition of the L1 due to immediate consequences of using two languages, but little is known about the neural signature of gradual loss of the L1 due to extended immersion in the L2. In the present study we use Event Related Potentials (ERPs) to examine the neural consequences of study abroad. Here we test the same picture naming paradigm in learners before, during, and after immersion and find that learners display this inhibitory effect in all phases of the study. We also confirm that increased L2 proficiency comes at the cost of reduced access to the native language. Critically, we find that these effects are modulated by the duration of the study abroad experience with the greatest cost to the native language occurring during the first few months of immersion. The implications of the modulation in language activity found in this study are considered for the way in which the neural networks for language processing are adjusted by context and experience.

G94

EFFECTS OF GESTURE RESTRICTION ON QUALITY OF NARRATIVE DISCOURSE Theodore Jenkins[1], Carl Coelho[1], Marie Coppola[1]; [1]University of Connecticut — This study examines the effects of the free use of hand gestures on the length, complexity, and organization of discourse. We manipulated participants' freedom to gesture in a narrative task in the following within-participant conditions: i. Restricted gesture (speaker's hands restrained, effectively stopping free gesture); ii. Unrestricted gesture (no mention of the hands). Ten participants (3 males) produced a narrative sample by verbally describing a picture book that contained no words. Each participant produced the narrative twice, once in each condition, and each time to an unfamiliar listener. Condition order was counterbalanced to control for potential order differences (e.g., gesture restriction first may produce different outcomes vs. no gesture restriction first). Discourse samples were coded for length (T-Units), organization (story grammar, or total number of complete events or episodes in the narrative), and syntactic complexity (total number of subordinate clauses). A significantly higher number of complete episodes were produced in the Unrestricted condition (Wilcoxon Signed-Rank Test, $p = .0117$). Additionally, participants consistently produced higher numbers of subordinate clauses in the Unrestricted condition and more incomplete episodes in the Restricted condition, while finding no differences in the narrative length. These same trends were preserved when condition order was considered. These patterns suggest that while gesture restriction does not dramatically affect narrative length or content, the ability to produce gesture promotes production of more complete episodes in a narrative sample and higher syntactic complexity. We conclude that the freedom to use gesture in discourse production may cognitively facilitate better discourse production.

G95

DISTINGUISHING GESTURE PROCESSING FROM SIGN LANGUAGE PROCESSING: THE CONTRIBUTIONS OF THE SUPERIOR TEMPORAL LOBE Shane Blau[1,2], Laurie Lawyer[2], Michelle Cohn[2], David Corina[1,2]; [1]Center for Mind and Brain, Davis, CA, [2]University of California, Davis — Goal: Studies of spoken language processing have observed differentiation of speech from non-speech sounds in the bilateral posterior superior temporal lobes. Here we examined whether similar temporal lobe regions were modulated by linguistic and non-linguistic gestures in deaf signers. Method: Subjects included 18 deaf signers (14 native) and 18 hearing non-signers, who during fMRI scanning (3T Trio Siemens, 3.63mm, TR 3000 ms.,TE 30 ms.) monitored video-clips of ASL signs and self-grooming gestures. For each exemplar, they indicated whether one or two hands were active during the gestures by means of a key press. This paradigm allows each group to attend and respond to all stimuli even though the hearing subjects were sign-naive. Results: Deaf subjects relative to hearing subjects showed activation in the left hemisphere STG for signs (MNI coordinates: -67, -36, 8), and bilateral STG for gestures (-53, -36, 8; 66, -40, 11) (each contrast relative to fixation). Closer examination of data from deaf subjects showed bilateral STG activation for sign language (-67, -36, 8; 59, -36, 0) with activations for gestures that lie nearly adjacent but typically more posterior (-56, -44, 4; 66, -44, 8) to sign language peaks (all p's $< .001$). These bilateral regions lay well within published regions of interest that differentiate speech from non-speech signals (e.g. -58 (+/-4.8), -33(+/-10.3),

-10(+/- 4.1) (Vouloumanos et al 2001, Narin et al 2003). Conclusion: These data provide evidence for a linguistic specification of the posterior superior temporal lobe that is agnostic to language modality.

LANGUAGE: Syntax

G96

PREDICTABILITY AND GAP-FILLER ORDERING IN DEPENDENCY FORMATION: AN MEG STUDY

Kimberly Leiken[1], Liina Pylkkänen[1,2,3]; [1]New York University, Department of Linguistics, [2]New York University, Department of Psychology, [3]New York University, NYU Abu Dhabi Institute — One of the most replicated findings in the cognitive neuroscience of syntax is increased activity in the left inferior frontal gyrus (LIFG) in response to object relative clauses (ORs, e.g. The fireman who the deputy called saved the sailor.) as compared to subject relatives. However, behavioral research has shown that ORs are only costly when involving stimulus material eliciting similarity-based interference (Lewis, 1996; Gordon, Hendrick, & Johnson, 2001; Gordon, Hendrick, & Levine, 2002; Lee et al., 2007, Van Dyke & McElree, 2006), and we recently showed that the LIFG increase is also dependent on such interference, i.e., no effects were obtained for the sheer presence of a dependency (Leiken & Pylkkänen, LCP, in press). In contrast with ORs, which always involve a cue indicating an upcoming dependency, the present study uses MEG to test dependencies that are not predictable, i.e. Verb Phrase Ellipsis (VPE, e.g. The husband hogged the blankets and Jane did too.) Additionally, we included a construction in which the so-called filler-gap order is reverse to that of ORs (e.g., The husband hogged the blankets that Jane grabbed __ afterward.) and VPEs, namely Right node raising (RNR, e.g. The husband hogged __ and Jane grabbed the pillows), to investigate whether potential dependency effects in the LIFG may be sensitive to filler-gap ordering. Our results show a sheer dependency effect (i.e., not dependent on similarity-based interference) for VPE and RNR, but not for ORs. Thus, our findings show that both predictability and filler-gap ordering matter for LIFG dependency effects.

G97

GRAMMAR TESTS FOR CLINICAL FUNCTIONAL MAGNETIC RESONANCE IMAGING IN PRE-SURGICAL CANDIDATES

Monika Polczynska[1,2], Mike Jones[1], Teena Moody[1], Susan Curtiss[1], Christopher Benjamin[1], Celia Vigil[1], Andrew Cho[1], Patricia Walshaw[1], Susan Bookheimer[1]; [1]UCLA, [2]Adam Mickiewicz University, Poznan — Evaluation of functional language areas with functional Magnetic Resonance Imaging (fMRI) is a reliable tool for pre-surgical planning in patients with brain tumors and medically refractory epilepsy (Kundu et al. 2013; Rosazza et al. 2013). Though clinical fMRI is used routinely, there is no standardized language mapping protocol. Most centers apply lexical-semantic tasks (Wang 2012), thus accounting for "meaning" but not "form" (grammar) of language. Grammar is a left-hemisphere lateralized language function that is one of the most complex components of cognition. Our goal was to add grammar items to a presurgical fMRI battery to increase the reliability of language mapping. Thirty-three individuals with epilepsy and 15 individuals with brain tumor participated in the study. Subjects performed a set of seven grammar items added to a standard presurgical fMRI battery (auditory naming, visual naming, word reading) administered at our center on a 3T Allegra scanner (epi bold: TE/TR = 35ms/2.5sec). Tasks included runs of syntactic and morphological stimuli subdivided into language comprehension and production items. Analysis of the fMRI data revealed activation in (1) classical language regions (Broca's and Wernicke's) seen on standard tasks and additional language sites known to support grammar, e.g., middle temporal gyrus; (2) significant right hemisphere activation in fronto-temporal areas in both patient groups; (3) more significant activation of functional language in grammar comprehension as compared with production tasks, suggesting that the former may be a more useful language mapping tool. To conclude, adding tasks testing grammar may help increase the precision of clinical language mapping.

G98

A ROLE FOR LEFT INFERIOR FRONTAL AND POSTERIOR SUPERIOR TEMPORAL CORTEX IN EXTRACTING A SYNTACTIC TREE FROM A SENTENCE

Chotiga Pattamadilok[1,2], Stanislas Dehaene[3,4], Christophe Pallier[3,5]; [1]Laboratoire Parole et Langage (LPL), CNRS: UMR 7309, Aix-Marseille Université, Aix-en-Provence, France, [2]Institut National de la Sante´ et de la Recherche Médicale, Institut du Cerveau et de la Moelle Epinière, UMRS 975, Paris, France, [3]Institut National de la Santé de la Recherche Médicale, U992, Cognitive Neuroimaging Unit, F-91191 Gif/Yvette, France, [4]Collège de France, F-75005 Paris, France, [5]Centre National de la Recherche Scientifique, F-75794 Paris, France — Upon hearing the sentence "Trees whose branches fall eventually die", how do we decide that it is the trees that die, and not the branches? The present behavioral and fMRI study explored the processes underlying the extraction of syntactically organized information from sentences. Participants were presented with sentences whose syntactic complexity was manipulated using either a center-embedded or an adjunct structure. The goal was to vary separately the hierarchical and the linear distance between the main verb and its subject. Each sentence was followed by a short subject + verb probe, and the participants had to check whether or not it matched a proposition expressed in the sentence. Behavioral and fMRI data showed a significant cost and enhanced activity within left inferior frontal and posterior superior temporal cortex whenever participants processed center-embedded sentences, which required extracting a non-trivial sub-tree formed by non-adjacent words. This syntactic complexity effect was not observed during online sentence processing but rather during the processing of the probe, and only when the verification could not rely upon a superficial lexical analysis. Moreover, the manipulation of linear distance affected performance and brain activity mainly when the sentences did not have a center embedded structure. Our findings suggest that tree extraction is a fundamental operation of a core syntax network that does not necessarily take place during sentence comprehension, but may be flexibly deployed later on, whenever we need to extract hierarchical information not obvious in the superficial sequence of words.

G99

REFERENTIAL AMBIGUITY AND REFERENTIAL FAILURE IN MANDARIN CHINESE - AN ERP STUDY

Chia-Ho Lai[1], Chia-Lin Lee[1]; [1]National Taiwan University — Unlike Indo-European languages, almost no morpho-syntactic markings for tense, case, and syntactic gender are used in Mandarin Chinese. Hence, whether and when maintaining referential coherence in Mandarin Chinese involves syntactic processing has been a matter of debate. The present study aimed to use event-related potentials (ERP) to examine a fundamental aspect of pronoun resolution in Mandarin Chinese by manipulating the number of possible antecedents. All experimental sentences contained two persons (denoted by proper names or nouns) and one third person singular pronoun ("TA", a homophone written differently for he/she/it). Stereotypical biological genders associated with the proper names and nouns were manipulated such that the pronoun has either (1) two possible antecedents and thus referentially ambiguous, (2) one possible antecedent and referentially unambiguous, or (3) zero possible antecedents and referentially failing. In view of the contextual influence on referential ambiguity resolution, degrees of contextual bias in ambiguous sentences were assessed with an offline referent selection task and divided into strong, moderate, and weak. Our results showed that, consistent with findings from Dutch (Nieuwland & Van Berkum, 2006), relative to unambiguous pronouns, ambiguous pronouns elicited a sustained anterior negativity (150-600ms). However, this ambiguity effect was not modulated by the degree of contextual bias, suggesting that the anterior negativity may reflect an all-or-none process. In addition, compared to unambiguous pronouns, referentially failing ones elicited a posterior P600 effect (500-700ms), suggesting the involvement of syntactic processing in pronoun resolution in Mandarin Chinese in this case.

G100

MUSIC AND LANGUAGE: FAMILIARITY EFFECTS ON (SHARED) PROCESSING

Nicole E. Calma[1], Laura Staum-Casasanto[2], Dan Finer[1], Robbin Miranda[3], Michael T. Ullman[4], John E. Drury[1]; [1]Stony Brook University, [2]University of Chicago, [3]Infinimetrics Corporation, [4]Georgetown University — Language and music plausibly involve distinct representational systems that

make use of shared syntactic/combinatorial mechanisms (Patel, 2003). This is consistent with subadditive anterior negativities in ERP studies when linguistic/musical syntax are simultaneously disrupted (Koelsch et al., 2005). However, open questions remain regarding other ERP responses, including P600 and N400 effects. Though similar P600-effects across domains have been found (Patel et al., 1998), such positivities have not previously been elicited in double language/music violation paradigms. Further, we are unaware of attempts to probe linguistic N400-effects and plausibly parallel responses in music. Miranda & Ullman (2007) report an N400-like effect for unexpected/violation notes in familiar/known (but not unfamiliar/novel) melodies (argued to reflect memory access/retrieval). Using the same stimuli, we presented participants with familiar/novel melodies with/without out-of-key notes, while presenting sentences visually/word-by-word. Sentences were either correct or semantically deviant (& the ball John will KICK/#BAKE&), with target words time-locked to critical musical notes. The linguistic violations elicited a biphasic N400/P600 pattern and a late anterior negativity. Out-of-key notes in both the familiar/novel melodies elicited anterior negativities and P600s but an N400-like effect was found only for the familiar melodies. Double violations yielded non-additive response patterns for the anterior negativities for both melody types. Strikingly, N400/P600 effects were both found to be sub-additive for the familiar melodies, while the same time-windows showed completely additive responses for the unfamiliar melodies. These data suggest that the two domains may (also) involve shared access/retrieval mechanisms, but that the P600-effects across domains otherwise correspond to distinct underlying neural generators.

LONG-TERM MEMORY: Episodic

G101

THE "TESTING EFFECT": RETRIEVAL RELATED FUNCTIONAL NEUROIMAGING DIFFERENCES AFTER A WEEK DELAY Eugenia Marin-Garcia[1,2,3], Aaron T. Mattfeld[1], Kathleen C. Candon[1], John D.E. Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Basque Center on Cognition, Brain and Language, [3]Ikerbasque — The "testing effect" is a robust memory phenomenon in which retrieval practice has a beneficial influence on behavioral performance compared to study alone. Understanding the neurobiology of the "testing effect" has important implications for educational practices. However, the neural basis related to better behavioral performance during the final test is unknown. In the present study participants were instructed to learn Swahili-English vocabulary word pairs. During the encoding phase, which occurred outside of the scanner, they were randomly assigned to one of two groups: "study/study" group, which only studied the word pairs and the "study/test" group, which had study/test runs with the word pairs. After a week delay, all participants returned for a final cued recall test in the scanner. The "study/test" group showed greater activation of the left putamen than the "study/study" group for correctly remembered words compared with words pairs that were forgotten. In contrast, activation throughout the prefrontal cortex and insula was greater for the "study/study" group when compared to the "study/test." These results may reflect the use of alternative strategies between the groups when participants are recalling cued words during the final test. The observed group differences suggest that testing during the learning phase recruits reward related brain regions that confer a lasting behavioral advantage during the final test, while traditional study alone recruits regions related to retrieval in the prefrontal cortex.

G102

NEURAL CORRELATES OF TEMPORAL CONTEXT RETRIEVAL Fang Wang[1], Rachel A. Diana[1]; [1]Virginia Tech — Temporal context memory is memory for the timing of events. People can make temporal judgments based on strategies such as assessing the relative familiarity of events or inferring temporal order from the semantic associations among events. The purpose of present study is to investigate the brain regions that support temporal context retrieval in the absence of such non-temporal strategies. We used three words familiar phrases (triplets) as stimuli. In study phase, three words were presented quickly one after another in either familiar or scrambled order. Participants were instructed to read aloud each word and try to remember the order of the words. Then they were tested on their memory for the order of the words in each triplet. We propose that memory for the scrambled triplets reflects primarily temporal retrieval for two reasons. First, participants were prevented from using semantic strategies during encoding. Second, the relative familiarity of the words in each triplet was similar and not diagnostic of the order of the words during encoding. Neuroimaging results indicate that temporal context retrieval, memory for the order of scrambled triplets, was associated with ventromedial prefrontal cortex and superior parietal cortex activation.

G103

RETROACTIVE MODULATION OF MEMORY BY REWARD Erin Kendall Braun[1], G. Elliott Wimmer[2], Anuya Patil[3], Blair Vail[1], Daphna Shohamy[1]; [1]Columbia University, [2]University Medical Center Hamburg-Eppendorf, [3]New York University — Memory is fundamental to adaptive behavior, because it allows past experience to guide future choices. Extensive research has demonstrated that reward feedback can retroactively reinforce preceding actions via dopaminergic projections to the striatum. Reward feedback may also retroactively modulate memory for preceding episodic experiences encoded by the hippocampus. While reward cues presented during or before encoding are related to enhanced episodic memory, much less is known about how reward modulates memory for prior experiences. To investigate this question, we developed a novel exploration paradigm. Participants navigated through a series of grid "mazes", one space at a time, to find a hidden "gold coin" worth a bonus $1. In each space, an incidental, trial-unique object picture was presented for 2s before participants moved forward. We manipulated the outcomes during exploration so that half of the mazes ended in reward. Afterwards, we administered a surprise memory test. To measure the effect of reward on memory over time, this test was administered either 15-minutes or 24-hours after encoding. Results show that immediately after encoding, participants exhibited enhanced memory for pictures from rewarded mazes; surprisingly, after consolidation, this main effect disappeared. Instead, after 24-hours we found a selective enhancement of memory for objects that were sequentially closer to the reward. Our results show that rewards retroactively enhance memory, but after consolidation this enhancement is selective for experiences proximal to the reward. Future research will explore how this retroactive reward modulation of memory facilitates the use of reward-related memory for subsequent decision making.

G104

TRANSFER OF "TESTING EFFECT": GENERALIZATION OF MEMORY BENEFITS DERIVED FROM TESTING PRACTICE TO STUDIED ONLY ITEMS Aaron T. Mattfeld[1], Eugenia Marin-Garcia[1,2,3], Kathleen C. Candon[1], John D.E. Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Basque Center on Cognition, Brain and Language, [3]Ikerbasque — We examined the transfer of the "testing-effect" - the memory benefit conferred by testing during encoding - to studied-only items using 3 different study-test schedules during training with Swahili-English vocabulary pairs. In the "between" experiment participants either only studied or studied and tested all pairs during training. In the "within mixed" experiment, training consisted of participants studying all pairs during study runs, and then intermixed within each study-test run, restudied half of the words while the other half were tested. Participants were never explicitly told which pairs would be only studied versus studied-tested. Training in the "within blocked" experiment consisted of participants studying half of the words during a block of study only runs and then studying and testing the other half of the words during a block of study/test runs. After a week, a final cued-recall test was administered. The magnitude of the "testing-effect" (difference in memory performance between study only and study/test pairs) was compared between the three experiments with a one-way ANOVA. We identified a significant main effect of experiment. Post hoc comparisons showed that the "testing-effect" in the within mixed experiment was smaller than in the other two and that this was due to an increase in the correct performance of the study items. These results suggest that having a context in which it is not clear which information is going to be tested during training generalizes the benefits of the "testing effect".

G105

ACTIVITY PATTERNS IN THE HIPPOCAMPUS MEDIATE PRIOR KNOWLEDGE INFLUENCES ON THE ENCODING OF NEW EVENTS

Oded Bein[1], Anat Maril[1]; [1]The Hebrew University of Jerusalem — Recent years have brought a surge of interest in the neuronal mechanisms underlying prior knowledge (schema) influences on the encoding of new events. Since prior knowledge effects inherently involve activation of existing representations, we sought to investigate how neural patterns of activation in the hippocampus mediate prior knowledge influences on the encoding of new events. Subjects were scanned while presented with target items (e.g., CHICKEN) encoded with a schema-related noun (e.g., 'egg'; schema condition) or with a schema-unrelated noun (e.g., 'earrings'; no-schema condition), and were later tested on their memory for these target items. A within-ROI between-conditions correlation analysis conducted in the hippocampus revealed a higher dissimilarity (lower correlation) between activation-patterns of later-remembered vs. later-forgotten items in the schema compared to the no-schema condition. Moreover, the degree of dissimilarity was positively correlated with memory performance in the schema condition only. We suggest that patterns' dissimilarity might reflect retrieval of existing knowledge (by reactivation of representational patterns) which supports later memory of schema items. Alternatively, schema items may be remembered by the allocation of a better-defined representational pattern in the hippocampus.

G106

ROLE OF THE VENTROMEDIAL PREFRONTAL CORTEX IN IMAGINING FUTURE AND FICTITIOUS EXPERIENCES

Elisa Ciaramelli[1], Elena Bertossi[1], Fabio Aleo[2]; [1]Dipartimento di Psicologia, Università di Bologna, Italy, [2]Centro studi e ricerche in Neuroscienze Cognitive, Cesena, Italy — The ventromedial prefrontal cortex (vmPFC) is part of a network supporting remembering the past and imagining the future (Buckner and Carroll, 2007). Consistently, patients with damage to the vmPFC (vmPFC patients) appear "stuck in the present moment", and may discount future rewards more steeply than healthy individuals (Sellitto et al., 2010). To date, however, it is unclear whether the vmPFC is crucially implicated in the imagination of future events. Here, vmPFC patients, control patients with lesions outside the vmPFC, and healthy controls imagined future as well as fictitious (atemporal) scenarios (Hassabis et al., 2007). A measure of the richness of imagined scenes was computed (Experiential Index) based on the assessment of patients' reports and qualitative ratings. The results show a reduced Experiential Index in vmPFC compared to the control groups in both future and fictitious scenarios. Interestingly, vmPFC patients rated their simulated experiences as less spatially coherent than did controls. These results indicate that the vmPFC is necessary for the simulation of new experiences, possibly by supporting the generation and maintenance of qualitative details in a coherent scene.

G107

A NAP RICH IN SLOW WAVE SLEEP SELECTIVELY PRESERVES EMOTIONAL SCENE COMPONENTS

Sara E. Alger[1], Alexis Chambers[1], Jessica D. Payne[1]; [1]University of Notre Dame — Sleep selectively preserves aspects of memory most valuable to remember, such as emotionally salient information, over less relevant details. The emotional tradeoff effect, in which memory for the emotional focus of a scene is preserved at the expense of surrounding neutral information, is amplified by a period of sleep. However, the ideal composition of sleep involved in increasing the magnitude of this tradeoff is unclear. Here, subjects viewed scenes containing an emotional or neutral foreground object placed on a neutral background. A baseline recognition test assessed immediate memory for half the encoded objects and backgrounds, presented separately, to ensure all groups encoded similarly. We then compared a period of wakefulness to a 90-min nap either early (11am) or late (3pm) in the day, with naps naturally differing in sleep stage composition. Retest on the remaining images occurred 7 hours after encoding. While both nap groups performed better than the Wake group, a greater tradeoff emerged in the Late-Nap group compared to the Wake group ($t_{26}=-2.47$, $p=.021$). The Late-Nap group also achieved significantly more slow wave sleep (SWS) than the Early-Nap group (minutes, $t_{28}=-3.02$, $p=.005$; percentage, $t_{28}=-3.40$, $p=.002$), while the Early-Nap group obtained a higher percentage of Stage 2 sleep ($t_{28}=2.59$, $p=.015$). Correspondingly, and in-line with behavioral findings, tradeoff scores correlated positively with SWS across both nap groups (minutes, $r=.38$, $p=.043$; percentage, $r=.44$, $p=.017$). Taken together, this provides strong evidence that, for daytime naps, a greater period of SWS-rich sleep is necessary for the selective preservation of emotionally salient information.

G108

ADOPTING LOCAL OR GLOBAL PROCESSING ORIENTATION PRIOR TO FACE RECOGNITION MODULATES EVENT-RELATED POTENTIAL (ERP) OLD/NEW EFFECTS

Susanna Bernstrup[1], Mikael Johansson[1]; [1]Lund University — Previous research has demonstrated that face recognition memory can be impaired after conducting perceptual tasks with a focus on details. Based on the principle of transfer-appropriate processing and the idea that faces typically are processed holistically, it has been argued that orientation towards local features diminishes the overlap between processes engaged at study and test, with worsened recognition memory as a result. The aim of the present experiment was to further elucidate how orientation affects face recognition memory, and to what extent global and local processing influence well-established ERP old/new effects. EEG was recorded while participants (N = 32) studied unfamiliar faces and conducted an ensuing recognition memory test. Orientation was manipulated between subjects, whereby participants preceding the test phase engaged in a task in which they processed either Local letters or Global letters of Navon figures. The two groups demonstrated qualitative differences in their pattern of behavioral and electrophysiological measures of memory, although old/new discrimination was unaffected by orientation. The Global group showed early mid-frontal and late parietal old/new effects, the putative indices of familiarity and recollection, respectively. An additional late and right-frontally distributed old/new effect was present, presumably reflecting post-retrieval monitoring. While the local group exhibited robust early mid-frontal and late parietal old/new effect, the late right frontal effect was absent. The local group also demonstrated a more liberal response criterion, suggesting that local processing affects memory control processes. The present results are discussed in light of face-related expertise effects on memory and the principle of transfer-appropriate processing.

G109

MEMORIES IN AND OUT OF CONTEXT: CONSEQUENCES OF CORTISOL

Vanessa A. van Ast[1,2], Sandra Cornelisse[3], Martijn Meeter[4], Marian Joëls[3], Merel Kindt[1]; [1]Radboud University Nijmegen, [2]University of Amsterdam, [3]Utrecht University, [4]VU University Amsterdam — Stress is known to exert considerable impact on learning and memory processes. Typically, stress effects are investigated for single items (e.g., pictures, words), but it remains unresolved how exactly stress may alter the storage of memories into their original encoding context (i.e., memory contextualization). This most likely involves effects of the stress hormone cortisol, acting via receptors located in the memory neurocircuitry. Cortisol via these receptors induces rapid non-genomic effects followed by slower genomic effects, which are thought to modulate cognitive function in opposite, complementary ways. In a first study we targeted these time-dependent effects of cortisol during memory encoding, and tested subsequent contextualization of emotional and neutral memories. Cortisol's rapid effects impaired emotional memory contextualization, while cortisol's slow effects enhanced it. In a second study we manipulated endogenous cortisol levels by means of a social stressor prior to encoding. Cortisol, but no other indices of stress, uniquely mediated the effects of stress on contextualization of neutral and negative memories. These results suggest that there is a specific role for cortisol in the way memories are integrated in their surrounding context. Since the inability to store fearful memories into their original encoding context is considered to be an important vulnerability factor for the development of anxiety disorders like posttraumatic stress disorder (PTSD), these results furthermore suggest that stress-induced cortisol responses and slow effects of cortisol serve a protective function against memory generalization, while high doses of cortisol may contribute to increased emotional memory generalization.

G110

REINSTATEMENT OF NEURAL PATTERNS DURING NARRATIVE FREE RECALL Janice Chen[1], Yuan Chang Leong[1], Uri Hasson[1]; [1]Princeton University — When we perceive the external world, we encode part of that experience into memory. During subsequent recall, some states of the brain supporting the initial perception of that experience are reinstated. Reinstatement can be measured by comparing the spatial patterns of neural activity during encoding against those observed during recall; this method can illuminate what networks in the brain are involved in representation of the encoded/recalled material. Previous studies have relied on simple stimuli and multiple encoding exposures to amplify effects. In this study, we present robust encoding-recall neural pattern similarity in a naturalistic task: watching a movie and freely recalling the plot. Twelve subjects watched a 50-minute movie (BBC's "Sherlock"), and then verbally recounted the movie, all while their brain activity was recorded using functional magnetic resonance imaging (fMRI). Recall sessions lasted 15 minutes on average. Neural data from the movie scans were divided into 50 segments, and data from the recall scans were divided into matching segments. Data were averaged across time within segments, and similarity between encoding/recall scene pairs was calculated (correlation across voxels). A searchlight analysis revealed a network of regions in which encoding/recall similarity was statistically significant, including retrosplenial, precuneus, lateral prefrontal, and lateral temporal cortices, and angular gyrus. This network corresponded closely to regions that were functionally correlated with retrosplenial cortex; the same network exhibited sensitivity to information over long timescales in previous studies. Our results suggest that these regions support representation of complex narrative information during encoding that is reinstated during verbal recall.

G111

NEURAL CORRELATES OF NARRATIVE REINSTATEMENT USING INTERLEAVED AUDITORY STORIES Michael Chow[1], Janice Chen[1], Christopher Honey[2], Uri Hasson[1]; [1]Princeton University, [2]University of Toronto — In everyday activities, we are often interrupted mid-task and must later return to the task. This ability to "pick up where you left off" requires a representation of the former state to be stored or maintained during the distraction, then reintroduced to active awareness when the task is resumed. We investigated how the brain supports the reintroduction of former states when processing complex natural stimuli. Thirty-six subjects listened to two auditory stories (30 minutes) while their brain activity was recorded using functional magnetic resonance imaging. Half of subjects heard the stories sequentially ("intact"); the other half switched between stories every minute ("interleaved"). Data from the "interleaved" condition were divided by story and concatenated, thus reconstructing the order of the "intact" stories. We focused on a network of brain regions known to be active during episodic retrieval: precuneus, retrosplenial, and medial prefrontal cortex, and angular gyrus. First, we observed that reconstructed timecourses in the "interleaved" condition were strongly correlated ($R > 0.5$) with timecourses from the "intact" condition. This suggests that the context of each story is rapidly reinstated when needed. Second, we observed a short-lived increase in response amplitude following the switches, which may be associated with retrieval of the relevant context. Finally, we observed that the multi-voxel pattern was similar within each story, but not across stories, suggesting that the stories were represented by two different sub-populations of neurons. Together, these results illuminate how the brain is capable of tracking and switching between multiple contexts.

G112

UNCERTAINTY INFLUENCES ITEM-LEVEL PERCEPTUAL PROCESSING FOR SCENES Matthew Gillespie[1], Dylan Nielson[1], Troy Smith[1], Emily Weichart[1], Per Sederberg[1]; [1]Ohio State University — Prior work has demonstrated that increasing the probability of a stimulus leads to decreased neural processing of that item when it is repeated, a phenomenon known as repetition attenuation (RA). Summerfield et al. (2008) demonstrated this in the fusiform face area (FFA) by presenting subjects with pairs of faces under two conditions of differing stimulus repetition probability (75% or 25%). However, it remains unclear whether decreased neural processing of items with a high probability of repetition is the result of item-specific predictions or a general reduction in uncertainty, as the findings with faces were not replicated with objects as the visual stimuli (Kovacs et al. 2013). The present event-related fMRI study sought to test the extent to which uncertainty alone could shape the perceptual processing of scenes. We varied (on a trial level) the pre-stimulus onset information such that subjects knew they were certain to see a novel item, certain to see a repeated item, or were uncertain whether the next presentation would be of a new or old item. Critically, we held constant the overall probability of item repetition, so each item was seen the same number of times. Our results show a significant increase in neural activity during processing of uncertain item repetitions in right hippocampus, bilateral cuneus, and bilateral anterior cingulate. These results lend support to the hypothesis that uncertainty plays a role in perceptual processing, even in the absence of item-specific predictions.

G113

THE RELATIONSHIP BETWEEN NEURAL AND EYE MOVEMENT REPETITION EFFECTS Rosanna Olsen[1], Bradley Buchsbaum[1,2], Douglas McQuiggan[1], Jennifer Ryan[1,2,3]; [1]Rotman Research Institute, Baycrest, [2]University of Toronto, Department of Psychology, [3]University of Toronto, Department of Psychiatry — It is well established that the fixation patterns elicited by repeated items is distinct from the viewing patterns to novel items. While this behavioral effect is thought to reflect experience-dependent memory processes, little is known about which brain regions support this type of learning. Furthermore, neuropsychological evidence is mixed as to whether the hippocampus is required for the manifestation of eye movement repetition effects for items. To address this question a concurrent functional magnetic resonance imaging and eye-tracking study of face repetition was conducted. Twenty participants were scanned while viewing faces and eye movements were simultaneously collected while the participants performed an age judgment on each face. A given face was presented one, two, three, or four times within a scan and a general linear model was used to model the brain response. Three parametric regressors were used as covariates of interest: 1) effect of repetition 2) response time and 3) number of fixations directed to the face. Areas within the medial temporal lobe (MTL; perirhinal cortex, amygdala, anterior hippocampus) and the fusiform gyrus demonstrated repetition suppression (a linear decrease with repetition) and these same regions also demonstrated a linear relationship with the number of fixations. The magnitude of the eye movement repetition effect was also significantly related to the amount of repetition suppression in the MTL across subjects. The regions that covaried with response time did not overlap with those elicited by the eye movement repetition effect, suggesting a dissociation between behavioral priming and the eye movement repetition effect.

G114

INTER-INDIVIDUAL DIFFERENCES IN SLEEP PARAMETERS AND EPISODIC MEMORY CONSOLIDATION DURING SLEEP Sandra Ackermann[1,2,3], Francina Hartmann[3], Andreas Papassotiropoulos[3,4], Dominique J.-F. de Quervain[3,4], Bjoern Rasch[1,5]; [1]University of Zurich, [2]Clinic of Affective Disorders and General Psychiatry, Psychiatric University Hospital Zurich, [3]University of Basel, [4]Psychiatric University Clinics, Basel, [5]University of Fribourg — Sleep and memory are stable and heritable traits that strongly differ between individuals. Sleep has been shown to benefit memory consolidation. While consolidation of declarative, hippocampus-dependent memories benefit from slow wave sleep, processing of emotional memory has been predominantly associated with REM sleep. Here we tested in a large sample of healthy young individuals whether inter-individual differences in sleep are predictive for individual differences in memory formation. The Memory task consisted of encoding and recalling emotional and neutral pictures. To test the sleep-dependency of the task, we conducted a pilot study in which subjects either slept between encoding and recall (n=28) or stayed awake (n=28). Subjects, who slept between encoding and recall showed better recall performance than subjects who stayed awake between encoding and recall. 929 subjects aged 18 to 35 years took part in the main study. Subjects encoded and recalled emotional and neutral pictures the evening before and the day after sleep was recorded at home using a portable EEG-recording device. Contrary to our expectations, we did not find any significant correlations between sleep and memory consolidation, except for a weak negative correlation between percentage of REM-sleep and overnight memory retention of pictures, independent of picture valence. Our results indicate that inter-individual differences in sleep are less predictive

for memory processes than previously assumed. Rather intra-individual than inter-individual differences seem to contribute to effects of sleep on memory consolidation.

G115

THE NEURAL REPRESENTATION OF LOCATION IN REMEMBERED EXPERIENCE Vishnu Sreekumar[1], Troy Smith[1], Simon Dennis[2], Dylan Nielson[1], Per Sederberg[1]; [1]Ohio State University, [2]University of Newcastle — In a series of studies, we track the neural correlates of remembered personal experience in an attempt to understand the representation of autobiographical memory in the brain. In the current study, we focus on the location in which events occur as a key element of experience. Five participants used android phones equipped with custom lifelogging software to collect data about their everyday events for a period of 4 weeks. The phone automatically captured images, obfuscated audio, GPS, orientation, accelerometry, gyroscopic and time information. Participants were brought into the lab 7-14 days after the data collection phase for a reminiscence task in an fMRI scanner. Each participant viewed his/her own images and mentally relived the corresponding events. In order to track the neural correlates of location, we employed representational similarity analysis (RSA) to identify the regions where the pattern of neural activity during retrieval was more similar for events that occurred in nearby locations (smaller distance between the corresponding GPS coordinates) than for events that occurred further apart. Patterns of neural activity correlate with location patterns in regions that are involved in manipulation of spatial attention (e.g. right superior parietal lobule), storage of spatial information (e.g. right middle frontal gyrus), representation of affect-laden autobiographical information (e.g. right middle temporal gyrus) and other language processing regions (e.g. left inferior frontal gyrus). Together these regions provide participants with a way to reconstruct the location and other related aspects of events in a narrative manner.

G116

INTERACTIONS BETWEEN MEDIAL TEMPORAL LOBE AND PREFRONTAL CORTEX USING A CONTEXT-DEPENDENT RELATIONAL LOAD TASK Justine E. Cohen[1,2], Robert S. Ross[3], Chantal E. Stern[1,2]; [1]Boston University, [2]Athinoula A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, [3]University of New Hampshire — We designed a context-dependent relational load task to explore medial temporal lobe (MTL) and prefrontal (PFC) contributions to context-dependent retrieval. In the task, picture frames were presented as a contextual cue (2 sec), followed by a face within the frame (2 sec), and then a scene (4 sec). In the low relational load (two context) condition, two of the frames were paired with two faces and two scenes and the correct response was dependent on which frame was presented. The high relational load (four context) condition was identical except that four frames were paired with four faces and four scenes. In the control condition, one frame and face were associated with one scene. One day after training, participants (N=19) were tested on the retrieval of the context-dependent associations during fMRI scanning. Results demonstrate significantly more activation in the hippocampus, caudate, and orbitofrontal cortex in both the 2 and 4 context conditions compared to the control condition. We used functional connectivity methods to further explore MTL-PFC interactions with seed regions in the hippocampal head, body, and tail and in the orbitofrontal cortex. The results indicate that PFC areas work in concert with MTL regions during context-dependent retrieval.

G117

ERP CORRELATES OF THE MAINTENANCE OF RECOLLECTED INFORMATION Leslie J Lewis[1], Kaia L Vilberg[1], Michael D Rugg[1]; [1]University of Texas at Dallas — Successful recollection is consistently associated with more positive-going ERP waveforms over left parietal scalp sites ("left parietal effect"). fMRI studies have reported a parallel effect: successful recollection is associated with enhanced activity in the left angular gyrus (LAG). In two recent fMRI studies, it was reported that LAG activity persists when recollected information is maintained across a delay period. Here, we investigated whether the left parietal ERP effect is similarly sustained over a delay interval following recollection. Participants (N=20) studied a series of word-picture pairs. In the subsequent test phase, both studied and unstudied words were presented under the requirement to judge whether the test item was old or new and, if old, to retrieve the associated study picture and maintain it across a variable delay interval (three or seven seconds after item onset). A cue at the end of the interval prompted one of three judgments to be made about the recollected image. Separate responses were made for words judged new or when item recognition was successful but recollection failed. ERPs elicited by recognized test items were contrasted over a 3 second epoch according to whether recollection was successful or unsuccessful. A recollection-sensitive left parietal effect was identified, and this effect was sustained across the epoch. Sustained recollection effects were also observed at frontal and central sites. The findings support the proposal that the left parietal ERP effect may be generated in the left angular gyrus, and provide further insight into the mechanisms underlying the maintenance of recollected information.

LONG-TERM MEMORY: Other

G118

THE NEURAL RESPONSE TO ISOLATED TONAL AND RHYTHMIC FEATURES FROM FAMILIAR SONGS WHEN RETRIEVAL FAILS Alexander Claxton[1], Anne Cleary[1], Carol Seger[1], Michael Thaut[1]; [1]Colorado State University — Research with visual feature-based cues has shown dissociable activation in the hippocampus and the perirhinal cortex depending on whether target retrieval in response to the cue succeeds or fails. Our study investigated the neural response to familiar auditory musical features (tone or rhythm) during retrieval failure. Participants heard brief piano clips of known songs at study. At test, they heard isolated tones and isolated rhythms, some from studied and some from unstudied song clips. Participants were asked to judge the familiarity of the song features as well as to identify the song. Our interest was in song retrieval failure. When song retrieval failed, the hippocampus showed no significant differences. However, the parahippocampal area showed greater activity for familiarized than unfamiliarized song features when retrieval failed ($p = .0013$). Additionally, areas of the left inferior frontal gyrus showed greater activation for familiarized than unfamiliarized song features during retrieval failure ($p = .0002$), as did the posterior superior temporal lobe ($p = .0002$). Finally, this comparison also revealed differential activation of areas of the basal ganglia ($p < .0001$). Overall the basal ganglia difference was carried largely by the isolated rhythm features, as when the data were separated according to feature-type, basal ganglia activation was greater for familiarized than for unfamiliarized isolated rhythms ($p = .0013$), but no differences were found for isolated tones. We also compared the study list to the isolated tones at test and found greater activation in the right hippocampus during study relative to test ($p = .0006$).

G119

IMPAIRED DETAILED AND PRESERVED SCHEMATIC REPRESENTATIONS IN REMOTE SPATIAL MEMORY Katherine A. Herdman[1], Asaf Gilboa[2,3], Morris Moscovitch[2,3], Gordon Winocur[2,3,4], R. Shayna Rosenbaum[1,2]; [1]York University, [2]Baycrest Hospital, [3]University of Toronto, [4]Trent University — It is commonly thought that spatial memory relies on the hippocampus (HC), a structure in the medial temporal lobe (MTL), but it is becoming clear that some aspects of spatial memory can be spared following HC damage. Findings in patients with extensive MTL damage indicate that the HC is not necessary for remote spatial memory of the gist or schematic aspects that are sufficient for navigating within environments learned long ago, though it may be necessary for representing spatial details contained within those same environments (Rosenbaum et al., 2000). We tested whether a similar pattern of intact schematic representations but impaired detailed representations would appear in patients with less extensive damage to the MTL or that is restricted to the fornix, a major output of the HC. Three patients with bilateral MTL damage, two patients with bilateral fornix lesions, and controls with experience navigating the same environments as the patients completed mental navigation tasks for multiple remote environments that assess identity and location of landmarks, distances and directions between them, and representations of routes. Patients' sketch maps and route descriptions that were lacking in detail suggest that the HC may be needed to represent details of environments, even following selective fornix damage, and might relate to the patients' episodic memory impairment. This contrasts with our findings of preserved schematic representations,

with some evidence of temporally graded impairment (worse performance on tests based on more recent vs. remote environments), consistent with patterns of remote semantic memory loss in the patients.

G120

AGE-RELATED DIFFERENCES IN OSCILLATORY NEURAL ACTIVITY IN VISUOSPATIAL MEMORY BINDING

Renante Rondina II[1,2], Rosanna Olsen[2], Lily Riggs[3], Jed Meltzer[1,2], Jennifer Ryan[1,2]; [1]University of Toronto, [2]Rotman Research Institute, [3]Hospital for Sick Children — This study examined differences in oscillatory neural activity between older and younger adults performing a visuospatial short-term relational memory task. We used magnetoencephalography (MEG) to quantify theta and alpha oscillations in the hippocampus and cortex in 12 younger and 12 older adults. On each trial, three objects were sequentially presented, and participants had to bind the spatial relations between objects to form a spatial configuration. After a two second delay, the objects were simultaneously re-presented and participants were asked whether the spatial configuration had changed. We used synthetic aperture magnetometry (SAM) to assess oscillatory neural activity in brain source space. Critically, there were no differences between groups in memory performance. However, preliminary analyses found that younger adults showed incremental theta power increases in the hippocampus during the encoding phase when they had to bind the spatial relations between objects, which correlated with task performance, whereas older adults showed incremental alpha power decreases in widespread cortical areas, particularly in the parietal lobe. This suggests that younger and older adults relied on different neural systems to perform the task, with young adults employing a hippocampal-dependent relational binding strategy, whereas older adults relied more on a parietal attentional mechanism. A comparison of prestimulus activity revealed greater baseline alpha power for older adults than younger adults, which may account for the larger modulation of alpha power induced by the task in older adults. These findings illuminate the role of hippocampal oscillatory activity in relational binding over short delays, and compensatory mechanisms in aging.

G121

FRONTO-TEMPORAL WHITE MATTER CONNECTIVITY PREDICTS LEARNING FROM REWARDS AND PUNISHMENTS

Kylie H. Hower[1], Tyler M. Rolheiser[2], Ingrid R. Olson[1]; [1]Temple University, [2]University of Alberta — Stimulus associations are frequently learned through the slow accrual of contingencies shaped by rewards and punishments. Successful performance on these tasks likely relies on mnemonic capabilities of the anterior and medial temporal lobes, as well as reward contingencies and valence information coded by the orbitofrontal cortex. These neural regions are structurally interconnected via an association fiber pathway called the uncinate fasciculus (UF). Here, we used diffusion tensor imaging (DTI) and behavioral paradigms to examine the relationship between behavioral performance on a name-face associative learning task and microstructural integrity of the UF. In addition, we examined indices linked to orbitofrontal cortex function: self-report measures of sensitivity to reward and punishment. In the associative learning task, participants (N=17, ages 18-27, M = 21.00, SD = 2.55) learned 30 name-face pairs over the course of 600 trials. During each trial, a face was presented along with two name options. Participants were trained to learn the correct name-face pairings as associative units based on the positive (correct) or negative (incorrect) feedback given after each trial. DTI data was collected on a 3T scanner (64 directions) and analyzed using FSL and TrackVis. Deterministic tractography was performed to compute the mean fractional anisotropy (FA) and mean diffusivity (MD) of bilateral UF. Regression analyses revealed a strong relationship between learning rate and microstructural properties of the UF, as well as a relationship with reward sensitivity. These findings suggest that the UF plays a role in encoding and updating feedback history with respect to learning associated reward contingencies.

G122

AUDITORY CLOSED-LOOP STIMULATION OF SLOW OSCILLATIONS TO ENHANCE MEMORY

Hong-Viet Ngo[1,2], Thomas Martinetz[2], Jan Born[1], Matthias Mölle[2]; [1]University of Tübingen, [2]University of Lübeck — The sleep slow oscillation is a distinct event in the human electroencephalogram with a characteristic peak frequency <1 Hz and amplitudes greater than 75 μV hallmarking slow-wave sleep. There is compelling evidence that these slow oscillations group thalamic-cortical spindle activity, the second unique feature found during sleep EEG, and hippocampal ripple activity and therefore plays a critical role in the interaction of the neocortex and subcortical structures involved in the consolidation of memory during sleep. Here we show in sleeping humans that brief auditory stimulation applied in synchrony with the endogenous slow oscillation rhythm with a closed-loop control approach reliably induces further slow oscillations and, consequently, the consolidation of declarative word pair memory. Furthermore, we will demonstrate that an auditory targeting an inducing of SO activity is in particular paralleled by a striking global response of spindle activity, which however also introduces a limitation to this stimulation approach. Nonetheless, closed-loop stimulation is a useful tool to investigate specific brain rhythms and their functional role.

G123

VERBAL CUEING OF ASSOCIATED EMOTIONAL MEMORIES DURING SLEEP

Mick Lehmann[1,2,3], Erich Seifritz[1,3], Björn Rasch[3,4]; [1]Psychiatric University Hospital Zurich, Switzerland, [2]University of Zurich, Switzerland, [3]Clinical Research Priority Program Sleep and Health, Switzerland, [4]University of Fribourg, Switzerland — Sleep is known to promote consolidation of memories, and the beneficial effect of sleep on memory relies on spontaneous reactivation of memories during sleep (Rasch & Born, 2013). Experimentally inducing memory reactivations during NonREM sleep by re-exposure to associated odors or sounds boosts sleep-dependent memory consolidation and improves later retrieval (Rasch et al., 2007; Diekelmann et al., 2011; Rudoy et al., 2009). In contrast for emotional fear memories, a recent study shows that odor-induced reactivation during NonREM sleep promotes fear extinction (Hauner et al., 2013), possibly suggesting a differential role of reactivation during sleep on the content of memories as compared to the memory-associated emotional arousal. Here we investigated whether reactivation of emotional memories during sleep affects memory content and emotional arousal differentially or not. Thirty participants learned associations between neutral spoken words with negative and neutral pictures. During the subsequent retention interval, half of the words were repeatedly replayed either during sleep or during wakefulness. Retrieval testing included tests for memory content (e.g. cued recall), associated emotional arousal (e.g. skin conductance response) as well as expectancy ratings (e.g. confidence whether a word was followed by a negative or neutral picture). Sleep was recorded using high density EEG (128 channels). Preliminary analysis showed that participants remembered more pictures after a retention interval followed by sleep as compared to wakefulness, which was more pronounced for cued word-pictures pairs.

G124

REPRESENTATION OF VISUAL INFORMATION FROM LONG-TERM MEMORY

Sue-Hyun Lee[1], Dwight Kravitz[1], Chris Baker[1]; [1]National Institute of Mental Health, National Institutes of Health — Long-term memory processes allow humans to store learned information, and recall that information later. Although prior studies have suggested that short-term (or working) memory retrieval generates object-specific representations in visual cortex, it remains unclear how specific the representations recalled from long-term memory are. To test whether the visual cortex as well as hippocampus represents object-specific activation during recall of information from long-term memory, we performed an event-related functional magnetic resonance imaging (fMRI) experiment, comprising separate perception, learning and recall sessions. During the perception session, participants were presented fixed pairings of 14 auditory psuedowords and object images (e.g. "tenire" - striped chair) inside scanner. During the learning session, on a separate day outside the scanner, participants were trained to memorize the pseudoword-object associations. Finally, one day after the learning, participants were scanned and instructed to recall each object image in response to the paired pseudoword. To test the veracity of the recalled visual information, participants were asked to draw detailed pictures of the object images after the retrieval scan session. We focused on two primary regions-of-interest: object-selective cortex and hippocampus. Both object-selective cortex and hippocampus were significantly activated during the recall of paired object images. Moreover, the response of both object-selective cortex and hippocampus areas could be used to decode the identity of individual remembered objects, and there was close correspondence between the representations during perception and retrieval in

object-selective cortex. These results suggest that recall of visual information from long-term memory activates a fine-grained representation in both hippocampal and cortical areas.

G125

INVESTIGATING INTERACTIONS BETWEEN WORKING MEMORY AND LONG-TERM MEMORY SYSTEMS USING THE HEBB REPETITION EFFECT

Kathryn Gigler[1], Paul Reber[1]; [1]Northwestern University — Long-term working memory (LTWM) reflects an interaction between working memory (WM) and long-term memory (LTM) systems in which effective WM capacity is expanded for experts due to knowledge representations in LTM. In the laboratory, this interaction can be studied with the Hebb repetition effect, where performance on a span-based WM task improves when a target sequence is presented repeatedly. Here the Hebb effect was examined using a visuospatial WM task in which cues were presented in four different spatial locations and participants attempted to reproduce presented sequences, with one target sequence presented repeatedly. Across three experiments, participants with explicit knowledge of the repeating sequence exhibited higher effective span for the repeated sequences. When the presented sequence started at the beginning of the sequence, the repetitions were obvious and the Hebb effect was obtained. When repetitions started from varying points within the sequence, only a subset of participants recognized the sequence. Participants who explicitly recognized the repeating sequence exhibited the Hebb WM expansion effect. Participants with higher WM capacity were more likely to recognize the sequence. Neuroimaging results highlight the interactions between LTM and WM systems. These results indicate the operation of a feedback loop whereby higher initial WM leads to increased knowledge in LTM, enhancing effective WM via LTWM, as seen with the Hebb effect. These results provide insight into why high WM capacity may lead to faster acquisition of expertise in complex domains.

G126

THE COGNITIVE AND NEURAL BASES OF FACE MEMORABILITY

Wilma A. Bainbridge[1], Aude Oliva[1]; [1]Massachusetts Institute of Technology — We encounter a constant stream of faces in our lives, and while we forever remember faces we have seen for only a minute, we also forget faces we see everyday. These faces differ in their memorability, a predictive value of whether a novel stimulus will be later remembered or forgotten. Memorability is often equated to the conceptual or perceptual atypicality of faces. We conducted a large-scale study to examine how an exhaustive set of 20 face attributes, including typicality, is predictive of memorability. Memorability scores (hit rate and false alarm rate from an online memory game) and attribute ratings were collected for 2,222 faces from a new publicly-available dataset (10k US Adult Faces Database). Using multiple linear regression models, we find that a subset of these attributes (e.g., irresponsible, kind) significantly predict memorability scores ($p < 10^{-115}$), that atypicality is not the sole predictor of memorability, and that there is still a large amount (54%) of unexplained yet consistent variance in memorability. In addition, we conducted an fMRI block-design study (N=14) using a perceptual paradigm and find several significant perceptual (e.g., occipital face area, parahippocampal place area) and memory regions (e.g., perirhinal cortex) in the brain with preferential activity for novel memorable versus forgettable images of faces and scenes, even with only single exposures. These results suggest that memorability can be used as a singular attribute to examine signatures of memory during the perception of an image.

G127

NEURAL REPRESENTATIONS UNDERLYING REAL-WORLD SPATIAL MEMORY RETRIEVAL

Lindsay K. Vass[1], Russell A. Epstein[1]; [1]University of Pennsylvania — When navigating within a real-world environment, one must often determine the direction to a distant goal based on one's current location and orientation. What are the neural representations that underlie this ability? We scanned university students with fMRI while they performed two versions of a judgment of relative direction task that required them to imagine themselves facing a particular direction at a particular campus location and then report whether a target building would be to their left or right. In version 1, the starting location and facing direction were indicated by word cues ("you are at X facing Y"). In version 2, the starting location and direction were indicated by a photograph depicting the view from X facing Y. The target was indicated verbally in both cases. We examined similarities between multivoxel patterns across the two versions of the experiment to test for representations of starting location, facing direction, and goal direction that were independent of stimulus modality. Preliminary results suggest that scene-selective retrosplenial complex (RSC) codes for both the facing direction and goal direction using an allocentric code that abstracts across different campus locations. In contrast, the parahippocampal place area (PPA) represents the individual views that can be observed from a given location. These results show that abstract directional information is represented in RSC when subjects retrieve information from spatial memory. Furthermore, these representations are elicited irrespective of whether the spatial memory system is driven by top-down imagery processes or bottom-up perceptual processes.

PERCEPTION & ACTION: Audition

G128

A MULTIGENERATIONAL STUDY: CLASSICAL CONDITIONING AND ASSOCIATIVE LEARNING WITH AUDITORY STIMULI AND 3RD INSTAR DROSOPHILA MELANOGASTER

Jessyka Venchkoski[1], Alexa Gammo[1], Adrianna Krul[1], Julian Keenan[1]; [1]Montclair State University — Previous research indicates that Drosophila melanogaster 3rd instar larvae have the capacity to learn association through classical conditioning with visual and olfactory cues. The current study was conducted to further extend the understanding of 3rd instar larvae associative learning with auditory cues. Preliminary findings suggest that the use of auditory stimuli with gustatory UCS (unconditioned stimuli) can result in successful associative learning. To determine potential genetic mechanisms, we conducted a generational experiment to test whether auditory associative learning capacities could spread to successive offspring. A 250 hertz tone was used as the conditioned stimulus, (CS). Fructose served as the gustatory UCS. Conditioning assays were performed in petri dishes on half agar-only, half agar and fructose. We ran 30 larvae through five, 3 minute conditioning trials where the UCS+ and CS were paired. Testing involved agar-only petri dishes in which only the tone was presented. One-third of the larvae that spent a significant amount of the three minutes on the positive zone (tone side) were separated and bred. Three separate assays were performed for the 33% of each of subsequent generations. The results are thus far mixed. It appears that conditioning occurs, and that under some conditions (eg, specific tones) conditioning can be achieved. However, the generational data demonstrate that while there are indicators of a genetic influence, more sensitive measures are required to determine any allele differences between those successfully conditioned and those that were not.

G129

EXPERT AND NON-EXPERT ATHLETES DIFFER IN PROCESSING OF AUDITORY STIMULI

Madeleine Warner[1], Victoria Wagner[1], Elizabeth Woods[1], Sian Beilock[2], Arturo Hernandez[1]; [1]University of Houston, [2]University of Chicago — Previous functional magnetic resonance imaging (fMRI) studies have shown that expertise in a sport can modulate neural responses (Beilock et al, 2008). However, these studies have only examined differences in the visual modality. The present study investigated the impact of athletic expertise on auditory processing. Participants were members of collegiate basketball and tennis teams (experts) and college-aged recreational players (non-experts). During the fMRI task, participants heard basketball and tennis sounds as well as environmental sounds. Following each sound, participants were asked to replay the sound or imagine doing the action associated with the sound. Significant differences were found between the two groups when imagining the actions associated with familiar sport sounds. Non-experts recruited a large region including the bilateral cerebellar vermis, thalamus, lingual gyrus and hippocampus. Non-experts showed greater activation for familiar environmental sounds recruiting regions including BA 3, superior parietal lobule and cingulate gyrus as well as a region in right inferior parietal lobule. Non-experts showed greater activation in right hippocampus when asked to use auditory imagery for unfamiliar environmental sounds. These results suggest that experts are more efficient at processing familiar sounds and better at tuning out irrelevant sounds. In the sports familiar tasks non-experts displayed greater activation in the primary visual cortex and bilateral hippocampus while experts displayed increased activation in regions associated with auditory

and motor planning. This suggests that non-experts may have used more visual imagery whereas experts may be better at linking the sound directly to the action.

G130

AUDITORY PROCESSES ON DIFFERENT TEMPORAL SCALES REVEALED BY PHASE AND POWER OF NEURAL OSCILLATIONS

Xiangbin Teng[1], David Poeppel[1]; [1]Department of Psychology, New York University — The auditory system operates on different timescales to extract acoustic information. The neural mechanisms underlying this multi-scale processing remain unclear. We investigated this question by using acoustic stimuli with temporal structures at three scales (~200, ~100 and ~30 ms). Participants were asked to identify different stimuli embedded in white noise at varying signal-to-noise ratios while undergoing magnetoencephalographic recording. MEG results showed that phase coherence across trials in the theta band (4 - 7 Hz) positively correlated with behavioral performance for the stimulus of timescale at ~ 200 ms but not for the stimuli of timescale 100 or 30 ms. Induced power in the gamma band (31 - 45 Hz) negatively correlated with behavioral performance for the stimulus of timescale at ~ 30 ms, but not for the stimuli of timescale 200 or 30 ms. For all stimuli, power in the alpha band (8 - 12 Hz) increased as behavioral performance decreased. The results suggest that the auditory system can employ a robust phase coding at the timescale of ~ 200 ms and power coding of ~ 30 ms, and that auditory processing generally correlates with desynchronization at the alpha band. The study sheds light on the mechanism of multi-scale processing in audition by determining distinct temporal processing regimes.

G131

CORTICAL CONTROL OF VOCAL PITCH FEEDBACK

H. Charles Li[1], Psyche Loui[2], Gus F. Halwani[1], Frank H. Guenther[3], Gottfried Schlaug[1]; [1]Beth Israel Deaconess Medical School / Harvard Medical School, [2]Wesleyan University, [3]Boston University — Speaking and singing require rapid and automatic coupling between feedforward and feedback processes of the auditory-motor system, but how the neural sensitivity to auditory feedback facilitates pitch production remains unclear. Here we investigated neural sensitivity to pitch-shifted auditory feedback in a combined behavioral and functional MRI study using 19 non-musicians. During the fMRI task, auditory feedback was randomly perturbed by shifting the participants' fundamental frequency (F0) 1 and 2 semitones (ST) in either direction across trials during a sparse-temporal sampled fMRI study. Behavioral recordings of vocal pitch production showed that participants compensated for the ±1ST perturbations by varying their F0 production in the direction opposite to the experimental manipulation, and appeared to follow the ±2ST perturbations (i.e., they varied their production in the same direction as the perturbation). Functional MRI for all production compared to no production conditions showed a vocal-motor network including feedback and feedforward sensorimotor integration and control regions, while the 1ST vs. non-perturbed contrast revealed a network that included left superior temporal sulcus (STS), planum temporale (PT), premotor cortex (PMC), ventral motor cortex (vMC), supplementary motor area (SMA), and right Heschl's gyrus (HG). The 2ST vs. non-perturbed contrast, however, only showed activation in the SMA. This network of auditory, motor, and auditory-motor mapping regions seems to play a critical role in auditory feedback control. The integration of sensory and motor information in the posterior ventral premotor cortex establishes it as one of the critical control regions of this network.

G132

COVERT VOICES AFFECT HOW LOUD YOU HEAR OVERT SOUNDS

Xing Tian[1], Xiangbin Teng[1], Nai Ding[1], David Poeppel[1]; [1]New York University — How do thoughts affect perception? We investigate the interaction between mental representation and perception in the auditory domain. In a behavioral and a Magnetoencephalography (MEG) experiment, participants were asked to imagine speaking the syllable /da/ loudly (loud condition) or softly (soft condition) before they heard the playback of their own voice of the same syllable. Behavioral results showed that the loudness rating of the playback was smaller in the loud condition than that in soft condition. MEG results demonstrated that the magnitude of neural responses to the overt auditory stimuli was smaller in the loud condition compared to those elicited in the soft condition. These consistent behavioral and electrophysiological results suggest that the top-down induced neural representation converges to the same representational format as the neural representation established during perception, even for basic sensory features such as loudness. Such a coordinate transformation in a top-down process forms the neurocomputational foundation that enables the interaction with a bottom-up process.

G133

MAPPING THE AUDITORY SENSORY MEMORY WITH FUNCTIONAL MAGNETIC RESONANCE IMAGING

Raffaele Cacciaglia[1,2], Sabine Grimm[1,2], Jordi Costa-Faidella[1,2], Katarzyna Zarnowiec[1,2], Carles Escera[1,2]; [1]Institute for Brain, Cognition and Behavior (IR3C), University of Barcelona, Barcelona, Catalonia-Spain., [2]Cognitive Neuroscience Research Group, University of Barcelona, Barcelona, Catalonia-Spain. — Auditory deviance detection has been related to the mismatch negativity (MMN), a component of the human event-related potentials (ERPs) peaking when an infrequent sound, referred as deviant (DEV), is embedded within repeatedly presented sounds, referred as standards (STD). MMN represents an indirect marker of auditory sensory memory, as its amplitude positively relates to the number of sounds that precede DEV stimuli. A putative direct signature of auditory sensory memory is the repetition positivity (RP), a positive wave of the human ERPs spanning between 50-200-ms, whose amplitude increases along with stimulus repetition. The goal of this study was to characterize the functional neuroanatomy of stimulus repetition effects in the auditory system, in order to uncover the neural correlates of the echoic memory trace formation. Fifteen participants underwent functional magnetic resonance imaging while presented with a roving standard paradigm. Stimuli were 100-ms pure tones delivered at 500-ms presentation rate, and were arranged in trains of different frequency and length. When contrasting DEV>STD trials, we found robust activation in the superior temporal gyrus and Heschl's gyrus. Activity in these two regions was modulated by DEV probability, being stronger for DEV stimuli preceded by a higher number of STDs. Further, low probable DEV sounds engaged a more distributed network, including subcortical stages of processing, such as the medial geniculate body and the inferior colliculus. Our results provide a hemodynamic correlate of the human auditory sensory memory and match emerging views of auditory deviance detection accounting for hierarchical predictive coding during perceptual learning.

G134

USING MUSIC TO INVESTIGATE THE NATURE OF NEURAL OSCILLATIONS IN AUDITORY CORTEX

Keith Doelling[1], David Poeppel[1,2]; [1]New York University, [2]NYU Abu Dhabi — The presence and role of neural oscillations in auditory cortex in the context of auditory perception has elicited controversy. A growing body of data supports the hypothesis that delta-theta oscillations track the envelope of an auditory input in order to parse the stimulus. An alternative hypothesis suggests oscillatory activity merely reflects onset responses to quasi-rhythmic stimuli. One prediction stemming only from the oscillatory model of tracking is the presence of a lower limit to the frequency range at which this oscillatory tracking mechanism breaks down. Here we test - using MEG - the ability of delta and theta oscillations to track stimuli whose envelopes maintained modal frequencies at ~8, ~5 and ~0.5 Hz using ecologically valid stimuli - classical music with carefully selected properties. Inter-trial coherence (ITC) analysis shows phase consistency for each clip in the fast- and mid-tempo pieces at their respective modulation rates (8 Hz, 5 Hz). For the slow piece, ITC is considerably lower at 0.5 Hz, the modal modulation rate of this condition. The experiment was repeated with stimuli at modulation rates of 1.5, 1 and .7 Hz. While ITC again showed phase consistency at 1.5 and 1 Hz, no such consistency was found at .7 Hz. The data thus suggest a boundary near 1 Hz. We hypothesize that the system compensates for slow inputs by tracking the envelope using oscillations at harmonic frequencies within the possible range of the system. Thus, the findings support an active role of delta-theta oscillations in auditory perception.

G135

BRAIN-NETWORK RECONFIGURATION AND PERCEPTUAL DECOUPLING DURING TRANCE

Michael J Hove[1,2], Johannes Stelzer[1], Till Nierhaus[1], Sabrina Thiel[1], Christopher Gundlach[1], Daniel S Margulies[1], Koene RA Van Dijk[2], Robert Turner[1], Peter E Keller[3,1], Bjorn Merker[4]; [1]Max Planck Insti-

tute for Human Cognitive and Brain Sciences, Leipzig, [2]Harvard Medical School, [3]University of Western Sydney, [4]Kristianstad, Sweden — Trance is a state of consciousness characterized by narrowed awareness of external surroundings and long used by shamans to gain valued insight. Shamans often induce trance by listening to rhythmic drumming. However, little is known about the underlying brain mechanisms. Using fMRI, we examined the brain networks associated with trance. Experienced shamanic practitioners (n=15; average shamanic experience = 9.3 years) listened to rhythmic drumming with their eyes closed, and either entered a trance state or remained in a non-trance state, during 8-minute runs. We analyzed network functional connectivity using a data-driven approach called eigenvector centrality mapping, and a seed-based approach with seeds placed in the default network and the auditory pathway. Participants reported a robust trance state in the scanner. fMRI results revealed that trance was associated with higher Eigenvector Centrality (i.e., stronger hubs) in three distinct regions: posterior cingulate cortex (PCC), anterior cingulate cortex (ACC), and left insula/operculum. Seed-based analysis revealed co-activation of the PCC seed (a key "default" network hub involved in internally-oriented states) and ACC and insula (key regions of the "salience" network important for selecting and amplifying relevant neural streams). Thus an internally-oriented neural stream could be amplified by the salience network. Additionally, during trance, seeds in the auditory brainstem and auditory cortex were less connected, suggesting perceptual decoupling and suppression of the monotonous auditory stimuli. In sum, trance involved co-active default and salience networks, and dampened sensory processing, perhaps allowing an extended internal train of thought wherein integration and moments of insight can occur.

THINKING: Decision making

G136

PARSING SELF-CONTROL IN INCARCERATED CRIMINALS: SELECTIVE MAPPING OF PSYCHOPATHY AND EXTERNALIZING TO FUNCTIONAL CIRCUITS FOR RESPONSE INHIBITION AND INTERFERENCE SUPPRESSION

Alexandra Rodman[1], Erik Kastman[1], Hayley Dorfman[1], Arielle Baskin-Sommers[2,3], Kent Kiehl[4,5], Joseph Newman[3], Joshua Buckholtz[1,6]; [1]Harvard University, [2]McLean Hospital, [3]University of Wisconsin-Madison, [4]University of New Mexico, [5]Mind Research Network, [6]Massachusetts General Hospital — Econometric estimates indicate that crime costs this country over $2 trillion per year, underscoring the need to understand individual variability in risk for criminal behavior. Externalizing (e.g., disinhibition, aggression) and psychopathy (e.g., instrumental antisocial behavior, callousness) are vastly over-represented in criminal offenders, yet their causal neurobiology remain unknown. Despite a final common behavioral endpoint (i.e. crime), recent work suggests that distinct cognitive deficits predispose poor self-control in externalizing and psychopathy. While externalizing has been linked to weak executive control, psychopaths actually exhibit enhanced selective attention in many contexts. To uncover selective mappings between circuit function, cognitive process, and antisocial behavior, we studied 49 male inmates at two medium-security prisons using a mobile 1.5 Tesla MRI scanner. During fMRI, participants performed a modified Eriksen flanker go/no-go task. In order to estimate brain activity related to interference suppression and response inhibition, we subtracted signal in "incongruent" trials from "congruent" trials and "no go" trials from that in "congruent" trials, respectively. Externalizing, but not psychopathy, was associated with reduced dorsolateral prefrontal cortex activity during response inhibition. By contrast, while psychopaths had enhanced activity in anterior medial prefrontal cortex during interference suppression, externalizing was unrelated. These selective associations persisted even after controlling for shared variance between these traits. In sum, we used functional imaging in incarcerated offenders to demonstrate a double dissociation between externalizing and psychopathy. The current data validate clinical and forensic distinctions between externalizing and psychopathy, and provide insight into the specific cognitive mechanisms predisposing poor self-control and antisocial behavior in each.

G137

ADVANTAGEOUS DECISION MAKING LINKED WITH INCREASED GRAY MATTER IN THE VENTROMEDIAL PREFRONTAL CORTEX

Shreya Divatia[1], Mareen Weber[1], Lauren A. Demers[1], Lily Preer[1], William Killgore[1]; [1]McLean Hospital, Harvard Medical School — The Iowa Gambling Task (IGT) is a decision making task that involves adaptive and implicit learning. Advantageous performance requires individuals to determine which decks will allow them to avoid losses and maximize potential long-term reward. Behavioral and neuroimaging studies have shown that individuals with lesions to the ventromedial prefrontal cortex (VMPFC) often are impaired in these capacities and show lower scores on personality traits of conscientiousness and higher impulsiveness. However, little is known about the association between gray matter volume of the VMPFC and IGT performance in healthy individuals. Fifty-three healthy right-handed adults (26 males) between the ages of 18 and 45 (M=30.8, SD=8.0) completed structural neuroimaging at 3T, the IGT, and the NEO PI-R (NEO), a multidimensional measure of personality. A voxel-based morphometric multiple regression analysis was conducted in VBM8 to explore the gray matter correlates of IGT hunch performance. Age and gender were used as covariates. As hypothesized, the ability to implicitly learn which decks were advantageous more quickly was positively correlated with increased gray matter volume in the VMPFC (57 voxels, p=.03, FWE corrected). Furthermore, IGT performance was correlated with personality variables on the NEO PI-R, including lower scores on Conscientiousness (p=.022) and higher Openness to experience (p=.002). These results suggest that decision-making ability, particularly the capacity to forgo short-term gains in the service of long-term goals, was associated with greater gray matter volume in the VMPFC and a personality style of greater openness to experience.

G138

IMPACT OF EMOTIONAL CONTEXT CONGRUENCY ON DECISION MAKING UNDER AMBIGUITY

Ania Aite[1], Grégoire Borst[1], Sylvain Moutier[1], Isabelle Varescon[2], Ingi Brown[3], Olivier Houdé[1], Mathieu Cassotti[1]; [1]CNRS Unit 3521, Laboratory for the Psychology of Child Development and Education, Paris Descartes University and Caen University, France, [2]Laboratoire de Psychopathologie et Processus de Santé, Paris Descartes University, [3]Centre de Gestion Scientifique, Mines ParisTech — Thanks to the study of emotional processes, the decision making field has known substantial advances the past two decades. Especially researches on decision abilities under ambiguity using the Iowa Gambling Task (IGT), an ecological task presumed to mimic daily-life decisions, led to posit the somatic marker hypothesis (SMH). According to this theory, the development of an integral emotional signal, in response to positive and negative feedbacks, lead participants towards advantageous choices in ambiguous situations. To determine whether the ability to choose advantageously in ambiguous situations is driven by an emotional signal, we manipulated the emotional context associated with feedbacks in the IGT. In this modified version of the IGT, a picture of either a happy face or a fearful face was presented after each feedback resulting in either a congruent or an incongruent emotional context with the feedback delivered. Critically, emotional context congruency affected participants' choices on the IGT: the congruent emotional context with the feedback (i.e., happy faces after rewards and fearful ones after punishments) improved participants' performances (i.e., happy faces after rewards and fearful ones after punishments), whereas the incongruent emotional context with the feedback (i.e., fearful faces after rewards and happy faces after punishments) impaired participants' performances. In line with the SMH, we provide additional evidence that decision making under ambiguity is driven by an integral emotional signal. Thus, decision making under ambiguity could be improved in patients with ventromedial prefrontal cortex lesions by reinforcing somatic markers by the presentation of a congruent emotional context with feedbacks.

G139

SENSORIMOTOR DYNAMICS OF FOOD CHOICES REVEALED BY REACHING

Kassandra Kelly[1], Jeff Moher[1], Alison Harris[2], Joo-Hyun Song[1]; [1]Brown University, [2]Claremont McKenna College — Despite a growing consensus on the neural representation of value, the relationship between sensorimotor action plans and preference-based decision-making remains unclear. Because most studies utilize discrete methods of response collection

(e.g., keypress), little is known about the evolution of the decision process over time. Here we examined the sensorimotor correlates of the decision process using continuous reaching dynamics. In Experiment 1, participants were presented with two images of appetitive foods side-by-side, and asked to reach to the image that they preferred. As the difference in taste ratings (measured via Likert scale) between the two foods decreased, reach movements were initiated more slowly and showed greater curvature in their trajectory, reflecting greater attraction towards the competing item. In Experiment 2, we further investigated the effects of competition between action plans on preferential choice. Participants first performed a forced-choice task, in which they were repeatedly cued to reach towards items taken from a previously rated set of neutral-valence foods. On a subsequent free-choice preference task, we demonstrated that when previously cued foods were present, participants' reaching trajectories displayed decreased curvature when selecting those foods and increased curvature when selecting alternative foods of the same valence. This pattern was not seen for uncued foods. Thus, cued foods were not only subject to less interference from alternative items, but also produced stronger competition even when unselected. Together, these results shed light on the connection between action and decision-making, and highlight the utility of reaching data in the study of the evolution of choice.

G140

WHEN YOUR HONESTY FAILS TO BE MY BEST POLICY: TEASING APART PROPENSITY TO LIE UNDER VARYING INCENTIVE STRUCTURES

Neil Garrett[1], Stephanie Lazzaro[1], Dan Ariely[2], Tali Sharot[1]; [1]University College London, [2]Duke University — Objective: In this study we examine how lying changes when incentives to self and others are manipulated and the neural computations that underlie this behaviour. Methods: While in the MRI scanner, subjects viewed images of jars filled with one penny coins and were tasked with advising another participant on how much money was in the jar. Unbeknownst to the other participant, the subject in the scanner learns that the payoff structure of the task changes in some blocks. Our task enables us to manipulate the incentives to examine how the propensity to lie changes when lying benefits neither party, both parties, or one party at the expense of the other. Results and Conclusions: Surprisingly, subjects did not simply maximize their own monetary rewards. Rather, they adopt a policy that also incorporates a cost for lying and a cost for anti-social behaviour. Specifically, when lying benefits only themselves and reduces the other's earnings they forgo potential earnings and lie less than when lying benefits both. However, they do not lie to increase the other participant's earnings if there is any monetary cost to themselves. The results suggest that the act of lying in and of itself is computed as a cost and that subjects engage in a cost-benefit analysis that takes into account (1) monetary rewards (2) pro-social behaviour and (3) social norms. fMRI results illuminate the underlying neural mechanisms involved in these computations, revealing both commonalities and differences in how these elements are tracked in the brain.

G141

REINFORCEMENT LEARNING IN INDIVIDUALS AT RISK FOR ALZHEIMER'S DISEASE

Christina M. Figueroa[1], Kathleen E. Hazlett[1], Riley Marinelli[1], Kristy A. Nielson[1,2]; [1]Marquette University, [2]Medical College of Wisconsin — Explicit memory (EM) is the hallmark of impairment in Alzheimer's disease (AD) while implicit memory (IM) has mixed task-dependent results. Models of memory processes have posited that hippocampal function is sensitive to reinforcement learning (RL). The hippocampus has also been found to be vital for the transfer of learned associations to novel situations. RL paradigms have been underutilized in assessing memory processes in individuals at risk for AD, which may aid in early identification of cognitive decline. Thirty-six apolipoprotein-E (APOE Îµ4) genotyped older adults (Male n=8; Mage=80; Meducation=15 years) performed word stem completion, word recognition, and RL tasks. The RL task was comprised of an RL phase, an implicit testing phase, and explicit recognition component. Group comparisons were made based on low risk (APOE Îµ4-; n=16) vs. high risk (APOE Îµ4+; n=20) for AD. A series of mixed ANOVAs based on task performance indicated that risk groups did not differ on RL or EM measures (word and RL recognition tasks). However, high risk participants exhibited significantly poorer IM performance (RL testing and word stem) than the low risk group, p = .03. The pattern of results in the present study was counter to prediction in that risk groups did not differ on EM measures, which was strongly supported by existing literature. However, the performance of poorer IM exhibited by the high risk group is consistent with results implicating the hippocampus in the application learned associations to novel environments. RL paradigms may offer high sensitivity for assessing preclinical decline.

G142

BIASED INPUT REGULATION OF STRIATAL REACTIVITY COMPRISES A CIRCUIT-LEVEL MECHANISM FOR HUMAN SELF-CONTROL.

Joshua Buckholtz[1,2,3], Erik Kastman[1], Hayley Dorfman[1]; [1]Department of Psychology, Harvard University, [2]Center for Brain Science, Harvard University, [3]Department of Psychiatry, Massachusetts General Hospital — Deficient self-control contributes to dysfunction and impairment across a wide range of psychiatric disorders and is notoriously difficult to treat, in part because we know little about the neurobiology of impulsive decision-making. Preclinical findings suggest that a circuit comprising midbrain DA nuclei, striatum, and lateral prefrontal cortex (LPFC) is crucial for regulating phasic DA transmission and adaptive choice behavior. We hypothesize that ascending (midbrain) and descending (LPFC) striatal inputs play opposing roles in regulating VS phasic DA response to reward cues during choice behavior. Specifically, we predict that relatively greater ascending control leads to larger phasic reward responses and more impulsive choices, while greater descending control results in weaker phasic responses and more adaptive decisions. To test this hypothesis, we measured striatal connectivity with LPFC and midbrain at rest and phasic striatal activity in two independent samples. Individual "input bias" scores were created by comparing participants' corticostriatal and mesostriatal connectivity coefficients (Higher = > LPFC input strength). We found that mesocorticostriatal "input bias" predicted subjective value-related striatal BOLD signal during an inter-temporal choice task (sample 1; 49 incarcerated criminal offenders) and reward feedback-related striatal BOLD during a gambling paradigm (sample 2; 68 healthy adults from the Human Connectome Project Q1 release). Specifically, ascending input bias (i.e. greater connectivity between midbrain and striatum than between LPFC and striatum) was linked to higher magnitude striatal BOLD responses in both tasks. These data indicate that individual variability in mesocorticolimbic circuit connectivity predisposes variability in self-control by modulating phasic reward responses in striatum.

G143

AN FMRI STUDY ON CHANGING PRICE RELATIONS EFFECTS

Fabian Simmank[1], Kai Fehse[1]; [1]LMU Munich — While gain and loss, brand preference, and price premium have effects on buying decisions, we were interested in changing price relations in products presented at the same time depending on whether a reference article is cheaper, intermediate, or more expensive than two other articles, or suspiciously cheap. Several sets of articles where presented with a reference article in the middle and two similar articles left and right. Those articles were associated with different, changing price relations. Subjects had to answer whether they would buy the reference article or not. Whole brain analysis revealed clusters in right superior and inferior parietal lobules covering horizontal intraparietal sulcus. A region-of-interest analysis revealed a linear progression in parietal lobules activation from cheaper reference to intermediate to more expensive, activation also increased when becoming too cheap. Dorsolateral prefrontal deactivation was found to behave analogous to this trend. Results suggest that different price relations are perceived quickly and the relation is reflected in areas found to be involved in number and quantity processing according to potential benefits. Suspicious relations ("too cheap") have an effect contradictory to a positive bargain buy. Revealing a deactivation in dorsolateral prefrontal cortex for the most convenient price relation, results show that there is a position of the most effortless buying experience in the price continuum. Representations of social status hierarchy and numbers share certain key properties. Thus, apart from mere numbers, effects of social status might also be implicated considering bandwagon, snob, or Veblen effect.

THINKING: Development & aging

G144

UNUSUAL DEVELOPMENTAL PATTERN OF BRAIN LATERALIZATION IN YOUNG BOYS WITH AUTISM SPECTRUM DISORDER: A CUSTOMIZED CHILD-SIZED MEG STUDY Hirotoshi Hiraishi[1], Mitsuru Kikuchi[1,2], Yuko Yoshimura[1], Sachiko Kitagawa[1], Chiaki Hasegawa[1], Toshio Munesue[1,2], Hideo Nakatani[2], Gerard B. Remijn[3], Tsunehisa Tsubokawa[4], Michio Suzuki[5], Haruhiro Higashida[1], Yoshio Minabe[1,2]; [1]Research Center for Child Mental Development, Kanazawa University, Kanazawa, Japan, [2]Department of Psychiatry and Neurobiology, Graduate School of Medical Science, Kanazawa University, Kanazawa, Japan, [3]International Education Center, Kyushu University, Fukuoka, Japan, [4]Department of Anesthesiology, Graduate School of Medical Science, Kanazawa University, Kanazawa, Japan, [5]Department of Neuropsychiatry, University of Toyama, Toyama, Japan — Background: Although autism spectrum disorder (ASD) is often described as comprising an unusual brain growth pattern and aberrant brain lateralization, physiological brain lateralization and its developmental trajectory in young children with ASD have yet to be examined thoroughly. Methods: Brain activity was measured non-invasively during consciousness in 38 young ASDs (3 to 7 years old) and 38 typically developing (TD) young boys (3 to 8 years old). We employed a customized child-sized magnetoencephalography (MEG) system in which the sensors were located as close to the brain as possible for optimal recording in young children. Between the right and left hemispheres, the use of widely spaced clusters of MEG sensors was a simple and effective method for minimizing field spread effects. We focused on the laterality index ((left - right) / (left + right)) of the relative power band in seven frequency bands. Results: The TDs displayed significantly rightward lateralized brain oscillations in the delta, theta-1 and alpha-1 frequency bands compared to the ASDs. When we investigated the developmental changes in brain lateralization, TD children exhibited significant age-dependent increases in the leftward lateralization of the theta-1, theta-2 and alpha-2 bands and a significant age-dependent decrease in the leftward lateralization of the gamma band. However, in the ASDs, there were no significant developmental changes in any frequency band. Conclusions: This is the first study to demonstrate unusual brain lateralization and aberrant developmental patterns of brain oscillations in young children with ASD using a novel and MEG approach.

THINKING: Other

G145

THE NEURAL BASIS OF PARALLEL INDIVIDUATION AND NUMERICAL ESTIMATION Peter Gordon[1], Sungbong Kim[1], Mary Llenell Banzuela Paz[1], Erin Reddick[1], Nancy Freedman[1], Adriel Brown[1], Michael Small[1], Lucy Owen[1]; [1]Teachers College, Columbia University — Research on numerical cognition with infants, children, adults, cross-cultural studies and animal studies converge on the conclusion that there are two distinct systems for the perception of numerical quantity: A small-number system (1~3) invoking parallel individuation, or "subitizing", and a large-number system (4+) that is based on Weberian magnitude estimation. The present study employed high density EEG to investigate the neural basis of differentiation between small-number (1~3), and large-number (4~6) perception. During EEG data collection, participants were presented with dot pattern stimuli containing 1 to 6 dots of varying size. They were instructed to press a key when they detected a change in the number of dots presented and were rewarded for correctly detecting changes. ERP analyses were conducted over the left and right occipital-temporal-parietal junction. For the early ERP component (N1; 160~180 ms), we observed that there was separation of ERPs within the subitizing range (1~3) but not beyond (4~6). A second later positivity (P3) was found in Cz and neighboring electrodes, that was associated with change detection. Numerical changes were categorized as "within small" (1~2, 2~1, 2~3, 3~2), "within large" (4~5,5~4,5~6,6~5). Changes that crossed the small to large boundary were labeled "small-to-large" and "large-to-small". The P3 was observed for all change categories except for "within large." These data, taken together, suggest a neural basis for the differentiation of small vs. large number perception at early stages of processing, and a later stage that involves more semantic numerical processing that is employed in change detection task.

G146

ONE THOUGHT, TWO THOUGHTS: INVESTIGATING THE LINKING OF SPONTANEOUS THOUGHTS WITH FMRI AND MINDFULNESS MEDITATION Melissa Ellamil[1], Sean Pritchard[2], Evan Thompson[1], Kalina Christoff[1]; [1]University of British Columbia, [2]Fielding Graduate University — Existing neuroscientific studies of spontaneous thought (e.g., mind wandering, daydreaming, stimulus-independent thought) lack direct and reliable methods for its observation and measurement, meaning its neural correlates and their contributions remain unclear. Vipassana or mindfulness meditation, which trains non-reactive, introspective observation of moment-to-moment mental processes, allows the collection of more precise information about the timing and nature of spontaneous thoughts. Thus, the present study employed an experience sampling procedure informed by extensive meditation practice to better examine the neural correlates of the linking or flow of spontaneous thoughts. Highly experienced Vipassana meditators practiced mindfulness while in the fMRI scanner, and reported via button presses whether a single thought or two consecutive thoughts arose and whether a single word or two consecutive words appeared onscreen (i.e., the control condition). Relative to consecutive thoughts, single thoughts were associated with enhanced activation of the hippocampus. In contrast, relative to single thoughts, consecutive thoughts were associated with increased activation of the medial prefrontal cortex and posterior cingulate cortex. The results suggest a generative function for the hippocampus and an elaborative function for the midline default network during spontaneous thought flow. Thus, integrating subjective reports informed by meditation with objective neuroimaging measures helped to reveal a more direct and fine-grained characterization of the contributions of various brain regions consistently implicated in spontaneous thought and resting state studies.

G148

BIAS TOWARD CONTINUOUS MAGNITUDE AFFECTS MEASUREMENT OF CHILDREN'S APPROXIMATE NUMBER SENSE Narae Kim[1], Selim Jang[1], Yunji Park[1], Junghyun Kweon[1], Joo Hyung Chun[1], Soohyun Cho[1]; [1]Chung-Ang University — Approximate number sense (hereafter, ANS) refers to the acuity for numerosity discrimination. ANS is commonly measured by comparing the numerosity between a pair of dot arrays. However, performance on this task is often influenced by cues from salient continuous magnitude. We aimed to investigate whether individual difference in the dependence on continuous magnitude affects measurements of ANS. Our numerosity comparison task was designed with four conditions; 1) area (AR) and 2) size (SZ) controlled conditions, in which the total area of dots (AR) and dot size (SZ) were equivalent between the two arrays of dots. Note, in the SZ condition, the total area of dots can serve as a salient continuous cue. Thus, AR condition provides a purer measure of ANS. 3) a congruent (CON) and 4) incongruent (IN) condition in which the total area of dots was larger in the more (CON) or less (IN) numerous array. n Children s performance was significantly better in the SZ compared to the AR condition and in the CON compared to the IN condition. The "RT between IN and CON conditions (i.e., bias toward continuous magnitude) was correlated with "RT between AR and SZ control conditions and performance efficiency on the AR condition. There was a significant correlation between math achievement and "ACC for children who had greater bias toward continuous magnitude (in terms of "ACC between IN and CON conditions). Our results indicate that bias toward continuous magnitude can affect measures of ANS and its relation to math achievement.

G149

ACUITY FOR CONTINUOUS MAGNITUDE BUT NOT PURE NUMEROSITY CORRELATES WITH CHILDREN'S MATH ACHIEVEMENT Yunji Park[1], Selim Jang[1], Soohyun Cho[1]; [1]Chung-Ang University — Approximate number sense (hereafter, ANS) enables instant recognition of numerosity. Individuals with more sensitive ANS have been reported to have higher mathematical achievement. The present study aimed to compare the sensitivity for continuous and discontinuous magnitude (ANS) and their respective correlations with math achievement in children. We measured ANS using the numerosity comparison task with two conditions; one con-

trolling for total area of dots in each array (hereafter AR condition), and the other controlling for average dot size in each array (hereafter SZ condition). Note, in the SZ condition, the total area of dots serves as a salient continuous visual cue positively correlated with numerosity. In contrast, the AR condition can be thought to be a purer measure of ANS excluding the influence of continuous visual magnitude. To measure acuity for continuous magnitude, we used a line length comparison task, in which subjects chose the longer between a pair of lines. There were significant differences between acuities measured from the aforementioned tasks ($p < .001$). Acuity was highest for length, and lowest for ANS measured without the influence of continuous visual magnitude (AR condition) (length acuity=.15, ANS from SZ =.19, ANS from AR=.27). In addition, length acuity and ANS only from the SZ (but not AR) condition were significantly correlated with mathematical achievement. Our results indicate that in children (at least for the age tested), the acuity for continuous magnitude and ANS measured under the influence of continuous magnitude (rather than a purer ANS) correlate with mathematical achievement.

G150

A PURER MEASURE OF APPROXIMATE NUMBER SENSE BETTER CORRELATES WITH MATHEMATICAL ACHIEVEMENT

Selim Jang[1], Yunji Park[1], Soohyun Cho[1]; [1]Chung-Ang University — Approximate number sense (hereafter ANS) refers to the ability to instantly recognize numerosity. ANS is found to be correlated with mathematical achievement. However, issues have been raised about the influence of continuous visual cues or the requirement for cognitive inhibition in measurements of ANS. The present study aimed to verify whether the relationship between ANS and math achievement still holds when the influence of salient visual magnitude and need for inhibition is controlled. We measured ANS using two tasks; Dots vs. Number (DN) and Dots vs. Dots (DD) tasks. In the DN task, participants compared between the numerosity of a dot array and a symbolic number. The DN task ensures that numerosity judgment can be carried out without the influence of continuous magnitude or the need for inhibition. In the DD task, subjects compared the numerosity between a pair of dot arrays. The DD task was administered with two conditions, which controlled for individual dot SIZE (SZ) and total AREA (AR) of dots across arrays. The total area is positively correlated with numerosity in the SZ (but not AR) controlled condition. The correlations between mathematical reasoning and ANS measured from the AR (but not SZ) controlled condition and the DN task were significant. In a stepwise regression analysis, the ANS from the DN task solely predicted mathematical reasoning while ANS from both DD conditions were left out. These results demonstrate a strong relationship between a purer measure of ANS and mathematical achievement.

G151

MIND WANDERING ON THE GOOD, THE BAD, AND THE USEFUL: DISTINCTIVE NEURAL CORRELATES OF SPONTANEOUS THOUGHTS DIFFERENTIATED BY EMOTIONAL VALENCE, UTILITY, AND SPONTANEITY

Kieran C. R. Fox[1], Melissa Ellamil[1], Matthew L. Dixon[1], Mara L. Puertolas[1], Alexander Rauscher[1], Kalina Christoff[1]; [1]University of British Columbia — "Mind wandering" (MW) has been most famously tied to activity in brain regions of the default mode network (DMN). However, studies to date have aimed at delineating a general, undifferentiated picture of the neural correlates of MW. We sought to refine this understanding by examining the neural correlates of different kinds of thoughts, specifically investigating the spontaneity, utility, and emotionality of spontaneous thoughts. During an fMRI scan, we allowed subjects to rest and think freely, interrupting their thinking at random intervals with occasional thought probes. Probes asked subjects about whether their thoughts arose spontaneously, or whether they were intentionally directing them; whether thoughts were related to their current concerns and goals in life, or not; and whether they were emotionally pleasant, unpleasant or neutral. We used an event-related design to examine neural activity during MW (just prior to the thought probe) according to subjects' responses. We found distinctive neural activity, as well as functional connectivity, underlying spontaneously arising vs. intentionally directed thoughts; thoughts related vs. unrelated to current concerns and goals; and emotionally pleasant vs. unpleasant thoughts. Counter to the prevailing view, thoughts were mostly emotionally positive and related to concerns and goals, suggesting an adaptive function. Our results refine the current understanding of "the" neural correlates of MW, suggesting that distinctive forms of spontaneous thinking recruit distinctive sets of brain regions. They also speak to clinical disorders involving dysfunctional forms of spontaneous thought, e.g. depressive rumination, by showing that negative, non-useful thoughts are neurally distinct from positive, useful thinking.

Poster Topic Index

D71 – D75, D77, Monday, April 7, 8:00 - 10:00 am
E74 – E80, Monday, April 7, 1:00 - 3:00 pm
F69 – F75, Tuesday, April 8, 8:00 - 10:00 am
G88 – G95, Tuesday, April 8, 1:00 - 3:00 pm

LANGUAGE: Semantic

A80 – A86, Saturday, April 5, 3:00 - 5:00 pm
B73 – B79, Sunday, April 6, 8:00 - 10:00 am
C82 – C87, Sunday, April 6, 1:00 - 3:00 pm
D78 – D84, Monday, April 7, 8:00 - 10:00 am
F76 – F83, Tuesday, April 8, 8:00 - 10:00 am

LANGUAGE: Syntax

B80 – B86, Sunday, April 6, 8:00 - 10:00 am
E81 – E87, Monday, April 7, 1:00 - 3:00 pm
G96 – G100, Tuesday, April 8, 1:00 - 3:00 pm

LONG-TERM MEMORY: Development & aging

B87 – B95, Sunday, April 6, 8:00 - 10:00 am
D85 – D95, Monday, April 7, 8:00 - 10:00 am

LONG-TERM MEMORY: Episodic

A87 – A101, Saturday, April 5, 3:00 - 5:00 pm
B96 – B110, Sunday, April 6, 8:00 - 10:00 am
C89 – C104, Sunday, April 6, 1:00 - 3:00 pm
D96 – D113, Monday, April 7, 8:00 - 10:00 am
E88 – E103, Monday, April 7, 1:00 - 3:00 pm
F84 – F98, Tuesday, April 8, 8:00 - 10:00 am
G101 – G117, Tuesday, April 8, 1:00 - 3:00 pm

LONG-TERM MEMORY: Other

E104 – E112, Monday, April 7, 1:00 - 3:00 pm
G118 – G127, Tuesday, April 8, 1:00 - 3:00 pm

LONG-TERM MEMORY: Priming

C105 – C108, Sunday, April 6, 1:00 - 3:00 pm

LONG-TERM MEMORY: Semantic

A102 – A111, Saturday, April 5, 3:00 - 5:00 pm
F99 – F108, Tuesday, April 8, 8:00 - 10:00 am

LONG-TERM MEMORY: Skill learning

C109 – C115, Sunday, April 6, 1:00 - 3:00 pm
E113 – E117, Monday, April 7, 1:00 - 3:00 pm
F109 – F114, Tuesday, April 8, 8:00 - 10:00 am

METHODS: Electrophysiology

A112 – A115, Saturday, April 5, 3:00 - 5:00 pm

METHODS: Neuroimaging

C116 – C123, Sunday, April 6, 1:00 - 3:00 pm
D114 – D120, Monday, April 7, 8:00 - 10:00 am
F115 – F122, Tuesday, April 8, 8:00 - 10:00 am

METHODS: Other

A116 – A118, Saturday, April 5, 3:00 - 5:00 pm

NEUROANATOMY

B111 – B117, Sunday, April 6, 8:00 - 10:00 am
E118 – E122, Monday, April 7, 1:00 - 3:00 pm

PERCEPTION & ACTION: Audition

A119 – A126, Saturday, April 5, 3:00 - 5:00 pm
D121 – D130, Monday, April 7, 8:00 - 10:00 am
E123 – E129, Monday, April 7, 1:00 - 3:00 pm
G128 – G135, Tuesday, April 8, 1:00 - 3:00 pm

PERCEPTION & ACTION: Development & aging

A127 – A135, Saturday, April 5, 3:00 - 5:00 pm

PERCEPTION & ACTION: Motor control

B118 – B125, Sunday, April 6, 8:00 - 10:00 am
C124 – C129, Sunday, April 6, 1:00 - 3:00 pm
F123 – F127, Tuesday, April 8, 8:00 - 10:00 am

PERCEPTION & ACTION: Multisensory

B126 – B132, Sunday, April 6, 8:00 - 10:00 am
E130 – E135, Monday, April 7, 1:00 - 3:00 pm

PERCEPTION & ACTION: Other

C130 – C135, Sunday, April 6, 1:00 - 3:00 pm
D131 – D136, Monday, April 7, 8:00 - 10:00 am
F128 – F131, Tuesday, April 8, 8:00 - 10:00 am

PERCEPTION & ACTION: Vision

A136 – A141, Saturday, April 5, 3:00 - 5:00 pm
B133 – B139, Sunday, April 6, 8:00 - 10:00 am
C136 – C141, Sunday, April 6, 1:00 - 3:00 pm
D137 – D142, Monday, April 7, 8:00 - 10:00 am
E136 – E141, Monday, April 7, 1:00 - 3:00 pm
F132 – F140, Tuesday, April 8, 8:00 - 10:00 am

THINKING: Decision making

A142 – A149, Saturday, April 5, 3:00 - 5:00 pm
B140 – B146, Sunday, April 6, 8:00 - 10:00 am
C143 – C148, Sunday, April 6, 1:00 - 3:00 pm
D143 – D149, Monday, April 7, 8:00 - 10:00 am
E142 – E148, Monday, April 7, 1:00 - 3:00 pm
F141 – F147, Tuesday, April 8, 8:00 - 10:00 am
G136 – G143, Tuesday, April 8, 1:00 - 3:00 pm

THINKING: Development & aging

C149 – C151, Sunday, April 6, 1:00 - 3:00 pm
D76, D150 – D152, Monday, April 7, 8:00 - 10:00 am
F148 – F150, Tuesday, April 8, 8:00 - 10:00 am
G144, Tuesday, April 8, 1:00 - 3:00 pm

THINKING: Other

G145 – G146, G148 – G151 Tuesday, April 8, 1:00 - 3:00 pm

THINKING: Problem solving

B147 – B150, Sunday, April 6, 8:00 - 10:00 am

THINKING: Reasoning

A150 – A152, Saturday, April 5, 3:00 - 5:00 pm
E149 – E151, Monday, April 7, 1:00 - 3:00 pm

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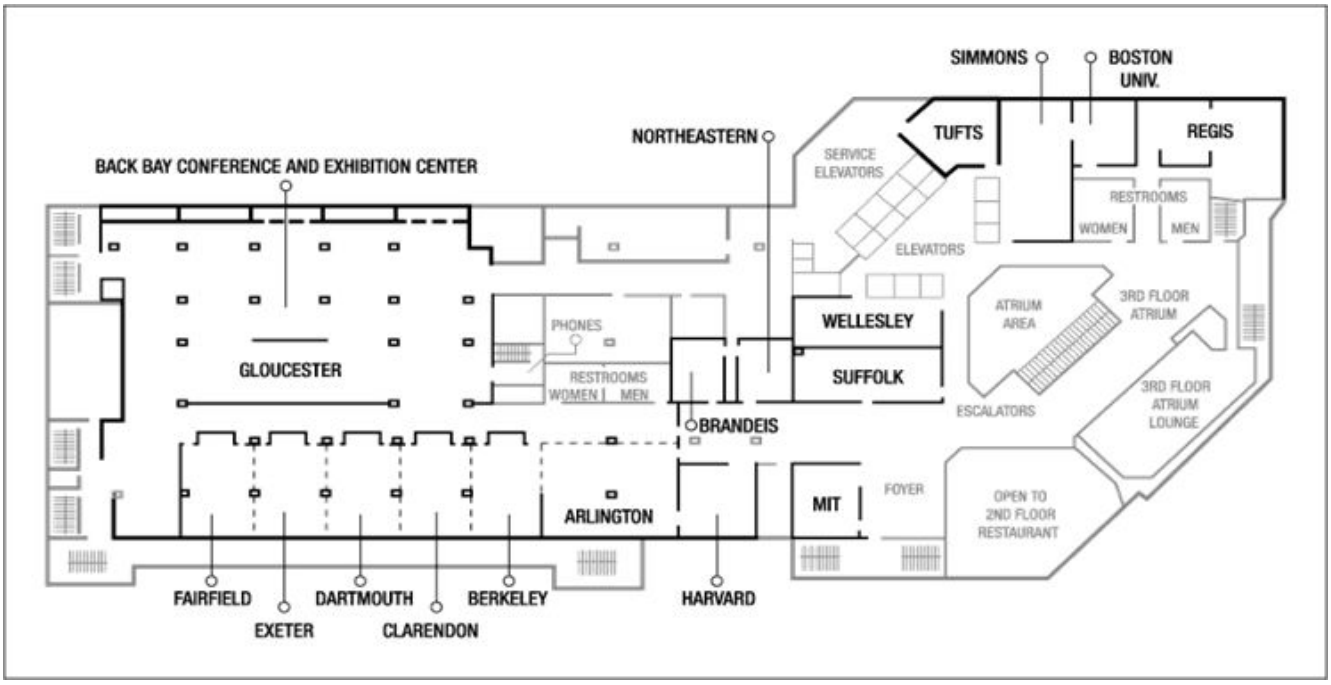
Boston Marriott Copley Place Floorplan

Third Floor: Back Bay Conference and Exhibition Hall



Fourth Floor: CNS Registration Desk