Cognitive Neuroscience Society

20th Annual Meeting, April 13-16, 2013
Hyatt Regency Hotel, San Francisco, California

2013 Annual Meeting Program

Contents

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Cognitive Neuroscience Society
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Schedule Overview

Saturday, April 13

11:00 am – 3:00 pm	Exhibitor Check-In, *Exhibit Hall*
11:00 am – 6:30 pm	Onsite Registration & Pre-Registration Check-In, *Grand Ballroom Foyer*
3:30 – 6:30 pm	Exhibits on Display, *Exhibit Hall*
3:30 – 6:30 pm	Poster Session A, *Exhibit Hall*
4:30 – 5:30 pm	Opening Ceremonies & 19th Annual George A. Miller Prize in Cognitive Neuroscience Lecture – **Fred Gage**, *Grand Ballroom*
5:30 – 6:30 pm	GAM & Welcome Reception, *Grand Ballroom Foyer & Exhibit Hall*

Sunday, April 14

7:30 am – 4:30 pm	Onsite Registration & Pre-Registration Check-In, *Grand Ballroom Foyer*
8:00 am – 4:30 pm	Exhibits on Display, *Exhibit Hall* (Closed from 12:00 – 1:30 pm)
8:00 – 8:30 am	Continental Breakfast, *Exhibit Hall*
8:00 – 11:00 am	Poster Session B, *Exhibit Hall*
9:00 – 10:00 am	Keynote Address – Wiley Lecture in Cognitive Neuroscience, **William Newsome**, *Grand Ballroom*
10:15 am – 12:00 pm	Invited Symposium 1 – Order and Disorder in the Emotion Brain: Emotional Regulation in Health and Disease – **Richard Davidson**, Chair, Grand Ballroom
12:00 – 1:00 pm	NSF Workshop, *Seacliff Room*
12:00 – 1:30 pm	Lunch Break
1:30 – 4:30 pm	Poster Session C, *Exhibit Hall*
1:30 – 3:00 pm	Invited Symposium 2 – Building Blocks for Language – **Peter Hagoort**, Chair, *Grand Ballroom*
3:00 – 3:30 pm	Coffee Service, *Exhibit Hall*
3:00 – 4:30 pm	Mini-Symposium 1- Analyzing patterns of brain activity to understand human vision and cognition, *Bayview Room*
	Mini-Symposium 2 - The role of concepts in affect and emotion: Contributions from affective neuroscience, *Seacliff Room*

20th Anniversary Gala Event

6:30 – 7:30 pm	Cocktails, *Atrium*
7:30 – 10:00 pm	Gala Dinner & Entertainment, *Grand Ballroom*

Monday, April 15

8:00 am – 8:00 pm	Onsite Registration & Pre-Registration Check-In, *Grand Ballroom Foyer*
8:00 – 8:30 am	Continental Breakfast, *Exhibit Hall*
8:00 – 11:00 am	Poster Session D, *Exhibit Hall*
8:00 am – 8:00 pm	Exhibits on Display, *Exhibit Hall* (Closed from 12:00 – 1:30 pm)
9:00 – 10:00 am	Keynote Address – MIT Press Lecture in Cognitive Neuroscience, **Patricia Kuhl**, *Grand Ballroom*
10:15 am – 12:00 pm	Invited Symposium 3 – Memory On Time – **Howard Eichenbaum**, Chair, *Grand Ballroom*
12:00 – 1:00 pm	Federal Funding Workshop, *Grand Ballroom B*
12:00 – 1:30 pm	Lunch Break

1:30 – 4:30 pm	Poster Session E, *Exhibit Hall*
1:30 – 3:00 pm	Routledge Psychology YIA Special Lectures, **Uta Noppeney**, **Tor Wager**, and **Roshan Cools**, *Bayview Room*
	Mini-Symposium 3 - The effects of working memory training on brain and behavior, *Garden Room*
	Mini-Symposium 4 - Where memory meets language, *Grand Ballroom B*
2:30 – 3:00 pm	Coffee Service, *Exhibit Hall*
3:00 – 4:30 pm	Invited Symposium 4 – Functional Specificity in the Visual System **Nancy Kanwisher**, Chair, *Grand Ballroom*
4:45 – 5:45 pm	Distinguished Career Contributions in Cognitive Neuroscience Lecture **Robert Knight**, *Grand Ballroom*
5:45 – 6:45 pm	DCC Reception, *Grand Ballroom Foyer & Exhibit Hall*
5:00 – 8:00 pm	Poster Session F, *Exhibit Hall*

Tuesday, April 16

8:00 am – 5:00 pm	Onsite Registration & Pre-Registration Check-In, *Grand Ballroom Foyer*
8:00 am – 4:30 pm	Exhibits on Display, *Exhibit Hall* (Closed from 12:00 – 1:30 pm)
8:00 – 8:30 am	Continental Breakfast, *Exhibit Hall*
8:00 – 11:00 am	Poster Session G, *Exhibit Hall*
9:00 – 10:00 am	Keynote Address – The New York Academy of Sciences Lecture in Cognitive Neuroscience **Joseph LeDoux**, *Grand Ballroom*
10:15 am – 12:00 pm	Invited Symposium 5 – Networking Attention – **Anna Nobre**, Chair, *Grand Ballroom*
12:00 – 1:30 pm	Lunch Break
1:30 – 3:00 pm	Mini-Symposium 5 - Neuroscience and Law: Promise and Perils – *Grand Ballroom B*
1:30 – 4:30 pm	Poster Session H, *Exhibit Hall*
2:30 – 3:00 pm	Coffee Service, *Exhibit Hall*
3:00 – 4:30 pm	Invited Symposium 6 – Emerging Models of Human and Animal Decision-Making **Paul Glimcher**, Chair, *Grand Ballroom*

CNSSA Student Social Night

Saturday, April 13, 6:30 pm, *Hotel Reception Area*

Come and join us for the annual CNSSA Student Social Night, Saturday April 13th, after the GAM reception. We will meet at 6:30 in the hotel reception area (close to the escalators on the second floor), and walk out to a nearby bar/restaurant. 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 postdocs of the CNS. Come network with other students and explore the wonderful city of San Francisco with us!

Keynotes

William Newsome

HHMI and Department of Neurobiology, Stanford University

Wiley Lecture in Cognitive Neuroscience Keynote Address

Sunday, April 14, 9:00 – 10:00 am, Grand Ballroom

A New Look at Gating: Selective Integration of Sensory Signals Through Network Dynamics

A hallmark of decision-making in primates is contextual sensitivity: a given stimulus can lead to different decisions depending on the context in which it is presented. This kind of flexible decision-making depends critically upon gating and integration of context-appropriate information sources within the brain. We have analyzed neural mechanisms underlying gating and integration in animals trained to perform a context-sensitive decision task. Surprisingly, both relevant and irrelevant sensory signals are present within frontal lobe circuits that form decisions, implying that gating occurs very late in the process. Dynamical systems analysis of the neural data, combined with a dynamical recurrent network model, suggests a novel mechanism in which gating and integration are combined in a single process.

Sponsored by WIREs COGNITIVE SCIENCE

Patricia K. Kuhl, Ph.D.

Co-Director, Institute for Learning & Brain Sciences Director, NSF Science of Learning Center (The LIFE Center)
University of Washington, Seattle, Washington

MIT Press Lecture in Cognitive Neuroscience Keynote Address

Monday, April 15, 9:00 – 10:00 am, Grand Ballroom

The Human Language Puzzle: Advancing Theory Through Brain Science

Debate on the origins of humans' capacity for language has engaged philosophers, neuroscientists, and biologists, and more recently engineers and computer scientists who want to create technologies that enhance language learning. In this talk, I will show how co-registration of MRI, DTI, and Magnetoencephalography (MEG) in young infants is revising traditional views on the brain mechanisms underlying human language. I will describe a theoretical model that addresses the initial state of language learning as well as the role of input in modifying that state. The main tenet is that in early language learning children's statistical learning and computational skills are 'gated' by the social brain. This model has led to the discovery of linguistic biomarkers that may allow early diagnosis of disabilities such as autism.

Sponsored by Journal of Cognitive Neuroscience JoCN Published by the MIT Press

Joseph LeDoux

Center for Neural Science, NYU, Emotional Brain Institute at NYU & Nathan Kline Institute

The New York Academy of Sciences Lecture in Cognitive Neuroscience Keynote Address

Tuesday, April 16, 9:00 – 10:00 am, Grand Ballroom

Emotion and Survival

The capacity to detect and respond to threats is an ancient survival mechanism, and predates, evolutionarily speaking, the capacity to have conscious emotional experiences. Circuits that detect and respond to threats are not fear circuits, not emotion circuits. In those organisms that have evolved the capacity to be aware of their environment and their internal physiological states, the feeling of fear can be experienced while the brain and body are responding to a threat. But the capacity to respond to threats is not the same as the capacity to consciously experience fear when well-being is threatened. Hard-wired survival circuits are often mistakenly described as emotion circuits. But these did not evolve to make emotions. They exist to keep animals alive and well.

Sponsored by

The Year in Cognitive Neuroscience

ANNALS of THE NEW YORK ACADEMY OF SCIENCES

George A. Miller Prize

Congratulations to the 2013 George A. Miller Award Winner, Dr. Fred Gage!

Please join us on Saturday, April 13, 4:30 pm, in the Grand Ballroom when Dr. Gage accepts this prestigious award and delivers his lecture. Reception to follow 5:30 – 6:30 pm in the Exhibit Hall.

Function and Regulation of Adult Neurogenesis

Fred H. Gage
Laboratory of Genetics, The Salk Institute, California

Most neurons in the adult central nervous system (CNS) are terminally differentiated, but evidence now exists that small populations of neurons are generated in the adult olfactory bulb and hippocampus. In the adult hippocampus, newly born neurons originate from putative stem cells that exist in the subgranular zone of the dentate gyrus. Progeny of these putative stem cells differentiate into neurons in the granular layer within a month of the cells' birth, and this late neurogenesis continues throughout the adult life of all mammals. The timing a process of neurogenesis in the adult dentate gyrus is now well characterized. In addition, environmental stimulation can differentially affect the proliferation, migration, and differentiation of these cells in vivo. These environmentally induced changes in the structural organization of the hippocampus, result in changes in electrophysiological responses in the hippocampus, as well as in hippocampal related behaviors. We are studying the cellular, molecular, as well as environmental influences that regulate neurogenesis in the adult brain and spinal cord. Computational model of adult neurogenesis has generated novel hypotheses with regard to its function with the hippocampus. The functional and practical significance of these findings will be discussed in light of their implications for alternative or expanded views of structural plasticity in the adult brain.

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 shall be 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.

Each year a call for nominations for the George A. Miller Prize will be made to the membership of the society. The recipient of the prize will attend the annual meeting of the Cognitive Neuroscience Society and deliver the George A. Miller lecture.

Previous Winners of the George A. Miller Lectureship

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 Award

Congratulations to Dr. Robert Knight for being awarded this honor!

Dr. Knight will give his special lecture on Monday, April 15, 4:45 pm, in the Grand Ballroom. Reception to follow 5:45 – 6:45 pm in the Grand Ballroom Foyer and Exhibit Hall.

Prefrontal Cortex and Behavior: Insights from Neurological and Neurosurgical Patients

Robert T. Knight, M.D.
Department of Psychology and the Helen Wills Neuroscience Institute, University of California, Berkeley

Human neuroscience began with the study of neurological patients in the 1800's with an ultimate goal of understanding cognition in health and disease. Damage to human prefrontal cortex (PFC) results in a profound disintegration of goal- directed behavior. Data from neuropsychological, electrophysiological and electrocorticographic studies in neurological and neurosurgical patients will be reviewed providing evidence that prefrontal cortex is a critical node for top-down control of neural networks supporting cognitive processing. For instance, studies of stroke patients reveals that multiple cognitive processes are dependent on PFC. Recordings of the electrocorticogram (ECoG) obtained directly from the cortical surface in neurosurgical patients document that high gamma oscillations (60-250Hz) are generated in PFC in a host of cognitive operations including attention, working memory, response selection and language. The behavioral and physiological findings obtained from PFC lesioned patients and ECoG recording in neurosurgical patients provide evidence that the devastating human prefrontal syndrome can be viewed as a failure of PFC to control distributed neural networks subserving human behavior.

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 20th annual meeting at the Hyatt Regency in San Francisco, CA.

Previous Winners of the Distinguished Career Contributions Award

2012 Morris Moscovitch

Young Investigator Award

Routledge Psychology YIA Special Lectures

YIA special lectures takes place on Monday, April 15, 1:30 – 3:00 pm, in the Bayview Room.

Congratulations to the 2013 Young Investigator Award Winners:

Uta Noppeney, Ph.D., University of Birmingham, UK

Tor Wager, Ph.D., University of Colorado

The 2012 Young Investigator winner is also presenting this year:

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

The purpose of the YIA 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. Each YIA award winner will give a special 30-minute talk at the meeting.

See What You Hear – The Neural Basis of Audiovisual Integration

Uta Noppeney
Department of Psychology and Computational Neuroscience and Cognitive Robotics Centre, University of Birmingham, UK

Integrating information across the senses is critical for effective interactions with the environment. Over the past decade, evidence has accumulated that multisensory integration is not deferred to later processing in association cortices but starts already in primary, putatively unisensory, areas. Given this multitude of multisensory integration sites, characterizing their functional similarities and differences is of critical importance.

Combining psychophysics, functional imaging and effective connectivity analyses, our research demonstrates that multisensory integration emerges in a functional hierarchy with temporal coincidence detection in primary sensory, informational integration in association and decisional interactions in prefrontal areas. Audiovisual interactions in low level sensory areas are mediated via multiple mechanisms including feedforward thalamocortical, direct connections between sensory areas and top down influences from higher order association areas.

In addition to identifying where in the brain sensory information is integrated, we also aimed to provide insights into the underlying computational operations using multivariate analyses at the macroscopic level of the BOLD response. In line with Bayesian principles our results suggest that audiovisual neural representations are formed by integrating sensory signals weighted according their relative reliability and task-relevance.

About Uta Noppeney

Uta Noppeney is Professor of Computational Neuroscience and co-head of the Computational Neuroscience and Cognitive Robotics Centre at the University of Birmingham, UK. She received a degree in medicine (1997, Freiburg University, Germany), a doctorate in medicine (1998, Freiburg University) and a PhD in neuroscience (2004, University College London, UK). After training in neurology at the University Hospital in Aachen, she conducted neuroscience research at Magdeburg University and subsequently at the Wellcome Trust Centre for Neuroimaging, University College London. In 2005, she became research group leader at the Max Planck Institute for Biological Cybernetics in Tübingen, Germany. She serves on the editorial boards of the Journal of Neuroscience, NeuroImage and Frontiers of Integrative Neuroscience. Her group's research employs psychophysics, functional imaging, transcranial magnetic stimulation and patient studies to better understand how the human brain integrates sensory information into a coherent percept of the environment and how it stores and retrieves this information from memory. To gain a more informed perspective on the computational operations and neural mechanisms of information integration, the group combines functional imaging with models of Bayesian inference and learning.

Towards a Neuroscience of Human Emotion

Tor D. Wager
The University of Colorado, Boulder

Emotions are powerful organizers of perceptual, mnemonic, motivational, and physiological processes. Understanding emotions, and their basic affective and cognitive ingredients, is essential for understanding healthy and disordered brain function. However, in spite of some claims to the contrary in the popular press, there are as yet no reliable human brain markers for affective processes. Here, I introduce an analysis framework for identifying fMRI patterns specific to particular types of mental events. This framework is qualitatively different from the "brain mapping" approach because it emphasizes a) optimization of psychological ("reverse") inference using machine learning; b) quantitative assessment of the diagnostic value of brain patterns; and c) prospective use of the same diagnostic patterns across studies. Using this approach, we have identified a brain pattern that can predict the intensity of physical pain at the level of the individual person with 90-100% accuracy in some tests. This brain marker for pain is distinct from other patterns that are diagnostic of other types of affective events (e.g., observed pain, aversive images, and romantic rejection). These results suggest that it may be possible to develop fMRI-based brain markers for distinct emotional states. Such markers would provide new ways of measuring and classifying emotions, characterizing brain disorders, and testing the effects of cognitive manipulations on pain and emotion.

About Tor Wager

Dr. Wager is the director of the Cognitive and Affective Neuroscience laboratory at the University of Colorado, Boulder. He received his Ph.D. from the University of Michigan in cognitive psychology in 2003, and served as an Assistant and Associate Professor at Columbia University from 2004-2009. In 2010, he joined the faculty of the Department of Psychology and Neuroscience at the University of Colorado, Boulder. He has a deep interest in how thinking influences affective experiences, affective learning, and brain-body communication.

Current studies in the lab are aimed at understanding how the brain represents different types of affect (including pain, rejection, canonical emotions, and compassion), and how affective representations are influenced by both conceptual and associative processes. These studies employ mainly functional magnetic resonance imaging (fMRI) and behavioral measures, but also include work combining fMRI with peripheral physiology, electroencephalography (EEG), transcranial magnetic stimulation (TMS), and pharmacology. In addition, though most studies investigate basic mechanisms in healthy individuals, collaborative studies include work on clinical pain, PTSD, depression, schizophrenia, and borderline personality disorder.

Dr. Wager places particular emphasis on the development and deployment of analytic methods, and has developed publically available software toolboxes for fMRI analysis, including optimized experimental design, multi-level mediation, change-point analysis, machine learning, and meta-analysis. He believes that collaborative development and open sharing of tools and data are critical ingredients in the advancement of human neuroscience.

National Science Foundation Wants Your Innovative Ideas

Sunday, April 14, 12:00 – 1:00 pm, *Seacliff Room*

The director for the Program in Cognitive Neuroscience at the NSF will discuss program funding priorities, review criteria and proposal process, and new funding mechanisms to give you the critical information for creating a successful application. Tips will be provided on how to reach your program director and how to prepare for an effective pre- and post-review discussion.

Speaker: Akaysha Tang, NSF

Dopaminergic Modulation of Frontostriatal Cognitive Function

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

The neurotransmitter dopamine is well known to play a key role in a wide variety of cognitive functions. Dopaminergic drugs are frequently prescribed for the treatment of neuropsychiatric disorders and they are also taken by healthy adults in order to boost cognitive performance. However there is large variability in the direction and extent of dopaminergic drug effects on cognition. In prior work we have focused on variability of drug efficacy between individuals, highlighting the role of individual differences in baseline levels of dopamine, personality, genetic predisposition and neuroanatomical connectivity. In the present talk, I will review these individual difference factors, but I will also present data that help understand the nature of within-subject variability in dopaminergic drug efficacy. Thus drug effects vary not only across different individuals but also within the same individual as a function task demands. Our pharmacological neuroimaging data elucidate the nature of this dependency on task demands and show that the same drug can have different effects on cognitive flexibility and cognitive stability depending on its site of action.

About Roshan Cools

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

Federal Funding: Training and Research Opportunities

Monday, April 15, 12:00 – 1:00 pm, *Grand Ballroom B*

We will highlight current federal training, career development, and research funding opportunities available. NIH Program Director will present an overview of relevant funding at each agency, the grant application, review and funding processes, and provide hints for successful grant writing along the way. Come learn how to advance your research with federal support!

Speaker: Steven Grant, NIH/NID

General Information

20th Anniversary Gala Event

Celebrating 20 years of Mind and Brain Discoveries. Join us on Sunday, April 14 in the Hyatt Regency Grand Ballroom for a celebration to last two decades.

6:30 – 7:30 pm Cocktails, *Atrium*
7:30 – 10:00 pm Gala Dinner & Entertainment

Formal Banquet Dinner - Reception featuring cocktails, hors d'ouevres and LIVE MAGIC will be held in the Hotel Lobby Atrium for Gala attendees. Daniel J. Levitin, Master of Ceremonies, LIVE MUSIC featuring Ben Sidran and Jessie Farrell.

Abstracts

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

ATM

An ATM is located on the Atrium level 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. Facilities will be provided to allow several computers to be connected to the LCD projector in a room. Presenters are strongly encouraged to arrive in their scheduled symposium room a minimum of 30 minutes before their talks so that they know how to set up their equipment.

Baggage Check

The Bell Desk - Assistance with luggage, packages and other carry-on's, is located with the Concierge, next to the front desk.

Business Center

The Business Center is located on the Bay Level adjacent to the Drumm Street windows. The following services are available: Copy Services, Facsimile Services, On-Site Computers, Internet Access, Typing Services, and Shipping Services (UPS and FedEx). After staffed hours, the business center can be accessed with your room key to access computers with internet and printing capabilities.

Catering

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

Saturday, April 13

GAM and Welcome Reception, 5:30 – 6:30 pm, *Grand Ballroom Foyer & Exhibit Hall*

Sunday, April 14

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

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

Monday, April 15

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

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

DCC Reception, 5:45 – 6:45 pm, *Grand Ballroom Foyer & Exhibit Hall*

Tuesday, April 16

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

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

Certificate of Attendance

To receive a Certificate of Attendance, please visit the Registration Counter on the Ballroom floor of the San Francisco Hyatt Regency Hotel. If you require any changes, we will be happy to email/mail a copy after the meeting. See also Receipts.

Chair People

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

Contact Us

To contact us onsite, visit the CNS Registration Desk on the Ballroom floor of the San Francisco Hyatt Regency Hotel or send an email to meeting@cogneurosociety.org We will respond to your email at our soonest opportunity.

Disclaimer

The Program Committee reserves the right to change the meeting program at any time without notice. Please note this program is correct at 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 Monday. Lost drink tickets will not be replaced.

Exhibit Hall

The conference exhibit is located in Pacific Concourse Exhibit Hall of the San Francisco Hyatt Regency 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		3:30 – 6:30 pm*
Sunday	8:00 am – 12:00 pm	1:30 – 4:30 pm*
Monday	8:00 am – 12:00 pm	1:30 – 8:00 pm*
Tuesday	8:00 am – 12:00 pm	1:30 – 4:30 pm*

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

Facebook

Find us on Facebook search for "CNS Annual Meeting" and like us!

Hotel

The San Francisco Hyatt Regency Hotel is our exclusive Hotel for the CNS 2013 Annual Meeting and where all CNS 2013 meeting events will be held. Hyatt Regency San Francisco, 5 Embarcadero Center, San Francisco CA 94111.

Hotel Restaurants

Eclipse Restaurant & Lounge. Whether you are in the mood for quick refreshment or a full meal, the culinary offerings at Eclipse will satiate you with an unforgettable interpretation of global dining.

Internet Access

CNS attendees will receive complimentary wireless internet in their guest room, when reserved within the CNS block and before March 21, 2013.

Free internet terminals are located in the Ballroom Foyer 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.

Lost & Found

The meeting Lost and Found is located at the Registration Counter on the Ballroom floor of the San Francisco Hyatt Regency Hotel.

Member Services

The member services desk is located at the Registration Counter on the Ballroom floor of the San Francisco Hyatt Regency Hotel. The member services desk will be open at the following times:

Saturday, April 13	11:00 am – 5:00 pm
Sunday, April 14	7:30 am – 4:30 pm
Monday, April 15	8:00 am – 8:00 pm
Tuesday, April 16	8:00 am – 12:30 pm

Message Center

Messages for meeting registrants can be left and retrieved at the Registration Counter on the Ballroom floor of the San Francisco Hyatt Regency 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

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Poster Sessions

Poster sessions are scheduled on Saturday, April 13, Sunday, April 14, Monday, April 15, and Tuesday, April 16. 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 Pacific Concourse Exhibit Hall of the San Francisco Hyatt Regency 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. Please email registration@cogneurosociety.org if you require an additional copy.. 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.

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Receptions

The GAM & Welcome Reception will be held in the Grand Ballroom Foyer & the Pacific Concourse Exhibit Hall, from 5:30 – 6:30 pm on Saturday, April 13, directly following the GAM Lecture honoring Fred Gage winner of the 19th Annual George A. Miller Prize in Cognitive Neuroscience.

Join us on Monday, April 15 from 5:45 – 6:45 pm in the Grand Ballroom Foyer & the Pacific Concourse Exhibit Hall, for the DCC reception directly following the DCC Lecture honoring Robert Knight, winner of the 2nd Annual Distinguished Career Contributions Awards.

Registration

The Registration Counter is located on the Ballroom floor of the San Francisco Hyatt Regency Hotel. The Registration Counter will be open at the following times:

Saturday, April 13	11:00 am – 6:30 pm
Sunday, April 14	7:30 am – 4:30 pm
Monday, April 15	8:00 am – 8:00 pm
Tuesday, April 16	8:00 am – 5:00 pm

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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.

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Taxis - There is a taxis stand at the front of the Hotel. A Taxi to or from SFO is about 20-30 minutes and is approximately $50-55.

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Exhibit Hall open to all attendees:

Saturday		3:30 – 6:30 pm
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Tuesday	8:00 am – 12:00 pm	1:30 – 4:30 pm

Exhibit Hall closed for the day - no entry:

Saturday	6:30 pm
Sunday	4:30 pm
Monday	8:00 pm
Tuesday	4:30 pm

Invited-Symposium Sessions

#	Title	Date	Time	Location
1	**Order and disorder in the emotion brain: Emotional regulation in health and disease**	Sunday, April 14	10:15 am – 12:00 pm	Grand Ballroom
2	**Building blocks for language**	Sunday, April 14	1:30 – 3:00 pm	Grand Ballroom
3	**Memory on time**	Monday, April 15	10:15 am – 12:00 pm	Grand Ballroom
4	**Functional Specificity in the Visual System**	Monday, April 15	3:00 – 4:30 pm	Grand Ballroom
5	**Networking Attention**	Tuesday April 16	10:15 am – 12:00 pm	Grand Ballroom
6	**Emerging models of human and animal decision-making**	Tuesday April 16	3:00 – 4:30 pm	Grand Ballroom

Invited-Symposium Session 1

ORDER AND DISORDER IN THE EMOTION BRAIN: EMOTIONAL REGULATION IN HEALTH AND DISEASE

Sunday, April 14, 10:15 am – 12:00 pm, Grand Ballroom

Chair: Richard J Davidson, UW-Madison

Speakers: Richard J Davidson, James Gross, Regina Lapate, Karina S. Blair

This symposium will feature recent research on the neural bases of emotional reactivity and regulation and illustrate the application of insights gleaned from basic research to the clinical arena in understanding fundamental abnormalities in mood and anxiety disorders. In addition, new approaches to the treatment of mood and anxiety disorders, as well to the promotion of well-being in putatively psychologically "healthy" individuals, based upon knowledge of the neural bases of emotion regulation, will be considered. The following speakers will participate: Richard J. Davidson, University of Wisconsin-Madison, Organizer James Gross, Stanford University Regina Lapate,University of Wisconsin-Madison, Karina Blair, NIMH

REACTIVITY, REGULATION AND RECOVERY: THE R'S OF EMOTION REGULATION FROM THE PERSPECTIVE OF AFFECTIVE NEUROSCIENCE

Richard J Davidson, University of Wisconsin-Madison

Parsing the temporal dynamics of emotional responding provides insights into understanding how reactivity, regulation and recovery in response to affectively salient stimuli can be disentangled. This talk will consider each of these subcomponents and provide illustrations from studies with both normal individuals and patients with mood and anxiety disorders/symptoms. Emphasis will be placed on prefrontal-amygdala and prefrontal-striatal connectivity, as well as on the temporal dynamics of amygdala activation in response to affective stimuli. Finally, behavioral strategies that alter brain function to improve emotion regulation for alleviating symptoms and promoting well-being will be described.

EMOTION REGULATION: CONCEPTUAL AND EMPIRICAL FOUNDATIONS

James Gross, Stanford University

The past decade has seen an extraordinary increase in research on emotion regulation. Work from dozens of laboratories around the world has converged to establish that emotion regulation plays a crucial role in determining a wide range of affective, cognitive, and social outcomes. My talk will have three parts. In the first part of the talk, I will define emotion regulation and describe a framework for understanding the role of emotion regulation in healthy adaptation. In the second part of the talk, I will review key behavioral findings which suggest that specific forms of emotion regulation have different consequences for affective, cognitive, and social functioning. In the third part of the talk, I will discuss the neural bases of one particularly important form of explicit emotion regulation, namely cognitive reappraisal, and consider how adaptive forms of emotion regulation such as reappraisal fail in the context of psychopathology.

INVESTIGATING EMOTIONAL REGULATION: INTEGRATING PSYCHOPHYSIOLOGY AND NEUROIMAGING WITH AN INDIVIDUAL-DIFFERENCES APPROACH

Regina Lapate, University of Wisconsin-Madison

The remarkable inter-individual heterogeneity that characterizes emotional responding makes individual differences a powerful tool for the study of emotional regulation processes and associated neural mechanisms. In this light, this talk will underscore the value of adopting an individual-differences approach to examine the neural bases and information-processing conditions promoting successful emotional regulation. In the first part of the talk, I will report on neu-

roimaging and psychophysiological data suggestive of high stability and generalizability of success in a particularly effective form of emotional regulation: cognitive reappraisal. In the next part of the talk, I will examine the regulatory consequences of processing emotion in conditions precluding cognitive reappraisal due to lack of awareness of the source of emotion. Specifically, I will review recent findings demonstrating a benefit of conscious awareness in preventing physiological responses to emotional provocation from biasing appraisal of unrelated neutral stimuli, including the neural bases underlying those effects. Finally, I will discuss the relevance of this work for understanding emotional circuitry function and dysfunction with improved specificity under a biologically informed and process-based approach.

EMOTIONAL REGULATION IN PATIENTS WITH ANXIETY DISORDERS

Karina S Blair, NIHM

Clinical reports suggest that emotion regulation difficulties are seen in a variety of anxiety conditions; e.g., Generalized Social Phobia (GSP), Generalized Anxiety Disorder (GAD) and Post Traumatic Stress Disorder (PTSD). However, the specific computational nature of this difficulty has only begun to emerge. This talk will focus on three studies of one form of emotional regulation; the role of dorsal prefrontal cortex (both medial and lateral regions) in attention control priming task relevant representations at the expense of emotional information. In the first study, patients with GSP, GAD and co-morbid GSP/GAD and healthy controls (HCs) performed an emotional reappraisal paradigm. Patients in all three groups showed reduced recruitment, relative to HCs, of dorsal anterior cingulate (dACC) and parietal cortices (PC) when explicitly regulating an emotional image. In the second study, patients with GSP, GAD and co-morbid GSP/GAD and healthy controls (HCs) performed the affective Stroop (AS) paradigm where task related priming of number representations implicitly reduces representation of emotional distracters. Again patients in all three groups showed reduced recruitment, relative to HCs, of dACC and PC as a function of task demands. In the third study, patients with PTSD, trauma controls (TCs) and HCs performed the AS. Patients with PTSD showed reduced recruitment of lateral frontal and PC when engaged by task demands while TCs showed indications of heightened recruitment of these regions. These data will be discussed in terms of emotional regulation deficits as a general risk factor for the development of a variety of anxiety conditions.

Invited-Symposium Session 2

BUILDING BLOCKS FOR LANGUAGE

Sunday, April 14, 1:30 – 3:00 pm, Grand Ballroom

Chair: Peter Hagoort, Donders Centre for Cognitive Neuroimaging

Speakers: Simon Fisher, Ghislaine Dehaene-Lambertz, Kara Federmeier, Peter Hagoort

The language system is based on a language-ready brain whose development is instructed by genes for building such a brain, by a structural and functional organization of the newborn and infant brain that seems predisposed to develop a full-fledged language system, and by the recruitment of other than core areas in the perisylvian cortex to realize the communication potential of language. This symposium will focus on these building blocks for language in its full glory.

DECODING THE GENETICS OF SPEECH AND LANGUAGE

Simon Fisher, MPI for Psycholinguistics; Nijmegen, the Netherlands

Researchers are beginning to uncover the neurogenetic pathways that contribute to our unparalleled capacity for spoken language. Initial clues come from identification of genetic risk factors implicated in developmental language disorders. The underlying genetic architecture is complex, involving a range of molecular mechanisms. For example, we have shown that rare protein-coding mutations of the FOXP2 transcription factor cause severe problems with sequencing of speech sounds, while common genetic risk variants of small effect size in genes like CNTNAP2, ATP2C2 and CMIP are associated with typical forms of language impairment. In my talk I will describe how investigations of genes like FOXP2, in humans, animals and cellular models, can unravel the complicated connections between genes and language. This depends on interdisciplinary research at multiple levels, from determining molecular interactions and functional roles in neural cell-biology all the way through to effects on brain structure and activity.

NEURAL BASIS OF INFANTS' LANGUAGE ABILITY

Ghislaine Dehaene-Lambertz, INSERM, Neurospin; Saclay, France

The development of non-invasive brain imaging techniques has opened the black-box of the infant brain and recent studies have revealed the early and complex organization of the peri-sylvian areas from the onset of the cerebral circuitry before term. I will discuss how these new data shed light on the emergence of language in the human species.

MANY STRUCTURES FROM THE SAME BLOCKS: LANGUAGE PROCESSING DYNAMICS IN THE TWO CEREBRAL HEMISPHERES

Kara Federmeier, University of Illinois at Urbana-Champaign & Beckmann Institute

Appreciating the meaning of a word, sentence, or larger discourse involves analyzing complex, often ambiguous

perceptual inputs and linking them to information stored in long-term memory. Electrophysiological data suggest that meaning arises through a binding process, established via activity in temporal lobe areas and reflected in the N400 component, which creates an initial semantic representation built from activity in a distributed, multimodal set of brain areas. Although initiated by word perception, this process is not strictly feedforward. Top-down information built over time from context substantively changes processing by pre-activating features of likely upcoming words. Strong temporal pressures are created by the fact that words are encountered at a rapid rate and that the binding process seems to be temporally constrained (N400 latency is strikingly invariant); information that is not available quickly enough cannot be incorporated immediately. Top-down processes that come on-line later thus serve to refine and revise the initial representation. The efficacy of top-down processing depends on the integrity of neural feedback connections, which appear to be different for the left and right cerebral hemispheres. In particular, left hemisphere dominance for language production attests to the presence of concept-to-form connections that are less well-developed in the right hemisphere. The consequence of this difference is a set of parallel, partially independent language comprehension systems. The multifaceted nature of meaning processing affords the brain important flexibility for dealing with varying processing circumstances, task demands, and resource availability.

THE NEUROBIOLOGY OF LANGUAGE BEYOND THE INFORMATION GIVEN

Peter Hagoort, Donders Institute for Brain, Cognition and Behaviour & Max Planck Institute for Psycholinguistics

Speakers and listeners do more than exchanging propositional content. They try to get things done with their utterances. For speakers this requires planning of utterances with knowledge about the listener in mind, whereas listeners need to make inferences that go beyond simulating sensorimotor aspects of propositional content. For example, the statement "It is hot in here" will usually not be answered with a statement of the kind "Yes, indeed it is 32 degrees Celsius", but rather with the answer "I will open the window", since the listener infers the speaker's intention behind her statement. I will discuss a series of studies that identify the network of brain regions involved in audience design and inferring speaker meaning. Likewise for indirect replies that require conversational implicatures, as in A: "Did you like my talk?" to which B replies: "It is hard to give a good presentation." I will show that in these cases the core language network needs to be extended with brain systems providing the necessary inferential machinery.

Invited-Symposium Session 3

MEMORY ON TIME

Monday, April 15, 10:15 am – 12:00 pm, Grand Ballroom

Chair: Howard Eichenbaum, Boston University

Speakers: Marc Howard, Lila Davachi, Wendy Suzuki, Howard Eichenbaum.

The idea that memories are organized in time was initially proposed by Aristotle and was a central feature of Tulving's original characterization of episodic memory. There is now considerable evidence that the hippocampus plays a central role in the temporal organization of memory. Furthermore, recent studies are beginning to inform us about how memories are organized in time, and by what mechanisms the hippocampus plays its role in temporal organization. This symposium will review recent evidence from state-of-the-art research on this topic in human and animal studies.

WHAT AND WHEN IN THE MIND AND BRAIN

Marc Howard, Boston University

The perception of time and memory are intimately linked. We consider the hypothesis that a variety of findings from cognitive and experimental psychology can be understood as operations on a gradually-changing representation of temporal history. Behavioral findings suggest three principles that this representation of temporal history should obey. First, at each moment this history contains information both about what stimuli were experienced and how far in the past they were experienced. Second, rather than falling off abruptly after some time scale, the history degrades gradually over hundreds or even thousands of seconds. Third, when an episodic memory is recovered, the brain "jumps back in time" to recover a previous state of the temporal history. We review neurophysiological evidence from a variety of species and brain regions and find evidence suggesting that each of these principles are respected in neural ensembles. These results suggest that it is possible to link cognition to neurophysiological findings across a variety of brain regions and domains of cognitive psychology.

CONTEXT AND THE HUMAN HIPPOCAMPUS

Lila Davachi, New York University

Hippocampal function has long been associated with our ability to form, consolidate and retrieve episodic memories. Hippocampal processing is tightly linked with binding sequential representations to the context in which they were encountered allowing for recovery of the 'what' (i.e. episodic representations), 'when' (i.e. sequential information) and the 'where' (i.e. context). I will present a series of behavioral and fMRI experiments focused on understanding how we form mnemonic links across sequences of stimuli and how event boundaries disrupt sequential associations. Thus, representations spanning the same event become better integrated in memory (measured using explicit and implicit measures) and are associated with greater hippocampal neural similarity measures. Likewise, representations within the same

event become reactivated during retrieval even when not deemed necessary for behavior. Thus, our perception of shared context modulates hippocampal neural similarity across sequential episodic representations and is related to how linked those representations become in memory. Further I will present evidence that hippocampal-prefrontal interactions support bridging across contexts to allow for higher-level temporal organization of our experiences.

INCREMENTAL TIMING IN THE MONKEY MEDIAL TEMPORAL LOBE

Wendy Suzuki, New York University

Recent work in my lab has focused on understanding how the brain encodes memory for temporal order, a critical component of episodic memory. To address this question, we recorded single unit activity and local field potentials from the medial temporal lobe including the hippocampus, the entorhinal cortex, the perirhinal cortex and visual area TE as monkeys performed a temporal order memory task. We found striking incremental timing signals from one item presentation to the next in the hippocampus. In contrast, the perirhinal cortex signaled the conjunction of items and their relative temporal order. These findings suggested that the perirhinal cortex might integrate timing information from the hippocampus with item information from visual area TE. We next asked if similar hippocampal incremental timing signals were also seen in other tasks that did not explicitly require memory for temporal order. When we examined hippocampal data from an object-place associative learning task we saw incremental timing signals very similar to the pattern seen in the temporal order memory task. In addition, we also identified incremental timing signals that also provided information about release type (early vs. late) as well as particular object-place combinations. These findings suggest that timing is a common signal conveyed by the hippocampus even in situations where memory for relative timing is not required.

MEMORY AND TIME CELLS IN THE HIPPOCAMPUS

Howard Eichenbaum, Boston University

Episodic memory is characterized by the temporal organization of events that constitute distinct experiences, and episodic memory depends on the hippocampus. Until recently, little has been known about how the hippocampus supports the temporal organization of memories. However, there are now descriptions of hippocampal 'time cells', principal neurons of the hippocampus that encode successive moments during an empty temporal gap between the key events. Time cells form qualitatively different representations ("re-time") when the main temporal parameter is altered. Distinct ensembles of time cells encode the key events and disambiguate different sequences of events to compose unique, temporally-organized representations of specific experiences. Time cells also encode spatial information and behavioral events to differing extents, but temporal signals are observed even when spatial and behavioral influences are eliminated. Finally, temporal information for hippocampal time cells may arise in the medial entrorhinal cortex, already known for its representations of spatial contexts. These findings suggest that the hippocampus segments temporally organized memories into events that occur at each moment within a temporally defined context much the same as they represent important events that occur in particular locations in spatially defined environmental contexts.

Invited-Symposium Session 4

FUNCTIONAL SPECIFICITY IN THE VISUAL SYSTEM

Monday, April 15, 3:00 – 4:30 pm, Grand Ballroom

Chair: Nancy Kanwisher, McGovern Institute, MIT

Speakers: James Haxby, Doris Tsao, David Pitcher, Josef Parvizi.

The visual system has been a primary battleground for one of the central debates in cognitive neuroscience: are some regions of the brain engaged selectively in a particular high-level mental process, or are all brain regions outside primary sensory and perceptual regions broadly engaged in many different mental processes? To address this question we will invite some of the major contributors to each of these views.

DISTRIBUTED REPRESENTATION IN THE HUMAN VISUAL SYSTEM

James Haxby, Dartmouth College

Visual cortical fields can be modeled as high-dimensional representational spaces. We model these spaces using a new algorithm, hyperalignment, that affords transformation of individual brains' voxel spaces into common, high-dimensional model spaces. Projecting individual data into common model spaces affords between-subject multivariate pattern (MVP) classification of fine distinctions among brain responses to faces, animals, and objects that equals or exceeds within-subject classification. Data in common model space coordinates can be projected back into the cortical topography of an individual's brain using the transpose of the transformation matrix for that subject. Building models with general validity across stimuli and across experiments requires broad sampling of visual stimuli, which we demonstrate using responses measured while subjects watch a full-length action movie. Models based on responses to still images from a moderate number of categories do not have general validity. Thus, category perception experiments do not provide adequate data for modeling the representational space in ventral temporal visual cortex. Category-selective regions are preserved in the model as single dimensions that reflect the relevant category contrast. The topographies associated with these dimensions agree well with the boundaries of individual-specific category-selective regions. The high-dimensional model, however, also shows that these regions have finer-scale topographies within them that afford fine distinctions among stimulus representations that are not accounted for by models based on category-selective regions. Thus, although category-selective regions are

significant features of the high-dimensional model, they are only subspaces that provide an insufficient basis for models of visual stimulus representation in ventral temporal visual cortex.

SYSTEMS FOR CATEGORY-SELECTIVE PROCESSING IN THE MACAQUE

Doris Tsao, CalTech

fMRI studies in the mid and late 1990s described an area in the human brain that showed strongly increased blood flow in functional magnetic resonance imaging (fMRI) experiments when people viewed pictures of faces compared to pictures of objects (1). This seemed to offer an ideal potential preparation for tackling the problem of how the brain extracts global visual form: a small piece of brain specialized to encode a single visual form. Thus, 12 years ago, Winrich Freiwald and I began a journey into exploring the neural basis of face processing. We decided to look for a face-selective area in macaque monkeys, reasoning that it would not be unreasonable to find such a region in monkeys, since face recognition is also integral to macaques—and most importantly, if we did find such a region, then we could target an electrode to the region (something not possible in humans) and directly record from individual neurons to ask how they are encoding faces. In my talk, I will discuss the anatomical and functional organization of the macaque face processing system, as well as the more recently discovered macaque scene processing system. How are regions within these two systems system connected to each other and the rest of the brain? What representations are used in face and scene-selective regions? What is the contribution of different regions to behavior? What information is communicated between regions?

TMS EVIDENCE FOR CATEGORY-SELECTIVE CORTICAL REGIONS IN HUMAN EXTRASTRIATE CORTEX

David Pitcher, Brain and Cognition, National Institute of Mental Health

Neuropsychological patients exhibiting category-selective visual agnosias have provided unique insights into the cognitive functions of the human brain but such case studies are exceptionally rare. To overcome the paucity of patients exhibiting category-selective deficits I have been using transcranial magnetic stimulation (TMS) to transiently disrupt face, object and human body perception in neurologically normal experimental subjects. Results support a modular account of cortical organization in which category-selective brain regions contribute solely to discrimination of their preferred category. Follow-up studies, that exploited the temporal precision of TMS, reveal the temporal dynamics underlying visual object perception in human occipitotemporal cortex.

HUMAN VISUAL NUMERAL AREA

Josef Parvizi, Stanford University

Is there an area within the human visual system that has a preferential response to numerals as there are for faces, words, and scenes? We addressed this question using intracranial electrophysiological recordings and observed significantly higher response in the high-frequency broadband range to visually presented numerals, compared to orthographically similar (i.e., letters and false fonts) or semantically and phonologically similar stimuli (i.e., number-words and non-number words). This preferential response had anatomically consistent location in the inferior temporal gyrus (ITG) and anterior to the temporo-occipital incisure. This region lies within or close to the functional magnetic resonance imaging (fMRI) signal-dropout zone caused by the nearby petrous bone and venous sinuses – an observation that explains prior negative findings in the fMRI studies of preferential response to numerals. Since visual numerals are culturally dependent symbols that are only learned through education, our novel finding of anatomically localized preferential response to such symbols provides yet another example of acquired category specific responses in the human visual system.

Invited-Symposium Session 5

NETWORKING ATTENTION

Tuesday, April 16, 10:15 am – 12:00 pm, Grand Ballroom

Chair: Anna Nobre, University of Oxford

Speakers: Michael I Posner, Sabine Kastner, Anna C Nobre, Earl K Miller.

Attention is a core aspect of our mental life, at the centre stage of cognitive neuroscience. This symposium brings together scientists working with different methods and at different levels of analysis to provide a contemporary view of the scope and properties of attention-related functions, and the mechanisms that make our cognition selective, flexible and adaptive.

ATTENTION NETWORKS PAST AND FUTURE

Michael I Posner, University of Oregon

Fifty years ago it was sufficient to show that attention changed certain operations in the information-processing stream between stimulus and response. Twenty years ago it became possible to implicate specific brain areas. Today papers examine putative brain networks that carry out some of the functions ascribed to attention and trace their activation and synchrony in real time. These networks are present in infancy but a long developmental process involving changes in connectivity is required to reach their adult state. Individual children and adults differ in the efficiency of attention networks in part due to different genetic polymorphisms that operate in interaction with environmental influences. The efficiency of attention networks can be improved by practice, and by changing the brain state in which they operate. Looking to the future, we should be able to foster the development of these networks, locate aspects that may be deficient in certain people and test methods designed to improve or eliminate the deficiencies.

NEURAL MECHANISMS OF ATTENTION CONTROL IN THE PRIMATE BRAIN

Sabine Kastner, Princeton University

Selective attention mechanisms route behaviorally relevant information through large-scale cortical networks. While there is evidence that populations of cortical neurons synchronize their activity to preferentially transmit information about attentional priorities, it is unclear how cortical synchrony across a network is accomplished. Based on its anatomical connectivity with the cortex, we hypothesized that the pulvinar, a thalamic nucleus, regulates cortical synchrony. To test this idea, we mapped pulvino-cortical networks within the visual system using diffusion tensor imaging and simultaneously recorded spikes and field potentials from these interconnected network sites in monkeys performing a visuo-spatial attention task. Here we show that the pulvinar synchronized activity between two interconnected cortical areas according to attentional allocation, suggesting not only a critical role for the thalamus in attentional selection, but more generally in regulating information transmission across visual cortex.

ATTENTION AT THE INTERFACE BETWEEN MEMORY AND PERCEPTION

Anna C Nobre, University of Oxford

Top-down biases that prioritise the selection and integration of some events over others in the information-processing stream are a hallmark of selective attention. In most empirical work and theoretical models, biases are derived from the sensory environment and operate upon incoming sensory signals. However, arguably, the most prevalent source of predictive biases about relevant events to unfold is past experience stored as long-term memories. Building on the contextual-cueing and spatial orienting paradigms, we developed tasks to investigate whether and how long-term memories bias perception. Behavioural evidence confirms that memories significantly enhance perceptual discrimination and response speeds for target items occurring within remembered spatial contexts. Brain imaging suggests the involvement of the hippocampus, as well as the fronto-parietal network in mediating spatial contextual memory biases, and electrophysiological recordings reveal modulation of oscillatory activity regulating visual excitability in anticipation of target events. Overall, the findings cast long-term memories as proactive mental functions flexibly and dynamically adapting our interactions with the environment from early perceptual stages.

ATTENTION IS RHYTHMIC

Earl K Miller, Massachusetts Institute of Technology

How are some thoughts favored over others? A wealth of data at the level of single neurons has yielded candidate brain areas and mechanisms for our best understood model: visual attention. Recent work has naturally evolved toward efforts at a more integrative, network, understanding. It suggests that focusing attention arises from interactions between widespread cortical and subcortical networks that may be regulated via their rhythmic synchronization. This could extend to all cognitive processes, suggesting our brain does not operate continuously, but rather discretely, with pulses of activity routing packets of information. Such discrete cycles would provide a backbone for coordinating computations (and their results) across disparate networks. However, it comes at a cost: it's naturally limited in bandwidth; only so many things can be computed or carried in a single oscillatory cycle. This can explain the most fundamental property of conscious thought, its limited capacity, which is the reason why we evolved attention in the first place.

Invited-Symposium Session 6

EMERGING MODELS OF HUMAN AND ANIMAL DECISION-MAKING

Tuesday, April 16, 3:00 – 4:30 pm, Grand Ballroom

Chair: Paul Glimcher, NYU

Speakers: Michael Platt, Matthew Rushworth, Antonio Rangel, Elizabeth Phelps.

Over the course of the last 25 years cognitive neuroscientist have gone from knowing next to nothing about how humans and animals make simple decisions to having a fairly comprehensive understanding of what is coded and where when decisions are being made. From these insights a number of powerful models of how the brain makes decisions has emerged. We propose to survey what is known and to identify the frontiers that will be engaged in the next 25 years.

NEURONAL MECHANISMS OF DECISION MAKING IN THE PRIMATE BRAIN

Michael Platt, Duke University

Neuronal Mechanisms of Decision Making in the Primate Brain Abstract. A major challenge for neuroeconomics is to provide biological explanations of decision making that cohere across systems, circuit, cellular, and molecular levels of neural structure and function. This talk will review neurophysiological evidence for the computation of basic economic variables, such as value, utility, and risk, by single neurons in the primate brain. This evidence will be situated within a broader set of basic neurobiological mechanisms that appear to subserve a wide array of functions. The existence of similar mechanisms in a wide array of animals will be marshaled to endorse the idea that basic mechanisms are conserved and repurposed by evolution to generate adaptive behavior and cognition.

NEURAL MECHANISMS FOR FORAGING

Matthew Rushworth, University of Oxford

Often when we design experiments to look at decision-making we ask our subjects to choose between limited numbers of options that are all presented simultaneously. When animals are foraging it is thought that they usually only

encounter a single option at a time. The key decision is, therefore, whether or not this option is sufficiently valuable that it is worth engaging with or whether the environment is sufficiently rich that it would be better to continue searching for something better. The effort involved in making these different choices must also be considered. The anterior cingulate cortex carries three signals that are needed for such decisions – a representation of the value of any option that might be engaged with, a representation of the average value of alternatives in the current environment, and a representation of the cost of the actions. Considering the ecological context in which decisions arise also provides a new perspective on other signals in the anterior cingulate cortex, for example signals that are related to the encoding of risk.

THE NEUROECONOMICS OF SIMPLE CHOICE

Antonio Rangel, CalTech

Neuroeconomics seeks to characterize the computational and neurobiological basis of different types of decisions. This talk will discuss a series of studies designed to understand how the brain makes simple choices, such as whether to choose and apple or an orange, as well as the quality of the resulting decision. This includes understanding how the brain assigns value to stimuli at the time of choice, how values are compared to make a choice, how they induce the motor movements necessary to implement the choices, and how these basic processes extend to more complex choice situations.

THE NEUROECONOMICS OF EMOTION AND DECISIONS

Elizabeth Phelps, New York University

One popular theory of emotion and decision-making suggests that there are competing systems of emotion and reason that may drive choices. In contrast to this view, recent research in affective neuroscience has highlighted a modulatory role for emotion's influence on a range of cognitive functions, including perception, attention and memory. In this talk, I will outline how emotion's influence on decision-making may also best be captured as a modulation of the value computation. Specifically, I will present data suggesting that the emotional reaction to decision options or outcomes is linked to choice behavior, and how modifying emotional responses may change the choice. Finally, I will discuss the overlap in the neural systems of emotion and decision-making with circuits typically implicated in affective learning and emotion regulation.

Mini-Symposium Sessions

#	Title	Date	Time	Location
1	**Analyzing patterns of brain activity to understand human vision and cognition**	Sunday, April 14	3:00 - 4:30 pm	Bayview Room
2	**The role of concepts in affect and emotion: Contributions from affective neuroscience**	Sunday, April 14	3:00 - 4:30 pm	Seacliff Room
3	**The effects of working memory training on brain and behavior**	Monday, April 15	1:30 - 3:00 pm	Garden Room
4	**Where memory meets language**	Monday, April 15	1:30 - 3:00 pm	Grand Ballroom B
5	**Neuroscience and Law: Promise and Perils**	Tuesday April 16	1:30 - 3:00 pm	Grand Ballroom B

Mini-Symposium Session 1

ANALYZING PATTERNS OF BRAIN ACTIVITY TO UNDERSTAND HUMAN VISION AND COGNITION

Sunday, April 14, 3:00 - 4:30 pm, Bayview Room

Chair: Frank Tong, Vanderbilt University

Speakers: Frank Tong, John Serences, Jack Gallant

Although the spatiotemporal resolution of the BOLD response provides a rather coarse measure of brain activity, recent studies have demonstrated that a wealth of information can be obtained by analyzing the signals contained in detailed fMRI activity patterns. These studies have revealed selective cortical responses to basic visual features, complex objects, real world scenes and natural movies, allowing for prediction of the viewed stimulus or semantic category with remarkable accuracy. The ability to isolate visually selective responses in the human brain has opened the way to investigations of the cortical mechanisms underlying visual perception, selective attention and working memory. This symposium will focus on recent advances in the study of human vision and cognition, describing how computational approaches can be used to characterize the information contained in the responses of individual voxels and cortical activity patterns. Central themes to be discussed will include the functional organization of visual and semantic selectivity in the human cortex, and how the visual specificity of top-down feedback can lead to adaptive changes to optimize task performance. Specific results will inform current theories of cortical organization, visual attention and working memory.

THE ROLE OF EARLY VISUAL AREAS IN HIGH-LEVEL VISUAL COGNITION

Frank Tong, Vanderbilt University

What cortical processes underlie people's ability to perceive, attend to, or remember, basic visual features or complex objects? To what extent might high-level processes of attention or memory depend on accessing relevant information in early visual areas? Using functional MRI and pattern classification methods, my lab has found that it is possible to decode what item a person is seeing, attending to, or remembering, from activity patterns in early visual areas (V1-V4). Our perceptual studies have revealed dynamic changes in cortical responses to orientation, based on task relevance, as well as cortical changes that occur after extensive perceptual training with specific orientation stimuli. When observers must attend to one of two overlapping objects, we observe a strong functional relationship between the attentional bias signals found in high-level object areas and those in early visual areas. Interestingly, object knowledge facilitates the efficacy of object-based selection in early visual areas. In studies of visual working memory, we find that information about simple and complex stimuli is actively maintained in the detailed activity patterns of the visual cortex, even after the overall BOLD response has fallen to baseline levels. Taken together, these results support an interactive model of visual processing, in which feedback signals to early visual areas are important for the top-down selection and maintenance of information needed to perform demanding cognitive tasks.

EVALUATING OPTIMAL MODELS OF INFORMATION PROCESSING IN VISUAL CORTEX

John Serences, University of California, San Diego

Current behavioral goals and motivational drives play a critical role in shaping and refining information processing so that only the most relevant external stimuli are perceived, represented in working memory, and allowed to influence decision making. Traditional accounts hold that such 'top-down' attentional factors are critically important in information processing precisely because attention enhances the gain of the sensory neurons that are selectively tuned to relevant stimulus features. These models are intuitively appealing, and suggest that attention effectively increases the intensity of important stimuli so that they are easier to

perceive, remember, and act upon. Using the early visual system as a model, recent work in my lab reexamines this traditional framework by showing that the ultimate role for attention is to modulate the gain of the most informative sensory neurons given whatever specific perceptual task confronts the observer. Counterintuitively, enhancing the gain of the most informative sensory neurons often means biasing patterns of neural activity away from the pattern that is evoked by the sensory stimulus. Guided by a simple model of information processing, we exploit multivariate activation patterns in early visual cortex, as measured with functional magnetic resonance imaging, to argue that the primary function of attention is not just to enhance the gain of stimulus-driven responses, but to optimize performance on the current perceptual task.

BEYOND LOCALIZATION: MAPPING PERCEPTUAL AND COGNITIVE FUNCTIONS IN THE HUMAN BRAIN

Jack Gallant, University of California, Berkeley

Most functional MRI studies focus on coarse localization of perceptual and cognitive processes. However, neurophysiological experiments suggest that many perceptual and cognitive processes are organized in systematic maps arranged across the cortical surface. One rapidly developing approach, voxel-wise modeling and decoding (VWMD), can recover these detailed maps. VWMD quantifies the transformation between stimulus or task features and BOLD responses. Different feature spaces are tested by comparing model predictions. Voxel-based receptive fields can be recovered, and tuning patterns can be assessed across voxels and across different individuals. VWMD also provides a principled and very sensitive method for decoding. When applied to brain activity evoked by natural movies, VWMD reveals highly detailed and systematic maps of structural and semantic information across the human brain. These patterns are consistent with the coarse parcellations provided by previous techniques, but provide much more detailed information and extend well beyond areas identified in earlier studies. Furthermore, VWMD shows that voxels throughout the brain shift their tuning toward an attended category. These widespread category tuning shifts expand the representation of the semantic space near the attended category, and compress the representation of the semantic space far from the attended category. Taken together these results show that the human brain contains multiple, complex maps of visual information, and that attention dynamically alters visual representations to optimize processing of behaviorally relevant objects during natural vision.

Mini-Symposium Session 2

THE ROLE OF CONCEPTS IN AFFECT AND EMOTION: CONTRIBUTIONS FROM AFFECTIVE NEUROSCIENCE

Sunday, April 14, 3:00 - 4:30 pm, Seacliff Room

Chair: Ajay Satpute, Northeastern University

Co-Chair: Kevin Ochsner, Columbia University

Speakers: Kevin Labar, Matt Lieberman, Kristin Lindquist, Ajay Satpute

Emerging research in cognitive and affective neuroscience is beginning to uncover the many ways in which concepts are central to generalizing, attenuating, constituting, and shaping our emotional and affective responses. In this mini-symposium session, each speaker will present findings that highlight one of these roles. The first speaker, Kevin Labar, examines how people generalize their fearful responses across conceptual categories. He presents findings from a novel fear conditioning paradigm which examines the generalization of fear to conceptually-related stimuli, and discusses how this may play an important role in understanding disorders of fear and anxiety in clinical settings. The second talk by Lisa Burklund and Matt Lieberman examines how concepts attenuate affective responses. They present studies showing that labeling affective responses with emotion words attenuates activity in the amygdala and extend these benefits to clinical settings involving phobia. The third speaker, Kristin Lindquist, shows that concepts play a constitutive role in generating emotional experiences. She presents findings from a meta-analysis of neuroimaging studies showing that manipulations of affect routinely engage regions associated with processing concepts, and results from patients with semantic dementia showing that they are unable to perceive emotion in faces. And the final talk by Ajay Satpute, Jochen Weber, and Kevin Ochsner, suggests that concepts may further shape affective responses. They present neuroimaging findings from a study showing that categorizing affective responses on the boundary between concepts shapes them to be more consistent with the selected concept.

CONCEPTUAL CONTRIBUTIONS TO FEAR LEARNING

Kevin Labar, Center for Cognitive Neuroscience, Duke University

While the neural systems that mediate simple expressions of fear learning are well delineated, how fears generalize to other stimuli on the basis of conceptual relationships remains unclear. Here, we used a novel fear-conditioning paradigm to examine how healthy adults acquire and generalize fears based on conceptual similarity. Subjects were presented with exemplars from two different object categories (animals and tools). Some of the exemplars from one of the categories were paired with shock, whereas exemplars from the other category were never paired with shock. Fear learning was quantified as increased skin conductance responses

and subjective shock expectancy ratings to exemplars from the 'threat' category compared to the 'safe' category. The results showed that fear learning to a conceptual category was mediated first by canonical conditioning-related brain regions, such as the amygdala and insula, but also by category-selective brain areas in occipital-temporal cortex. We also discovered a mechanistic account for the spread of fear across category exemplars based on hippocampal signaling of object typicality, which was reflected in greater functional coupling with the amygdala early in learning. Finally, multivariate statistical analyses showed experience-dependent alterations in the cortical and amygdalar representations of the object categories. An additional behavioral study using a sensory preconditioning procedure further showed that categorical boundaries thwart generalization on the basis of conceptual relationships. These studies reveal how conceptual factors contribute to conditioned learning and provide new insights to neurobiologically-based models of human anxiety disorders characterized by overgeneralization of fear, particularly based on conceptual relationships.

AFFECT LABELING AS IMPLICIT EMOTION REGULATION

Matt Lieberman, University of California, Los Angeles

Spinoza wrote that "Emotion, which is a passion, ceases to be a passion as soon as we form a clear and distinct idea, thereof." This talk will explore why it is that putting feelings into words ('affect labeling') can help to calm our emotional responses. This talk will examine the ways in which affect labeling serves as a form of self-control in general and as a form of implicit emotion regulation more specifically. Neurally, I will focus on the overlap during affect labeling, reappraisal, and motor self-control. Multiple studies focusing on the experiential and physiological responses during implicit and explicit emotion regulation also point to convergence. Finally, I will present clinical extensions of this work on treating phobias and on mindfulness meditation effects.

CONCEPTUALIZATION SUPPORTS EMOTION

Kristin Lindquist, University of North Carolina, Chapel Hill

Growing evidence suggests that conceptual processes are an important component that help give rise to emotion experiences and perceptions. In particular, constructionist approaches to emotion hypothesize that emotions are emergent products that occur when conceptual knowledge about emotion is used to make meaning of basic affective states in context. In this talk, I present evidence from neuroimaging and neuropsychology suggesting that brain regions involved in conceptual processing play an important role in the experience and perception of emotions. I begin by presenting meta-analytic evidence from the neuroimaging literature on emotion demonstrating that brain areas involved in semantic knowledge representation and retrieval, such as the anterior temporal lobe and ventrolateral prefrontal cortex, routinely show increased activation during emotion experiences and perceptions. I next present a neuroimaging study demonstrating that anterior temporal lobe activity increases when participants experience an unpleasant state as an instance of a discrete emotion. I close by presenting neuropsychological evidence that neurodegeneration in the anterior temporal lobes due to Frontotemporal Dementia impairs patients' ability to perceive discrete emotions on faces. Patients are unable to perceive discrete emotions on faces, although they have the maintained ability to perceive positive, negative and neutral affect. Together, these findings suggest that conceptual processing is indeed an important component, that along with basic affective processing, helps give rise to emotions. I discuss the implications of these findings for the science of emotion and a constructionist approach to the mind, more generally.

THE NEURAL DIALOGUE BETWEEN CONCEPTS AND AFFECTIVE RESPONSES

Ajay Satpute[1], Jochen Weber[2], Kevin Ochsner[2]; [1]Northeastern University, [2]Columbia University

Affective experiences are considered to be continuous and free-flowing, but conceptualizing them requires that people categorize their affective responses into discrete concepts. In this talk, we present studies that examine how continuously varying affective responses are placed into discrete categories and the consequences that this may have for how people make sense of their affective experiences. In the beginning, I describe a study which shows that putting affective feelings into statements such as "I feel bad" engages three systems: one associated with attributing mental states to affective responses that includes the dorsomedial prefrontal cortex, a second associated with categorizing affective responses into semantic concepts that includes the ventrolateral prefrontal cortex, and a third associated with the intensity of the affective response that includes the amygdala and anterior insula. I then present emerging findings which show that concepts may in turn shape affective responses. Specifically, we investigated the "category boundary effect" for affective responses. We observed that when having to categorize affective feelings that are on the boundary between available concepts (e.g. labeling a mildly negative affective response as either "neutral" or "bad"), that this situation elicits conflict and is associated activity in the dorsal anterior cingulate cortex, and that resolving this conflict leads to increasing or decreasing activity in the anterior insula to be more congruent with the selected concept. These findings contribute to delineating the functional architecture involved in putting affective feelings into words, and further outline a neural mechanism for how concepts may in turn shape affective responses.

Mini-Symposium Session 3

THE EFFECTS OF WORKING MEMORY TRAINING ON BRAIN AND BEHAVIOR

Monday, April 15, 1:30 - 3:00 pm, Garden Room

Chair: Bornali Kundu, University of Wisconsin - Madison

Co-Chair: Bradley R. Postle, University of Wisconsin - Madison

Speakers: Susanne M. Jaeggi, Christos Constantinidis, Torkel Klingberg, Bornali Kundu

The past decade has witnessed an explosion of interest in working memory training, largely because successful demonstrations have refuted the long-held assumption that working memory capacity is an inherent trait, insensitive to environmental influence. Cognitive training has also shown the potential to treat neurological and psychiatric disorders. Of late, however, progress has been slowed by questions of how, or even whether, working memory training may transfer to untrained tasks. This mini-symposium will directly address this by bringing together four perspectives from which working memory training has been studied. Jaeggi will address the theoretical (and practical) bases for predicting the transfer of working memory training to untrained tasks. Constantinidis will characterize the effects of working memory training on single-neuron responses and neuronal population dynamics, as measured in the non-human primate. Klingberg will consider genetic and developmental factors that influence variation in working memory training effects, and their neural correlates as measured through human brain imaging. Finally, Kundu will present evidence that a causal factor underlying working memory training effects is training-related changes in effective connectivity within task-relevant networks. Collectively, these talks will provide a broad foundation from which to evaluate the training literature. Emergent from it will be a principled understanding of what factors determine the success, or otherwise, of a training protocol. Thus, this mini-symposium will bring timely attention to a domain of cognitive neuroscience that is simultaneously among the most exciting and most controversial, and one that holds great potential for translation to the clinic, the classroom, and beyond.

TRANSFER OF WORKING MEMORY TRAINING: THEORETICAL AND PRACTICAL CONSIDERATIONS

Susanne M. Jaeggi, University of Maryland - College Park

Working memory training and the study of transfer and plasticity are among the current hot topics in cognitive neuroscience. While some have argued that there is no evidence for transfer as a function of cognitive training, we and others have pointed out that working memory training can be, indeed, effective, but that there are important mediating and moderating factors that might determine training success. In this talk, I will provide evidence for the efficacy of several working memory interventions developed in our laboratories, and review the emerging literature coming from other groups. I will show data that demonstrate transfer to non-trained tasks throughout the lifespan, that is, in young adults, in old adults, in typically developing children, as well as children with ADHD. I will also discuss the neural correlates that accompany working memory training as observed with our interventions. However, I will also point out that transfer effects can be elusive, and that some of the effects do not seem to be easily replicated. I will argue that instead of taking inconsistencies as a proof for a lack of efficacy, researchers need to develop innovative approaches to move the cognitive training literature beyond the simple question of whether or not training is effective, and to address questions of underlying mechanisms, individual differences, and training features and parameters that might mediate and moderate the efficacy of training.

EFFECTS OF WORKING MEMORY TRAINING AT THE NEURONAL LEVEL

Christos Constantinidis[1], Xue-Lian Qi[1], [1]Wake Forest School of Medicine

Neurons in the lateral prefrontal cortex are active during the execution of cognitive tasks that require working memory. Prior studies suggest that the activity of single neurons is shaped by learning, though much is unknown about how training alters neural activity and cortical organization. To address this question, we performed neurophysiological recordings in non-human primates before and after they were trained to perform working memory tasks. Prior to any training, prefrontal neurons responded to stimuli, exhibited persistent activity after their offset, and differentiated between matching and non-matching stimuli presented in sequence. After training, more neurons were recruited by the stimuli and exhibited higher firing rates, particularly during the delay periods of the task. Operant stimuli that needed to be recognized in order to perform the task elicited higher overall rates of responses, while the variability of individual discharges and correlation of discharges between neurons decreased after training. New information was incorporated in the activity of a small population of neurons highly specialized for the task and in a larger population of neurons that exhibited modest task related information, while information about other aspects of stimuli remained present in neuronal activity. Despite such changes, the relative selectivity of the dorsal and ventral aspect of the lateral prefrontal cortex was not altered with regard to spatial and non-spatial stimuli. These results indicate the nature of neuronal changes induced by training and the limits of plasticity of cortical areas mediating cognitive tasks.

TRAINING OF WORKING MEMORY

Torkel Klingberg, Karolinska Institute

Impaired working memory is associated with low academic performance and with distractability and inattention in clinically defined groups, such as in ADHD, but the same associations are also relevant in the general population. Klingberg and collaborators have developed and tested a computerized method for training working memory (Klingberg et al. 2002, 2005, Klingberg 2010), which showed, for the first time, that working memory capacity can be enhanced.

Moreover, improving working memory also decreases the symptoms of inattention in everyday life. This has now been confirmed by several independent research groups using the same method, which also allows comparison of effect sizes across different ages and patient groups. The method can be used as an instrument for studying brain plasticity. Klingberg and collegues have shown that training of working memory changes brain activity in frontal and parietal regions, and is associated with changes in the density of dopamine D1-receptors in the cortex. Polymorphisms of the DAT-1 gene affect the relative benefit of cognitive training, which is consistent with a key role of dopamine for training-related plasticity. Questions for future research include: which tasks are more effective, what training paradigms are more effective and what are the factors promoting plasticity?

CHANGES IN CORTICAL EFFECTIVE CONNECTIVITY UNDERLIE WORKING MEMORY TRAINING

Bornali Kundu[1], Bradley R. Postle[1], [1]University of Wisconsin - Madison

Although long considered a natively endowed and fixed trait, working memory ability has recently been shown to improve with intensive training. What remains controversial and poorly understood, however, are the factors underlying this improvement, and the extent to which working memory training gains transfer to other cognitive tasks. To explore these questions, we trained subjects on either an adaptive n-back working memory task or a control task (Tetris) for five hours per day, five days per week, for five weeks. Pre- and post-training measures assessed individual performance on visuospatial short-term memory (VSTM), selective attention, interference control, and several psychometric tasks. Here we will present evidence from electrophysiology (EEG) and simultaneous transcranial magnetic stimulation (TMS) and EEG that both near and far transfer of working memory training to other cognitive tasks is supported by changes in task-related effective connectivity in frontoparietal and extrastriate networks that are engaged by both the trained and transfer tasks. One consequence of this is greater efficiency of stimulus processing, as evidenced by training-related changes in the 'contralateral delay activity', an EEG index of individual differences in short-term memory capacity and visual search performance. These patterns of training and transfer highlight the role of common neural systems in determining individual differences in many aspects of visuospatial cognition.

Mini-Symposium Session 4

WHERE MEMORY MEETS LANGUAGE

Monday, April 15, 1:30 - 3:00 pm, Grand Ballroom B

Chair: Tamara Y. Swaab, UC Davis

Speakers: Sharon L. Thompson-Schill, Tamara Y. Swaab, Melissa C. Duff, Gina Kuperberg

The idea that language is a modular system, which is relatively insulated from other neurocognitive systems, has been seriously challenged by our growing knowledge of the brain's functional architecture. In this mini-symposium, we will explore the extent to which language processing and production engage the same neurocognitive mechanisms, representations and circuitry that support long-term memory, working memory, declarative memory and executive function. Our speakers will discuss studies using multiple complementary methods––fMRI, ERPs, MEG, eye-tracking, and neuropsychological work in patient populations. We will present evidence suggesting that language processing and production draw upon: 1) frontally-mediated control mechanisms that act to select the correct linguistic representation from competing alternatives to resolve linguistic ambiguity (Thompson-Schill), 2) fronto-parietal-temporal circuits that maintain higher-level representations within working memory, allowing spoken language comprehension to be guided by discourse context, rather than associations between individual words (Swaab), 3) hippocampal circuits that establish, recover, maintain and use declarative memory representations to process discourse (Duff), and 4) highly distributed semantic representations that interact with a context to generate semantic predictions, which can directly influence the neural circuits that are recruited to integrate incoming words into this context (Kuperberg). Together, we will examine which of these neural circuits are necessary for language processing, how they influence individual differences in language comprehension, and the consequences of their breakdown in patient populations (neuropsychiatric disorders and amnesia patients.

THE ROLE OF COGNITIVE CONTROL IN LANGUAGE PRODUCTION AND COMPREHENSION

Sharon L. Thompson-Schill, University of Pennsylvania, Philadelphia PA USA

For over a century, the relationship between left prefrontal cortex and language processing has been accepted, yet the precise characterization of this link remains controversial. Recent advances in both the psycholinguistic study of language processing and the neuroscientific study of frontal lobe function have converged on an intriguing possibility: The demands to resolve competition between incompatible characterizations of a linguistic stimulus may recruit top-down cognitive control processes mediated by prefrontal cortex. Under this account, the brain region traditionally known as "Broca's area" – one of the principle language centers in classical models of language dysfunction – may be better described in attentional than linguistic terms. This hypothesis draws on a large body of research into the function of prefrontal cortex, and contrasts with other more domain-specific accounts of the function of Broca's region. I will present recent evidence from a number of methodologies that demonstrate the link between frontally-mediated control processes and language production and comprehension. Evidence of shared regulatory mechanisms across domains has implications for the psychological and neural architecture of language and may broadly inform the study of both linguistic and nonlinguistic cognitive processes.

SPEECH AND SPAN: THE ROLE OF WORKING MEMORY IN SPOKEN LANGUAGE COMPREHENSION

Tamara Y. Swaab, University of California, Davis CA USA

Spoken language comprehension involves managing a set of interrelated cognitive tasks, including activation of stored phonological and semantic representations of words, activation or construction of syntactic structure representations, determination of how newly activated words relate to previously introduced information, and ultimately the construction of a representation of the meaning of the message. Whereas the processing of individual words and syntactic structures in isolation can proceed relatively automatically, the construction of a coherent representation of the overall message may rely more on controlled processing, requiring maintenance of previous context and rapid integration of incoming input in Working Memory (WM). This is especially the case for spoken language comprehension since listeners have no control over the rate of input, nor can they ''re-experience'' parts of the speech signal. I will present evidence from healthy adults and schizophrenia patients indicating that individual differences or impairments in the controlled maintenance of context predict which kind of language information is prioritized or processed during spoken language comprehension: the meanings of individual words or the integrated representation of the language context. I propose that processing of individual word meanings or scenarios is supported by a ventral pathway in the temporal lobes and that controlled maintenance of the language context is supported by a dorsal pathway that connects prefrontal cortex with temporal cortex via the parietal lobes. The degree to which these pathways are activated not only depends on the language task at hand, but also on language processing differences between individuals as a function of WM.

THE ROLE OF DECLARATIVE MEMORY IN LANGUAGE USE AND PROCESSING

Melissa C. Duff, University of Iowa

Language use requires the creative (re)combination and integration of mental representations and the rapid and incremental processing of flexible and contextually defined mappings. How this is accomplished in the brain, however, is an open question. Attempts to link aspects of memory (e.g., working memory) to specific properties of language are longstanding. The hippocampal declarative memory system, however, has not received serious consideration as a neural/cognitive system involved in language use and processing. I propose that the hallmark characteristics of the hippocampal declarative memory system including its relational binding and representational flexibility, along with recent findings stretching the scope of hippocampus-dependent processes to include functions that operate in-the-moment, position this memory system as a key contributor to language. That is, the same processes by which the hippocampal declarative memory system creates and flexibly integrates representations across diverse sources in the formation of new memories, and maintains representations on-line, are the same processes necessary for the use and processing of language. Combining discourse analysis, eye-tracking, and neuropsychological methods I will present evidence of disruptions across various aspects of language use and real-time language processing in patients with hippocampal amnesia suggesting difficulty establishing, recovering, maintaining and using declarative memory representations in service of language use and processing. Linking disruptions in language to the declarative memory system demonstrates how promiscuously the hallmark processing features of the hippocampus are called upon by a variety of cognitive domains, including language, and expands the network of neural and cognitive systems that support language use.

WHERE MEMORY MEETS LANGUAGE: A DYNAMIC NEURAL ARCHITECTURE OF LANGUAGE COMPREHENSION

Gina Kuperberg[1,2,3]; [1]Tufts University, [2]Mass. General Hospital, [3]Martinos Center for Biomedical Imaging

Our semantic and real-world knowledge is highly distributed across the brain. How much of this stored knowledge can we draw upon to make sense of language? And how quickly can we mobilize it during real-time comprehension? I will discuss ERP, MEG and fMRI studies suggesting that, through connections to the left anterior temporal cortex, all our stored semantic knowledge is potentially available to facilitate our access to the semantic features of an incoming word within only 250ms of its onset. Moreover, in a locally constraining context, a pre-activated semantic representation can be linked to its stored orthographic, phonological and syntactic representation(s) to generate a lexical prediction within the left posterior lateral temporal cortex. I propose that we actually begin to integrate these lexical predictions into their context, ahead of any bottom-up input. This means that if an incoming word matches a prediction, it is very easily integrated. If, however, there is a prediction error at any level of representation (semantic, syntactic, phonological or orthographic), we recruit left inferior frontal, inferior parietal and sometimes dorsolateral prefrontal cortices in additional, and sometimes prolonged, attempts to combinatorially integrate that word into its context. Thus, direct neural links between semantic memory, the lexicon and domain-general control regions allow for a highly dynamic language comprehension system. This Bayesian framework helps us understand how we use our semantic and real-world knowledge to resolve ambiguity, protect us from misinterpretations in noisy environments, flexibly allocate resources in response to environmental demands, and learn new linguistic and non-linguistic information.

Mini-Symposium Session 5

NEUROSCIENCE AND LAW: PROMISE AND PERILS

Tuesday, April 16, 1:30 - 3:00 pm, Grand Ballroom B

Chair: Francis Shen, University of Minnesota Law School, MacArthur Foundation Research Network on Law and Neuroscience

Co-Chair: Anthony Wagner, Stanford University

Speakers: Martha J. Farah, BJ Casey, Anthony Wagner, Francis Shen

This mini-symposium will introduce recent and exciting developments at the intersection of cognitive neuroscience and law. Recent years have seen tremendous growth in neuroscience evidence in courts and legislatures. These recent developments include: the first hearing on admissibility of fMRI lie detection evidence; the first admission of qEEG evidence for a reduced sentence in a homicide case; and the U.S. Supreme Court citing brain development research in multiple cases. International developments are also in progress. France has established a national Neuroscience and Public Policy program; U.K. policymakers have been briefed on developmental neuroscience; and courts in India have considered brain-based memory evidence in criminal cases. These and other developments create a pressing need for increased dialogue between neuroscience and law. This CNS mini-symposium is an excellent opportunity to foster such dialogue, and to introduce the science community to some of the ways in which (for better or worse) their work is being used in legal settings. The four scholars in the proposed panel are contributing to this interdisciplinary field, participating in the MacArthur Foundation Research Network on Law and Neuroscience. In so doing, they have wrestled with the often difficult translation of scientific research into legal doctrine and policy. Panelists will speak both to the general challenges of this interdisciplinary enterprise, as well as to specific insights gleaned from their scholarship on topics such as brain-based memory and lie detection; adolescent brain development and criminal responsibility; neuroethics; and the evidentiary challenges faced by courts and legislatures in evaluating neuroscientific data.

NEUROSCIENCE, RESPONSIBILITY, AND THE LAW

Martha J. Farah, University of Pennsylvania

The issue of neuroscience and responsibility has drawn significant academic interest, as well as media coverage. In this first talk, Dr. Farah, Director of the Center for Neuroscience and Society at the University of Pennsylvania, will discuss the fundamental distinction between: (1) the use of neuroscience to question the very idea of free will and thus challenge the foundations of law, and (2) the use of neuroscience, working within existing legal frameworks, to help establish relevant legal facts such as capacity for self-control or memory of a crime scene. By establishing this distinction at the start of the panel, Dr. Farah will lay the groundwork for the subsequent panel talks on developmental neuroscience, and on memory detection. Neuroscientific evidence of cognitive impairment is already being used in courts to support arguments for diminished legal responsibility. Focusing on the issues of self-control and addiction, Farah will assess whether this trend is likely to continue and whether such developments should be welcomed. As the public learns more about advances in the neuroscience of decision-making, antisocial behavior and so forth, will these changing societal intuitions produce a shift in the system of legal punishment? Will cognitive neuroscience shed new and useful light on the mental states and abilities that the law deems relevant in assessing responsibility? Farah will address these questions, as she explores the present and future potential of neuroscience to provide useful information to legal actors.

DEVELOPMENTAL NEUROSCIENCE AND CRIMINAL RESPONSIBILITY

BJ Casey, Cornell University

The criminal justice system continues to debate how best to respond to and to help prevent adolescent criminal behavior. Increasingly, cognitive neuroscience is contributing to these debates. In the 2012 U.S. Supreme Court case, Miller v. Alabama, for instance, which "forbids a sentencing scheme that mandates life in prison without possibility of parole for juvenile offenders," Justice Elana Kagan noted that "developments in psychology and brain science continue to show fundamental differences between juvenile and adult minds" in "parts of the brain involved in behavior control." As the Supreme Court, as well as lower courts and legislatures, increasingly look to neuroscience to inform their judgments, new questions arise about how this science is (and should be) used by judges and policymakers. In this talk, Dr. Casey will discuss the potential legal relevance of our growing understanding of the developmental influences on adolescent decision-making and risk-taking. Although adolescents are quite capable of making informed decisions, in the heat of the moment, their decisions are often suboptimal. Casey will highlight her work and others showing that these poor decisions may be due to enhanced activity of deep structure in the brain (ventral striatum) to appetitive cues in adolescents in the absence of a mature top down control from slower developing prefrontal regions. Casey will consider the promises, and limitations, of the current knowledge base for informing legal decision making and discuss the ways in which the research has been influenced by collaborative work with legal scholars.

FMRI-BASED MEMORY AND LIE DECTION

Anthony Wagner, Stanford University

Decisions at many stages of the legal process are frequently informed by testimonial evidence. Relevant legal decision makers––e.g., jurors, judges, attorneys, and parole board members––are frequently faced with the challenge of deciding whether testimonial evidence is accurate or inaccurate. For instance, legal decision makers often must decide whether they believe an eye witness's memory to be

accurate or mistaken; at other times, decision makers must decide whether they believe testimony to be honest or dishonest. How these decisions are made often dramatically affects whether a fair and just legal outcome is reached. Development of methods capable of detecting deception and memory with high sensitivity and specificity, while being robust to countermeasures, could greatly improve the legal system. On the other hand, premature or improper use of brain-based detection techniques could do serious harm. These possibilities are no longer purely academic speculation, as attempts to introduce brain-based lie detection and memory detection evidence in the courts have increased in recent years. In light of these legal developments, this talk will provide an assessment of the current and future feasibility of using fMRI to identify and characterize the neural processes associated with lying and remembering in legally relevant contexts. The talk will consider what is known and not known about fMRI-based lie detection, and will discuss on-going research examining whether memories can be detected at the individual-subject and individual-event levels, as is often required by the legal system.

THE FUTURE OF NEUROSCIENCE AND LAW

Francis Shen[1,2]; [1]University of Minnesota Law School, [2]MacArthur Foundation Research Network on Law and Neuroscience

In this final talk, Dr. Shen, the Executive Director of Education and Outreach for the MacArthur Foundation Research Network on Law and Neuroscience, and co-author of the first law coursebook on Law and Neuroscience, will discuss how neuroscience is likely to be at times adopted, and at times rejected, across different legal contexts. The talk will emphasize the distinction between scientific certainty versus legal certainty, and how this difference animates much of the debate about whether, and how, neuroscience should be used in law. The talk will provide context, by summarizing (beyond the other three talks) the many ways in which neuroscience is already being contemplated by law. The talk will then discuss law's rules governing admissibility of expert evidence in court, and why, in the criminal law, this evidence has appeared primarily for sentencing rather than guilt determinations. The talk will next discuss the possible constitutional limitations on the collection and use of certain neuroimaging evidence. Finally, the talk will discuss ways in which neuroscience experiments might be made more legally relevant. The talk will highlight emerging research on the neural correlates of criminal mental states as one example of a successful collaboration between legal scholars and cognitive neuroscientists. The talk will conclude by discussing the rise of: new funding sources as the MacArthur Law and Neuroscience Network; interdisciplinary neurolaw conferences; cross-listed Law and Neuroscience courses for students; and outreach efforts to disseminate law and neuroscience materials to the public.

Poster Schedule

Poster sessions are scheduled for Saturday-Tuesday in the Pacific Concourse Exhibit Hall of the San Francisco Hyatt Regency Hotel. All attendees must present their CNS 2013 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 2013 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.

Poster Session	Date	Setup Begins	Session Begins	Session Ends	Take-Down Completed
A	Saturday, April 13	3:00 pm*	3:30 pm	6:30 pm	7:00 pm
B	Sunday, April 14	7:30 am*	8:00 am	11:00 am	11:30 am
C	Sunday, April 14	1:00 pm*	1:30 pm	4:30 pm	5:00 pm
D	Monday, April 15	7:30 am*	8:00 am	11:00 am	11:30 am
E	Monday, April 15	1:00 pm*	1:30 pm	4:30 pm	4:35 pm
F	Monday, April 15	4:35 pm	5:00 pm	8:00 pm	8:15 pm
G	Tuesday April 16	7:30 am*	8:00 am	11:00 am	11:30 am
H	Tuesday April 16	1:00 pm*	1:30 pm	4:30 pm	4:35 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.

** Please remove your poster promptly at take down complete time, so that the next presenter may set up their poster.

Poster Session A

A1

NEURAL CORRELATES OF SELECTIVE ATTENTION TO SOUND OBJECT REPRESENTATIONS Kristina C. Backer[1,2], Claude Alain[1,2]; [1]Rotman Research Institute, [2]University of Toronto — The object-based account of auditory attention postulates that we can selectively attend to one of several sound object representations in short-term memory (STM) even in the absence of relevant external stimuli, through top-down, reflective processing. The present study aimed to test this hypothesis using EEG and to assess whether attention to a sound object representation is domain-general (i.e., unspecific to a particular feature) and/or domain-specific (i.e., attention to semantic (what) or spatial (where) feature modulates the neural responses). Participants were presented with four different sounds from four possible locations simultaneously (i.e., memory array), followed by either an informative or neutral retro-cue during the retention interval, and then a single-item memory probe. Participants indicated whether or not the probe's location matched its original location within the memory array. Informative Semantic and Spatial retro-cues led to faster reaction times compared to Neutral retro-cues. Informative Semantic and Spatial retro-cues generated a larger sustained potential than Neutral cues over the left frontocentral scalp region from about 500 to 1500 ms post-retro-cue onset; this sustained potential's amplitude was similar across informative Semantic and Spatial retro-cue trials. A time-frequency analysis showed that both Semantic and Spatial retro-cues led to greater alpha suppression at parietal sites than Neutral trials for the duration of the sustained potential (i.e., ~500 to 1500 ms post-cue onset). These findings provide novel evidence for a domain-general mechanism of attentional orienting to an auditory representation held within STM.

A2

EFFECTS OF MONAURAL VERSUS BINAURAL STIMULUS PRESENTATION ON THE NOVELTY P3 Adithya Chandregowda[1], Yael Arbel[1], Emanuel Donchin[1]; [1]University of South Florida — We investigated the effects of monaural (right or left ear) and binaural stimulus presentation on Novelty P3 and the P300. Healthy young adults were presented with stimuli via circumaural headphones either to their right ear (group-A), their left ear (group-B), or to both ears (group-C). The stimuli consisted of: frequent tones (200 Hz) which were presented on 80% of the trials, rare tones (650 Hz) which were presented on 10% of the trials, and novel (bizarre) sounds which were presented on 10% of the trials. A practice block was used to familiarize participants with the three types of auditory stimuli. During the experiment, participants were instructed to count the number of bizarre sounds. It is important to note that in all three groups (A, B & C) novel stimuli elicited both the Novelty P3 and the P300, supporting previous findings that "task irrelevancy" is not a mandatory condition for the elicitation of the Novelty P3. Our results indicated that the binaural stimulus presentation (group-C) had a suppressive effect on the amplitude of the Novelty P3 as compared to monaural stimulus presentation (groups-A and B). Such suppressive effects were not seen for the P300. These results suggest that the neural activity that gives rise to the novelty P3, which is viewed as an orientation related response, is sensitive to the part of auditory-pathway that is being stimulated (right, left or both). Additional research is needed to elucidate whether a similar pattern can be found in free field sound localization.

A3

INVARIANCE OF THE EARLY BILATERAL NEGATIVITY IN AUDITORY TARGET IDENTIFICATION Marissa L. Gamble[1], Andrew H. Pilling[1], Marty G. Woldorff[1]; [1]Duke University — Previously (Gamble & Woldorff, under review), using a rapid, temporally distributed, auditory stimulus paradigm (10 stimuli in 500 ms), we found a differential early bilateral negativity (EBN) beginning at 60 ms for pitch-deviant targets relative to pitch-deviant nontargets, indicating nonlateralized target identification. This was followed by the lateralized N2ac ERP component (Gamble & Luck, 2011), reflecting the focusing of attention to the targets. It is unclear whether the rapid stimulus presentation or the large pitch differences is the catalyst for this EBN effect. Mismatch negativity (MMN) paradigms with much slower (250 ms) SOAs have not shown this early target-specific effect, suggesting that longer SOAs may reduce or eliminate the need for an early target identification mechanism. Here, 10 sounds were presented (half to each ear) on each trial at three SOAs (50, 150, 250 ms, separate blocks). These 10 stimuli consisted of one high, one low, and eight standard tones presented in pseudo-random order, with high and low deviants to opposing ears. One deviant was designated the target in each block, which participants had to identify and discriminate if it was amplitude modulated. The contralateral-minus-ipsilateral difference waveforms for targets versus nontargets, indexing the focusing of attention (the N2ac), was present across SOAs. In addition, the absolute value of the target-related enhancement of the EBN was consistent across all SOAs, but was multiplicatively larger at the short SOAs. These results indicate that presentation rate does not fully explain this early target-specific enhancement, although faster SOAs seem to augment this effect.

A4

VISUAL WORKING MEMORY CAPACITY PREDICTS AUDITORY SELECTIVE ATTENTION IN MULTIPLE CONTEXTS Ryan Giuliano[1], Christina Karns[1], Helen Neville[1]; [1]University of Oregon — Individual differences in working memory capacity are a powerful measure of variation in intellectual ability, predicting fluid intelligence and real-world outcomes such as SAT scores and GPA. However, much research suggests that variations in capacity do not arise from the amount of available storage space per se but rather from the ability to control attention, with models of working memory stipulating this as a domain-general attention resource. This relationship has been demonstrated directly in low-level attention tasks as reduced capture associated with larger working memory capacities. Yet, to our knowledge there is little research demonstrating a relationship between attention and working memory across sensory modalities, drawing into question the assumption of a domain-general attentional resource. We directly tested this by examining ERP indices of auditory selective attention and individual estimates of visual working memory capacity in entirely separate tasks. We report findings from three separate experiments: each demonstrate that individual differences in visually-measured working memory capacity predict the magnitude of attention-related modulation in auditory ERPs. In two non-linguistic tasks, memory capacity predicted both spatial and temporal auditory capture behaviorally and was mirrored by changes in ERPs during each experiment. In a linguistic attention task, we observed a novel, early-latency P1 attentional modulation of auditory ERPs for linguistic stimuli, and this effect was predicted by individual estimates of capacity. These findings provide strong support for the domain-generality of the attentional control mechanism implicated in the wide variation of working memory capacity across individuals.

A5

HAPPY HOUR IN YOUR HEAD: UN-MIXING THE COCKTAIL PARTY IN YOUR BRAIN Dillon A. Hambrook[1], Matthew S. Tata[1]; [1]University of Lethbridge — Your brain can select one auditory stream from a complex mixture. This is the classic cocktail party effect. Attentional selection gives that stream access to a network of brain areas that do different jobs but work on the same input. One theory suggests that endogenous neural oscillations allow activity in these different subsystems to be bound together. However, recent evidence shows that neural oscillations respond to exogenous signals as well. Theta band (3-7 Hz) electroencephalogram (EEG) tracks the dynamic envelope of rhythmic stimuli such as speech. It is possible that by selectively entraining neuroelectric dynamics to acoustic dynamics, the selected speech envelope gains privileged access to a synchronized network that performs tasks including: memory encoding, decision making, and response planning. Unsynchronized input is excluded from this network. The brain might solve the cocktail party problem by selective theta-band coherence with a single acoustic envelope. We tested this theory using a selective listening task with target and distractor speech presented at different locations. We recorded neuroelectric dynamics with dense-array EEG. By convolving the EEG response with a signal derived from the individual acoustic dynamics of target and distractor streams, we effectively filter

and un-mix the EEG response and identify phase-locked activity unique to each stream. We show an attentional effect in this evoked response lagging the speech signal by 100-200ms and a sustained difference in the evoked potential lagging the speech signal by 200-500ms. These data are consistent with the theory that phase tracking offers a solution to the cocktail-party problem.

A6

LATERALITY IN ORIENTING 'WHAT' AND 'WHERE' AUDITORY ATTENTION: A BIMODAL BRAIN IMAGING STUDY WITH FUNCTIONAL NEAR-INFRARED SPECTROSCOPY AND ELECTROENCEPHALOGRAPHY

Masamitsu Harasawa[1], Junji Ohyama[2], Masanori Nambu[3], Michiteru Kitazaki[3]; [1]Japan Broadcasting Corporation, [2]National Institute of Advanced Industrial Science and Technology, Japan, [3]Toyohashi University of Technology — In these years evidence of separate 'what' and 'where' auditory systems is increasing. However, neural network involved in orienting object and spatial auditory attention is little known. Here we investigated the mechanisms of orienting auditory attention by a bimodal brain imaging technique. Methods: Experimental task was detecting target sound items among dichotically presented sound sequences (25 seconds) consisted of about 30 short (200 ms) pure tones including 15% targets (pure tone with a 40 ms gap). In half trials high (1200 Hz) and low (600 Hz) tones were presented to left and right ears respectively and in the other half vice versa. Targets appeared only in one side cued at 10 seconds before the stimulus onset by a pitch of sound ('what') or a visual arrow ('where'). The two modalities of cerebral activities were measured simultaneously, a change of oxy-hemoglobin concentration with functional near-infrared spectroscopy and an alpha oscillation (8-12 Hz) with electroencephalography. We analyzed the correlation between them. Results: In 'what' condition, attending the left induced significant negative correlation several seconds after the stimulus onset. In 'where' condition, attending the right induced significant positive correlation during cue-lead time. The both significant correlations were salient in bilateral temporal cortices. Conclusions: The combination of the direction of attention and the type of attention indicated the clear laterality in regulation of attention network and that alpha rhythm is involved in suppression of sensory input when attending feature of sound but not when attending 'location' of sound.

A7

AGE-RELATED DIFFERENCES IN COGNITIVE AND NEURAL ACTIVITY IN TARGET PROCESSING: UTILIZING PCA TO INVESTIGATE THE SPATIAL DISTRIBUTION OF THE P3B

Brittany Alperin[1], Katherine Mott[1], Tatyana Zhuravleva[1], Phillip Holcomb[2], Dorene Rentz[1], Kirk Daffner[1]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — The neural underpinnings of age-related changes in the processing of designated targets remain uncertain. In young adults, research using grand average ERPs has identified a posteriorly-distributed P3b component, interpreted as an index of categorization/memory updating, and an anteriorly-distributed P3a component, interpreted as an index of orienting/executive control. One of the most common observations in the ERP literature is that the P3b component becomes more anteriorly distributed as a function of age. Does this finding represent an age-related shift in the neural processors that mediate categorization/updating, or is it a reflection of overlapping components that index different cognitive operations? This question was investigated using temporospatial principal component analysis (PCA). ERPs were measured in 12 young and 15 old well-matched adults during a task in which they responded to designated target letters. Consistent with other reports, grand average ERPs suggested that old subjects generated a more anteriorly-distributed target P3b that encompassed a larger portion of the scalp. However, temporospatial PCA revealed two spatially distinct factors: an anterior P3a and a centro-posterior P3b. For the old subjects, the P3a and P3b did not differ in amplitude. For the young subjects, the P3b was substantially larger than the P3a. In summary, PCA revealed that rather than having a more widely/frontally distributed target P3b, older subjects had a large P3a and P3b overlapping during the same temporal interval. Age-related increase in P3a amplitude may be due to older subject's increased reliance on executive control operations that provide extra scaffolding for carrying out the categorization process.

A8

SPATIAL ATTENTION CONTROL AS A FUNCTION OF NORMAL AGING AND WORKING MEMORY CAPACITY

Danielle Charney[1], Edward Golob[1]; [1]Tulane University — Individual differences in attentional control are implicated in both cognitive aging and working memory capacity (WMC). However, direct comparisons of attention control in aging and WMC are just emerging and little is known about their neural correlates. Here we examined attention control in a spatial attention task as a function of age and WMC. Auditory event-related potentials (ERPs) previously shown to indicate spatial attention gradients (P3a, slow wave) were recorded to test the hypothesis that attentional gradients are more shallow in aging and lower WMC. Young (n=20, 19±1 yrs.) and Older adults (n=11, 72±7) performed two WMC tasks (operation and symmetry span). In the attention task subjects heard random sequences of white noise drawn from five horizontal locations (180° range, 45° intervals; 4 non-targets and 1 target). Left or right targets (±90°) were tested in separate blocks. P3a amplitudes to non-targets had linear increases with greater distance from the attended location for both age groups ($p<.001$). Older adults overall had a shallow slope in P3a amplitude (T±90°, $p<.001$), and low WMC older adults had the shallow gradient compared with high WMC adults ($p<.05$). Older adults also had smaller slow wave amplitudes (600-800 ms latency) compared to younger adults ($p<.004$). Older adults with low WMC exhibited the shallowest slow-wave gradient compared to high WMC adults ($p<.03$). The results suggest that spatial attention control is less focused in older adults with low WMC, and supports the idea that attention control is a major factor underlying WMC.

A9

VISUAL SEARCH AND THE N2PC IN CHILDREN

Jane Couperus[1], Colin Quirk[1]; [1]Hampshire College — While there is growing understanding of visual selective attention in children, some aspects such as selection in the presence of distractors are not well understood. Adult studies suggest that when presented with a visual search task, an enhanced negativity is seen beginning around 200ms (the N2pc) that reflects selection of a target item among distractors (Eimer, Kiss, and Nicholas, 2011). However, as to date this effect has only been examined in adults, this study was designed to investigate the presence of the N2pc in children. Fifteen children (ages 10-12) and 18 adults (ages 18-22) completed a visual search task in which they were asked to attend to a fixation surrounded by 7 grey and 2 colored (red, green, or blue) letters and numbers. Participants were asked to attend to one of the three colors and indicate (when present), if it was a letter or number, leaving the other colored item as a distractor. Three types of displays were analyzed at parietal electrodes P7 and P8; lateral target/lateral distractor (LT/LD), lateral target/midline distractor (LT/MD); and midline target/lateral distractor (MT/LD). Both adults and children showed a significant increased negativity contralateral as compared to ipsilateral to the target (reflected in the N2pc) in both displays with a lateral target (LT/LD $F(1,32)=14.49$, $p=.001$ and LT/MD $F(1,32)=7.15$, $p=.012$) while no such effect was seen in displays with a midline target (MT/LD and NT, $p>.05$). This suggests that children, like adults, utilized additional resources to select a target item when distractors are present.

A10

AGE-RELATED DIFFERENCES IN MULTITASKING UNDER WORKING MEMORY LOAD

Joey Ka-Yee Essoe[1], Camarin Rolle[1], Jason Samaha[1], Kayla Bowen[1], Joaquin Anguera[1], Adam Gazzaley[1]; [1]University of California at San Francisco — Cognitive aging research has demonstrated that aging negatively impacts multitasking abilities. In the present experiment, we examined how perceptual discrimination performance in the setting of another task (visuo- motor tracking) changes as a function of age and working memory load. Perceptual discrimination abilities were tested in 21 younger (22.9yrs ± 3.1) and 18 older adults (67.1yrs ± 5.9) while engaging in a custom-designed video game ("NeuroRacer"). A 2x2 design was used to assess discrimination abilities across the two age groups with the following manipulations: (1) Working memory (WM) load: remember either 0 or 2 items, (2) Visuomotor tracking (Drive): keep the car at the center of the road or have the car on auto-pilot. Analyses revealed a 3-way interaction of perceptual discrimination for response time (RT) between WM, Drive, and age group ($p=.03$). Interrogation of this interaction involved splitting by multitasking vs. non-multitasking, which revealed a significant

2-way interaction of age and WM load only in the multitasking condition (p=.006). Interrogating that 2-way interaction revealed that older adults show a significant increase in RT in the presence of WM load (p<.01), while RT in younger adults is not impacted significantly by load (p=.41). When controlling for RT, there were no differences in accuracy between younger and older adults suggesting the observed effects were not influenced by a speed-accuracy trade-off. Thus, the present findings indicate that only older adult's multitasking abilities are negatively impacted by the presence of a working memory load.

A11

TWO ALLELES OF THE DOPAMINE D4 RECEPTOR GENE RELATE TO EXECUTIVE ATTENTION IN THE ATTENTION NETWORK TEST IN YOUNG AND OLD ADULTS

Katherine R. Gamble[1], Halley G. Feldman[1], James H. Howard, Jr.[1,2,3], Darlene V. Howard[1]; [1]Georgetown University, [2]The Catholic University of America, [3]Georgetown University Medical Center — The present study investigated how two alleles of the dopamine D4 receptor (DRD4) gene relate to executive attention as assessed by the Attention Network Test (ANT). DRD4 primarily influences neurotransmission in the prefrontal cortex, and has effects on cognition (Savitz et al., 2006), with particular implications in conflict, error detection and response (Frank and Fossella, 2011), suggesting that some DRD4 genotypes might influence executive attention in the ANT, which involves conflict detection and inhibition. We genotyped 32 older adults and 35 college-aged adults for a -1217 guanine insertion/deletion polymorphism and a 120 base pair repeat allele in DRD4. The design for the -1217 insertion/deletion was 2 (Age: Young vs. Old) x 3 (Genotype: GG/GG vs. G/GG vs. G/G), and for the 120 base pair repeat was 2 (Age) x 2 (Genotype: long/short vs. long/long). For the -1217G insertion/deletion, we found a significant main effect of age and an age x genotype interaction, such that older adults with two guanine deletions had significantly worse executive attention than the heterozygous insertion/deletion or the insertion class, while there were no significant genotype effects in the young group. For the 120 base pair repeat, there was a significant main effect of genotype, and despite there being no interaction with age, for the older, but not young adults, the heterozygous (long/short) group had significantly better executive attention than the homozygous long group. These results suggest that genetic effects of DRD4 on executive attention become more pronounced with age.

A12

ATTENTION AND LONG-TERM MEMORY PROBLEMS IN CHILDREN WITH BRAIN TUMORS BEFORE AND AFTER MEDICAL INTERVENTION

Theda Heinks[1,2], Maja Steinlin[1,2], Kurt Leibundgut[1]; [1]University Children's Hospital Berne, Switzerland, [2]Center for Cognition, Learning and Memory, University of Berne, Switzerland — Extensive research has shown that survivors of childhood cancer often demonstrate neurocognitive deficits especially when the malignancies and/or the treatments (surgery, chemotherapy, radiation therapy) involve the Central Nervous System (CNS). Goal of this study was to monitor cognitive abilities over the course of treatment with a standardized comprehensive neuropsychological test battery. All children (ages 3-18; n=61) hospitalized at the University Children's Hospital Berne for treatment of malignancies underwent their first comprehensive neuropsychological assessment (T1) in the days following initial diagnosis. The second neuropsychological assessment (T2) was performed 8 weeks after the end of chemo- and/or radiation therapy, the third assessment (T3) 1 year after the end of treatment. Results show that immediately after diagnosis children with brain tumors show significantly worse performance on tests of verbal learning, long-term memory and attention compared to children with non-CNS malignancies. At this point the two groups do not differ, however, in other cognitive areas (FSIQ, performance speed, executive functions, working memory). Immediately and one year after the end of medical treatment the differences between the two groups are still evident and in measures of attention and memory grow even more significant. This shows that even before any medical treatment verbal memory and attention are cognitive areas especially vulnerable to malignancies involving the CNS. Chemo- and/or radiation therapy then further contribute to cognitive decline that continues even after treatment is completed. Future steps of this study will include implementation and evaluation of a cognitive training program for affected children.

A13

5-HTT AS A FACTOR OF RISK AND RESILIENCE IN YOUNG CHILDREN

Elif Isbell[1], Theodore Bell[1], Helen Neville[1]; [1]University of Oregon — Carrying either one or two copies of the short allele of the serotonin transporter linked polymorphic region (5-HTTLPR) has been associated with susceptibility for psychopathology in interaction with adverse life events (e.g. Caspi et al., 2003; Cicchetti, Rogosch, & Sturge-Apple, 2007). However, carriers of the short allele (S-carriers) have also been observed to perform better than individuals homozygous for the long allele in various aspects of cognition, such as working memory and cognitive control (e.g. Anderson, Bell, & Awh, 2012; Strobel et al., 2007). To our best knowledge, how the polymorphisms of 5-HTTLPR relate to the development of socio-emotional, and cognitive skills has not been investigated among the same group of participants. Using a sample of one hundred and sixty-eight 3- to 5-year-old children from lower socioeconomic backgrounds, we examined the relationship between the polymorphisms of 5-HTTLPR and individual differences observed in problem behaviors and social skills, as well as in language, non-verbal intelligence, and neural indices of attention. The teachers reported the S-carrier children to display more problem behaviors than children homozygous for the long allele. Furthermore, teachers rated the S-carriers as children with poorer social skills. In contrast, S-carriers outperformed the children homozygous for the long allele in measures of receptive language and nonverbal IQ. Moreover, S-carriers showed more pronounced selective attention effects as measured by event-related potentials (ERPs). These findings suggest that while 5-HTT can be a factor of risk for psychopathology, it can also promote resilience for cognitive abilities in the face of early life adversity.

A14

AGING, EMPATHY, AND PROSOCIALITY

Janelle Beadle[1], Alexander Sheehan[1], Brian Dahlben[1], Angela H. Gutchess[1]; [1]Brandeis University — GOALS. In younger adults, experiencing emotional empathy (e.g., compassion) increases prosocial behaviors (e.g., charitable donation), but this relationship has been rarely investigated in older adults. Separate lines of research have shown that a majority of older adults engage in prosocial behaviors, and there is preliminary evidence for increased emotional empathy with age. Thus, we investigated the degree to which age-related differences in emotional empathy may be associated with prosocial behavior. METHODS. Fourty-eight neurologically and psychiatrically healthy adults participated in the study, including 24 younger (age: M=19.8, SD=2 years) and 24 older (age: M=77.9, SD= 7.7 years) adults. Participants believed they were playing an economic game (Dictator Game) against a series of two opponents and read a note from each "opponent" (a pre-prepared note) prior to playing the game against them in order to induce an empathetic or neutral state. After each induction, emotional empathy was measured through self-report ratings and behavior on the Dictator Game. RESULTS. There were no age-related differences in empathy ratings. However, older adults showed greater prosocial behavior than younger adults, giving more money to their opponent after undergoing the empathy induction than the neutral induction. CONCLUSIONS. This study demonstrates that experiencing empathy may produce greater prosocial behavior in older than younger adults. Furthermore, older adults were not simply more generous at baseline, but instead only after empathy had been induced. Future research may consider factors that may mediate the relationship between empathy and prosocial behavior in aging such as changes in executive function ability.

A15

MIND YOUR ELDERS, UNLESS THEY ARE WRONG: ERP EVIDENCE FOR AN EARLY DEVELOPMENTAL SHIFT IN RESISTANCE TO FALSE NEGATIVE FEEDBACK

Grace Berman[1], Elvira Zobel[1], Joel Voss[1], Margaret Briggs-Gowan[2], Lauren Wakschlag[1]; [1]Northwestern University Feinberg School of Medicine, [2]University of Connecticut School of Medicine — Evidence suggests that young children are especially influenced by adult feedback even when contrary to objective reality, yet little is known about causes of this heightened susceptibility to false feedback or why it becomes less influential with age. We therefore sought mechanistic information by examining changes in neural correlates of false feedback within a narrow developmental window. ERP correlates of correct performance in a developmentally adapted Go/No-Go paradigm were identified in 19 children

(49-78months). The paradigm included a rigged block in which false negative feedback was given, and we compared behavior and ERPs for younger (mean=55mo.) to older (mean=68mo.) children to identify developmental shifts in susceptibility to negative feedback. For younger children only, correct responses during the rigged block were associated with significantly reduced amplitude of ERP correlates of response evaluation (the Correct-Response Negativity; CRN) relative to correct responses during standard blocks. This ERP correlate of disrupted evaluation following false feedback onset rapidly after correct responses (<100ms). Older children did not show this effect, despite equivalent self-reported frustration by the false negative feedback. Overall, CRN amplitudes were higher in older versus younger children, suggesting possible differences in response evaluation confidence. These findings indicate that false negative feedback interferes with rapid, potentially automatic, response evaluation in younger children. Strikingly, these rapid and substantial reductions in susceptibility occurred across a mere 13-month period. These findings help identify critical early periods during which neurocognitive processing is especially sensitive to modification by feedback, which could be used to guide developmental timing of preventive interventions.

A16

DEVELOPMENTAL PATTERNS OF NEURAL RESPONSES TO REWARDS DIFFER FOR SELF AND FRIENDS Barbara R. Braams[1], Berna Güroglu[1], Jiska S. Peper[1], Eveline A. Crone[1,2]; [1]Leiden University, The Netherlands, [2]University of Amsterdam, The Netherlands — In adolescence increased risk-taking is observed, possibly related to an imbalance between an earlier developing reward system and later developing fronto-parietal regions (Somerville, Jones & Casey, 2010). Also, in adolescence peer relations become more important. Peers influence risk-taking, although the exact mechanism is not yet clear. The aim of this study was to shed light on this interaction. 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, or another (disliked) person. On stimulus onset, when the outcome of the trial has not been revealed, striatum activation was highest when playing for Self, then Friend and playing for Other resulted in lowest striatum activation. Developmentally, a peak in striatum activation when playing for Self was identified in mid-adolescence. Whereas playing for Friend showed a linear increasing pattern. On feedback onset a Person x Outcome interaction was located in the striatum. Winning for Self and Friend resulted in striatum activation, whereas losing for Self and Friend resulted in deactivation. The pattern for the other player is reversed. The peak in striatum activation when playing for Self is consistent with predictions from the Somerville et al (2010) model. However, a linear increase of striatum activation when playing for Friend shows that striatum activation is dependent on contextual factors rather than a pure signal for reward. Possibly, striatum activation is dependent on social brain regions that are still developing in adolescence.

A17

NEURAL CORRELATES OF THE OWN-AGE BIAS IN YOUNGER AND OLDER ADULTS Jeffrey Brooks[1], Simon Davis[2], Jessica Komes[3], Roberto Cabeza[1]; [1]Duke University, [2]University of Cambridge, [3]Friedrich Schiller University of Jena — Although humans are often considered to be experts in face processing, recognition of different classes of faces differs substantially. For example, humans reliably exhibit the "own-race bias", a memory deficit for faces of a race different from one's own. Similarly, several studies suggest better recognition for faces of the viewer's own age group - an "own-age bias" (OAB). Studies of older adults have shown that they exhibit deficiencies in early stages of face processing, leading to recruitment of new functional networks to support face perception. However, it is unclear whether these age-related differences represent a meaningful response to the perceptual demands associated with face processing. To test the effects of age and visual complexity on face processing, we scanned younger and older adults using fMRI while subjects performed a similarity judgment on matched pairs of faces. We varied the complexity of the task by morphing one of the two faces. While we observed a main effect of similarity on both RT and accuracy for all subjects; there was no main effect of face type (young, old faces). fMRI analyses revealed a neural basis for the OAB in ventral temporal and frontal cortices, such that left fusiform and left frontal cortex responded selectively to own-age faces. Older adults showed decreases in activity in fusiform cortex with increasing difficulty, but increases in frontal activity. These results suggest that older adults may rely on a broader frontotemporal network to perform face discrimination, especially as this operation becomes more perceptually demanding.

A18

COOPERATIVE INVESTMENT IN ADOLESCENT SOCIAL NETWORKS Stephanie Burnett Heyes[1], Yeou-Rong Jih[1], Per Block[1], Jennifer Y Lau[1]; [1]University of Oxford — A multitude of changes in social attitudes and behaviour occur during adolescence. One notable change is the development of nuanced prosociality, with age-associated increases in prosocial moral reasoning and strategic cooperation. The current study investigated cooperation in two established UK school-based adolescent networks. Social ties were mapped exhaustively in a Year 9 (13-14yrs) and a Year 12 (16-17yrs) class using a social network questionnaire that assessed relationship duration, perceived nature (e.g. best friend, close friend), trust/confiding and companionship; a modified Dictator Game played with all other network members yielded a behavioural measure of cooperation. We used an analytic technique that takes into account statistical interdependence among observations to assess the relationship between bidirectional social ties and cooperative investment. In both networks, out-link strength (social ties reported by a participant toward peers) predicted investment – that is, adolescents invested more in individuals to whom they reported stronger ties. However, in only the older adolescent group did the difference between out- and in-link strength predict investment – that is, only older adolescents invested more in individuals who reciprocated strong ties. This is consistent with the notion that nuanced prosociality develops throughout adolescence. In the Year 12 network, but not in the Year 9 network, cooperative investment takes into account the extent to which authentic social ties are reciprocated. This ecologically valid experimental paradigm accounts for the strength of social ties within authentic social networks and has potential to further the understanding of adolescent cooperative dynamics and the development of nuanced prosociality.

A19

WHITE MATTER TRACT INTEGRITY IN LATE-LIFE DEPRESSION: ASSOCIATIONS WITH SEVERITY AND COGNITION Rebecca Charlton[1,2], Melissa Lamar[1], Olusola Ajilore[1], Aifeng Zhang[1], Shaolin Yang[1], Anand Kumar[1]; [1]Department of Psychiatry, University of Illinois at Chicago, Chicago, IL., [2]Department of Psychology, Goldsmiths University, London, UK — Although significant changes in both grey and white matter have been noted in Late-life Depression, the pathophysiology of implicated white matter tracts has not been fully described. Furthermore, associations with known cognitive deficits in Late-life Depression remain unclear. We examine the integrity of specific white matter tracts in Late-life Depression versus Health Controls. Participants aged over 60 years old were recruited from the community. The sample included 23 clinically diagnosed individuals with Late-life Depression and 23 Health Controls. White matter integrity metrics (fractional anisotropy, mean diffusivity, axial diffusivity, radial diffusivity) were calculated in bilateral Cingulum and Uncinate Fasciculus. Depression severity was measured using the Center for Epidemiological Studies Depression scale. Composite scores for Learning and Memory and Executive Function were created using standardized neuropsychological assessments. White matter integrity was lower in Late-life Depression versus Controls in Bilateral Cingulum and Right Uncinate Fasciculus ($p \leq .05$). In the whole sample, depression severity correlated with integrity in Bilateral Cingulum and Right Uncinate Fasciculus ($p \leq .05$). In patients, depression severity correlated with integrity of Left Uncinate Fasciculus ($p = .03$), this tract also correlated with Executive Function ($p = .02$). Among Controls, tract integrity did not correlate with depression scores; however Learning and Memory correlated with integrity of Bilateral Uncinate Fasciculus and Bilateral Cingulum; Executive Function correlated with Right Uncinate and Left Cingulum ($p \leq .05$). White matter tract-integrity was lower in Late-life Depression compared to Controls and was associated with depression severity across all participants. Tract-integrity was associated with cognition in both groups but more robustly among healthy controls.

A20

MINDFULNESS TRAINING FOR PATIENTS WITH EARLY-STAGE ALZHEIMER'S DISEASE AND THEIR CAREGIVERS

Jessica D. Creery[1], Michael Maslar[1], Jessica Kiragu[1], Paul J. Reber[1], Kathryn L. Gigler[1], Susan M. Florczak[1], Sandra Weintraub[1], M.-Marsel Mesulam[1], Ken A. Paller[1]; [1]Northwestern University — Mindfulness-based therapies can improve cognitive and emotional functioning in diverse clinical populations. People with neurodegenerative disorders need new strategies to help them cope with these challenges, as do their caregivers. Caregivers shoulder relentless pressure and responsibility, and are prone to depression and other disorders. We therefore tested an 8-week program in mindfulness tailored for combined groups of patients and their caregivers. The hope was to decrease stress, improve moods, and lessen the tendency to react in habitual but maladaptive ways. We hypothesized that practice with attention and coping skills in this intervention could produce cognitive and emotional benefits. Although the needs of patients and caregivers differ, keeping them together has some advantages. For example, caregivers worked with patients between sessions to help them practice the new skills. We acquired a set of cognitive, behavioral, and emotional measures both before and after the training period. We also tested an active control group to determine the extent to which mindfulness is specifically helpful. The control group engaged in repeated testing with an adaptive working-memory test in weekly group sessions over 8 weeks. Results showed that participants who received mindfulness training benefited in several distinct ways. Improvements were observed on a questionnaire-based quality-of-life measure in both patients and caregivers. Furthermore, depression symptoms lessened, and processing speed was faster on several cognitive tests. This research thus suggests that mindfulness practice represents a novel way to produce positive change in patients and caregivers, and that it should be applied more widely in elders.

A21

PRIOR EXPERIENCES IN ONLINE GAME MODULATE NEURAL REACTIVITY TO GAME-RELATED SCENES

Hyeon Min Ahn[1], Shin Ah Kim[1], Sang Hee Kim[1]; [1]Korea University — Excessive online gaming has been associated with increased neural activity to game-related images in dopaminergic neural systems including the striatum and orbitofrontal cortex. We wanted to examine whether this modulation is closely linked to prior experiences in online games. Eighteen healthy men (24.16 yrs ± 2.30) and nine women (23.88 yrs ± 2.31) with little or no past experiences with online games were recruited in this study. Participants were randomly assigned to one of the three groups. The game group played Diablo III 2 hrs/day for 5 days. The drama group watched a fantasy drama "Legend of the Seeker (LOS)" with the same schedule as the game group. The control group was free of any treatment. All participants completed two brain scanning sessions before and after the treatment. They viewed Diablo III images, LOS images and neutral images during scanning. Prior to the treatment, participants showed increased activation in the left striatum for the game images in contrast to neutral images. After the treatment we found that the game group showed greater activation for game images, in contrast to neutral images, in the right caudate, right amygdala, and left lateral orbitofrontal cortex as compared to the control group. Whereas the drama group showed greater activation for game images only in the parietal regions. Our results suggest that experience with online games may induce altered neural sensitivity to game-related cues in emotion and reward-related brain regions and help us to better understand the cognitive and neural pathology of online gaming addiction.

A22

SOCIAL AND NON-SOCIAL LEARNING OF FMRI-BASED NEUROFEEDBACK OF THE ACC: EFFECTS ON COGNITIVE INTERFERENCE

Eliza M. Alawi[1,2], Krystyna A. Mathiak[1,2], Yury Koush[4,5], Miriam Dyck[1,2], Julia Cordes[1,2], Saurabh Bhavsar[1,2], Tilman Gaber[1], Florian Zepf[1], Mikhail Zvyagintsev[1,2], Klaus Mathiak[1,2,3]; [1]RWTH Aachen University, Germany, [2]JARA-Translational Brain Research, Germany, [3]INM-1, Forschungszentrum Jülich GmbH, [4]École Polytechnique Fédérale de Lausanne, Switzerland, [5]CIBM, University of Geneva, Switzerland — Neurofeedback based on rt-fMRI trains subjects to regulate localized brain activity. Typically subjects see a visual display in form of a bar that indicates the level of activity in a selected brain region. We developed a new paradigm, in which social feedback is provided. We studied the effectiveness of social feedback on anterior cingulate cortex (ACC) activity and tested the psychological effects on cognitive interference. Healthy volunteers (n=18), trained on 3 days, were divided into 2 different learning groups; in one group social feedback was provided to learn to regulate ACC activity, the other group learned through standard non-social feedback. During social feedback, an avatar provided a positive facial expression (smile) when the level of activity in the ACC increased and it gradually became neutral when the activity decreased. During standard non-social feedback a moving green bar indicated the ACC activity. We conducted this study to test if social reinforcement can train control of localized ACC activity, if a transfer to sessions without feedback emerged and if a generalization of the training to a cognitive interference task takes place. Our preliminary results indicate that regulation of localized ACC activation was learned and transfer of learned ACC control to sessions without feedback emerged. This effect was stronger with social neurofeedback. Thus, social feedback improved learning to control localized ACC activity compared to standard feedback. Networks underlying the Simon effect were modulated at the ACC after neurofeedback training. Localized neurofeedback can selectively and specifically modulate networks underlying cognitive interference processes.

A23

A PRELIMINARY ANALYSIS OF AGGRESSIVE BEHAVIOR UNDER OXYTOCIN DOSE

Joe Alcorn[1,3], Nadeeka Dias[1,3], F. Gerald Moeller[2,3], Scott Lane[1,2,3]; [1]Neuroscience Program at the Graduate School of Biomedical Sciences, [2]Menninger Department of Psychiatry and Behavioral Sciences, [3]University of Texas Health Science Center at Houston. — Acute administration of oxytocin in human subjects has been shown to promote prosocial behaviors such as trust, generosity, and cooperation. Prosocial behaviors stand in contrast to antisocial behavior such as aggression. Aggression is an enduring problematic social behavior often resulting in deleterious consequences to criminal justice and public health systems. Aggression is prominent in antisocial personality disorder (ASPD), and exacerbated by the presence of a substance use disorder (SUD). The goal of this project is to investigate the acute effects of oxytocin (across three dose levels: 12IU, 24IU, and 48IU) on aggression in adult human subjects at high risk for aggression: those with ASPD and SUD. We measured subject's aggressive responding using the Point Subtraction Aggression Paradigm (PSAP), a well-validated laboratory measure of aggression, using a within-subjects counterbalanced design. The hypothesis is that OT administration will decrease human aggressive behavior compared to placebo. Preliminary data suggest that aggressive responding has differential effects, based on subject's baseline (pre-dose) level of aggressive responding. Specifically, subjects with low levels of baseline aggressive behavior show an increase in aggressive behavior at the 24IU dose followed by decreased responding at 48IU. Changes in aggressive behavior did not correspond with increased physiological arousal or mood.

A24

ANXIETY RELATED PERSONALITY TRAITS AND EMOTION REGULATION STRATEGIES PREDICT NUMBER AND INTEGRITY OF PROBABILISTICALLY TRACKED PATHWAYS BETWEEN THE AMYGDALA AND PREFRONTAL CORTEX REGIONS

Annuschka Eden[1], Jan Schreiber[2], Katharina Keuper[1], Inga Laeger[3], Peter Zwanzger[3], Christian Dobel[1]; [1]Institute for Biomagnetism and Biosignalanalysis, University Hospital Muenster, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, [3]Department of Psychiatry, University Hospital Muenster — Functional connectivity between the amygdala and the prefrontal cortex (PFC) is inversely correlated with anxiety, indicating greater connectivity in low-anxious persons (i.e. Kim et al., 2011; Pezawas et al., 2005). On the basis of this, a framework was adopted that assumes medial PFC regions to actively regulate the amygdala (i.e. Bishop, 2007; Hare et al., 2008; Hariri et al., 2003). Investigating analog connections in white matter, Kim and Whalen (2009) applied Diffusion Tensor Imaging (DTI) and found that trait anxiety predicted the structural integrity of an amygdala-PFC pathway. However, the authors did not calculate the tracts on their sample but relied on a depression-specific pathway defined by another independent study. Critically, this tract merely connected the amygdala and the perigenual anterior cingulated cortex. Here, we collected and analyzed DTI-data and measures

of anxiety related personality traits (neuroticism, trait anxiety) as well as emotion regulation strategies of 48 female persons. By use of probabilistic tractography we individually calculated pathways between the amygdala and PFC regions that have consistently been associated with emotion/anxiety related functioning. We hypothesized anxious persons and persons with ineffective emotion regulation strategies to dispose of lesser/weaker pathways. Results confirm that anxious personality traits are associated with lesser pathways and lower fractional anisotropy between amygdala and the dorsolateral as well as the ventromedial PFC. Ineffective emotion regulation strategies are associated with lesser pathways between amygdala and the dorsolateral as well as the dorsomedial PFC. These data can be interpreted as a structural complement to functional top-down emotion regulation processes.

A25

EFFECTS OF VALENCE CONTEXT ON SLEEP DEPENDENT CONSOLIDATION OF EMOTIONAL MEMORIES Bengi Baran[1], Rebecca M.C. Spencer[1]; [1]University of Massachusetts Amherst — Over three experiments we investigated the effects of sleep on memory and emotional reactivity for picture stimuli in varying emotional contexts. Participants provided valence and arousal ratings for picture stimuli before and after intervals (12 hrs) containing sleep or wake. Recognition of the stimuli from session 1 was also probed 12 hrs later. In Experiment 1, in which stimuli were negative or neutral in valence, we found that overnight sleep was associated with better memory for negative [$F(1,79)= 5.53$, $p= .02$] and neutral pictures [$F(1,79)= 8.51$, $p= .004$] relative to wake. Furthermore, the initial negative emotional reactivity was relatively preserved over sleep, an effect that correlated with more time spent in late-night REM sleep. However, when the same neutral pictures were paired with positive pictures in Experiment 2, we found that sleep did not benefit neutral pictures ($p=.61$) but memory for positive pictures tended to be greater following sleep relative to wake[$F(1,68)= 3.76$, $p=.06$]. Emotional reactivity for positive pictures was attenuated (towards neutral) in both sleep and wake groups but the magnitude tended to be greater in the sleep group [$F(1,68)= 3.09$, $p= .08$]. Finally, in Experiment 3, when positive, negative and neutral pictures were combined, sleep again enhanced memory for neutral pictures [$F(1,33)= 7.27$, $p=.01$]. Thus, neutral memories encoded in the presence of negative items were consolidated over sleep but not when encoded in the presence of positive items alone. These results support a role of sleep in selectively enhancing memories but only in restricted emotional contexts.

A26

EMBODIMENT AND MEMORY Jenny-Charlotte Baumeister[1], Raffaella I. Rumiati[1], Francesco Foroni[1]; [1]SISSA - Trieste — According to the theories of embodied cognition, the processing of emotional content strongly relies on a re-experience of the emotional information in one' self (embodied simulations), which, amongst other bodily reactions, is reflected in spontaneous facial expressions that occur in accordance to the relevant emotion. That is, recognizing and interpreting emotional information (e.g., about happiness) involves spontaneous facial muscle resonance, like a spontaneous facial expressions of happiness. No research, so far, has investigated whether embodied simulations have any role beyond initial processing/recognition, helping memory retrieval of emotional information. In the present study we test whether embodied simulations (during encoding and/or retrieval) play a role in memory for emotional material. Eighty-one participants underwent a memory task involving emotional and neutral words consisting of an encoding and retrieval phase. Depending on the experimental condition, facial muscles were blocked by a hardening facial mask either during encoding, or during retrieval, or during both encoding and retrieval, or never (control). Results show, that memory for emotional words significantly decreased if embodiment was blocked at either point in time during the experiment (during encoding, retrieval or during both) in comparison to the control group (i.e., no blocking during the complete experiment). In summary, embodied simulations play a crucial role also in memory retrieval, in line with what embodied theories of emotion processing would suggest

A27

THE INFLUENCE OF RESTING CORTISOL ON SUBSEQUENT REMEMBERING AND FORGETTING OF EMOTIONAL OBJECTS Kelly Bennion[1], Jessica Payne[2], Katherine Mickley Steinmetz[3], Elizabeth Kensinger[1]; [1]Boston College, [2]The University of Notre Dame, [3]Wofford College — While research has investigated neural activity during successful encoding of emotional stimuli, processes engaged during encoding can also predict subsequent forgetting. The first goal of the present study was to examine the neural correlates of subsequent remembering and subsequent forgetting of emotional objects. The second goal was to explore the effect of resting cortisol levels on these processes. Stress-related cortisol rises are known to affect encoding processes, but the influence of resting cortisol levels is less clear. Participants gave cortisol samples via oral swab prior to an encoding and retrieval task during fMRI. They were presented with images composed of a negative or neutral object superimposed on a neutral background. After a twenty-minute delay, participants underwent a recognition task in which they viewed negative and neutral objects and backgrounds separately, distinguishing new objects and backgrounds from those previously studied. Neural activity during encoding of subsequently remembered (remembered > forgotten) and subsequently forgotten (forgotten > remembered) negative objects was analyzed. As expected, when not controlling for cortisol levels, regions within the medial temporal lobe and orbitofrontal cortex were activated during successful encoding and regions throughout the default network were associated with subsequent forgetting. However, including pre-encoding cortisol levels as a covariate restricted the set of regions revealed by these contrasts. Moreover, cortisol levels were related to increased activity in the cingulate gyrus during subsequent remembering and visual activity during subsequent forgetting, suggesting that resting cortisol levels modulate activity in regions associated with subsequent remembering and forgetting.

A28

AFFECTIVE MODULATION OF COGNITIVE CONTROL VARIES WITH PERFORMANCE-CONTINGENCY Senne Braem[1], Joseph King[2], Franziska Korb[2], Ruth Krebs[1], Wim Notebaert[1], Tobias Egner[2]; [1]Ghent University, [2]Duke University — Cognitive control describes the ability to flexibly adapt behaviour in line with internal goals. One important question is how cognitive control mechanisms are influenced by motivational processes, but recent studies have produced equivocal results on how positive or negative affective stimuli modulate control. Here, we sought to clarify this issue by disentangling effects of stimulus valence from whether affective stimuli were performance-contingent or not. As a metric of cognitive control, we employed the "Goschke effect", i.e., the observation that task-switch costs are increased after incongruent, as opposed to congruent trials (Goschke, 2000). Specifically, using a parity/magnitude task-switching fMRI paradigm, we contrasted the effects of presenting positive or negative IAPS pictures either following each response ("mood condition" – not performance-contingent), or following correct responses only ("reward condition" – performance-contingent). Overall, the Goschke effect was associated with recruitment of a cognitive control network involving the dorsal striatum and lateral frontal and parietal regions. However, both the behavioural and neural expressions of the Goschke effect were modulated by stimulus valence and response-contingency: In the mood condition, the effect was present following positive pictures but absent following negative pictures, whereas the opposite pattern was found in the reward condition. Moreover, this behavioural interaction effect was mirrored by activity modulations in the medial prefrontal cortex, posterior cingulate cortex, and right parietal lobe. Our results demonstrate that the affective modulation of behavioural signatures and neural mechanisms of cognitive control strongly depend on whether affective stimuli act as potential teaching signals (i.e, they are performance-contingent) or not.

A29

PERCEPTUAL PROCESSING ENHANCES THE EFFECT OF EMOTION ON RETRIEVAL: AN FMRI STUDY Nadia Brashier[1], Ilana Dew[1], Maureen Ritchey[1,2], Kevin LaBar[1], Roberto Cabeza[1]; [1]Duke University, [2]University of California-Davis — Memory is typically better for emotional relative to neutral stimuli, and for stimuli encoded under conceptual relative to perceptual processing conditions. However, there is relatively little informa-

tion as to how emotion and encoding operations interact to affect memory retrieval. A question of particular interest is how neural activations associated with retrieving emotional information are differentially influenced by conceptual versus perceptual processing during encoding. In the current fMRI study, participants (N = 19) viewed positive, negative, and neutral images in two encoding conditions: a shallow, perceptually-focused condition and a deep, semantically-focused condition. Recognition memory was tested two days later. As reported in a previous study (Ritchey, LaBar & Cabeza, 2010), memory was more accurate for negative relative to neutral images, as well as for the deep compared to the shallow encoding condition. The memory-enhancing effects of emotion were enhanced under shallow conditions, thus demonstrating an interaction between emotion and levels of processing on memory. The fMRI data showed that during successful memory retrieval (hits>misses) amygdala activity was greater in the negative shallow condition relative to both: a) negative deep and b) neutral shallow conditions. This pattern suggests that arousal-based amygdala activation, specific to negative valence, determines successful retrieval when other encoding strategies are minimized (i.e., shallow processing conditions).

A30

BEHAVIORAL AND NEURAL RESPONSES TO DECEPTION IN ADOLESCENTS AND ADULTS

Kaitlyn Breiner[1], Adriana Galvan[1,2]; [1]Department of Psychology, University of California, Los Angeles, [2]Brain Research Institute, University of California, Los Angeles — Trust and cooperation are advantageous at all stages of development to forge and maintain social relationships (Lahno, 1995; van den Bos et al., 2011). This is particularly important during adolescence when individuals are navigating an increasingly complex social world. Violation of these behaviors can have harmful social repercussions; however behavioral and neural responses to peer deceit in adolescents remain elusive. In this study, we addressed this question using a modified version of the Prisoner's Dilemma game that included deceit trials while participants received a functional magnetic resonance imaging (fMRI) scan. Participants played the game with a close friend who accompanied them to the lab, an age and sex-matched stranger (confederate), and with the computer (control), in each of three rounds. Violation of social expectations was assessed by examining participants' behavioral and neural responses following trials in which the opponent deceived the target participant. There was a significant developmental difference in responses to deceit [$F(1, 39) = 4.272$, $p < .05$], such that adolescents (M= 47.04%) were less likely than adults (M= 64.51%) to cooperate with their friends following deceit. This result was paralleled by greater medial prefrontal activation in adolescents in preliminary fMRI analyses. There were no developmental differences in response to deceit by strangers or computer. These data suggest that compared to adults, adolescents are more behaviorally and neurobiologically sensitive to violation of social expectations, particularly when the deceit is by a close friend.

A31

PAIN PERCEPTION AND RISK-AVERSION IN FINANCIAL DECISION-MAKING

Janaina Brizante[1,2], Marcus Vinicius C Baldo[1]; [1]Biomedical Sciences Institute, University of São Paulo, [2]Center for Cognitive Neuroscience, Duke University — Introduction: Physical and social pain share neural substrates and have both been shown to influence decision-making. These areas may embody part of an adaptive system involved in the processing of salient information to choices. Therefore, pain perception could be an important component of decision-making. We explored the relationship between pain perception (nociception and social exclusion) and financial risk-aversion. Methods: Fifteen male subjects completed three tasks assessing risk preferences and physical and social pain tolerances. In the risk task, participants bet $5 in $0.10 or $0.90 increments on a roulette with probabilities of 60% and 80%. Physical pain tolerance was assessed using a nociception/cold pressor task (cold water: 35.6 F). Immediately after, they rated the pain felt. To measure social pain tolerance, participants played the cyberball game, then completing the Need-and-Threat-Scale (NTS). Results: A trend-level negative correlation was observed between total amount spent on the roulette and physical pain scores ($r=-0.529$, $p=0.052$). There was also a suggestion of a relationship with NTS scores ($r=-0.425$, $p=0.130$), such that the greater the pain, the smaller the bets. Time in ice water inversely correlated with pain rating ($r=-0.533$, $p=0.050$), indicating that individuals who tolerated more physical pain also reported experiencing less pain. Conclusion: We have found preliminary evidence that there is a relationship between sensitivity to physical and social pain and risk-aversion. Specifically, the more sensitive to pain in these two domains, the more risk-aversive the individual. These results highlight sensitivity to pain (physical and social) as an important player in the decision-making process.

A32

MANUAL MOTOR ASYMMETRIES PREDICT NEURAL ORGANIZATION OF EMOTION

Geoffrey Brookshire[1], Daniel Casasanto[1,2]; [1]The New School for Social Research, [2]Donders Institute for Brain, Cognition, & Behaviour, Radboud University — According to decades of work in affective neuroscience, approach motivational states are primarily supported by the left hemisphere, and avoidance motivational states by the right hemisphere. Yet the cause of this lateralization has remained unknown. The Sword and Shield Hypothesis (SSH) proposes that the cortical organization of motivation depends on the neural locus of motor control for the dominant hand (the ''sword hand,'' used preferentially to perform approach actions) and the nondominant hand (the ''shield hand,'' used preferentially to perform avoidance actions). The SSH predicts that people whose brains are differently organized for manual motor control should show corresponding differences in the cortical organization of emotions. To test this prediction we applied transcranial direct current stimulation (tDCS) bilaterally to participants' dorsolateral prefrontal cortex, over 5 sessions. Participants' manual motor asymmetries and emotional states were measured before and after this course of stimulation. Results showed that the effects of stimulation on mood were parametrically related to manual motor asymmetries. Positive emotions increased in right-handers who received left-excitatory/right-inhibitory (L+/R-) stimulation, but decreased in those who received left-inhibitory/right-excitatory (L-/R+) stimulation. By contrast, positive emotions decreased in non-right-handers following L+/R- stimulation, but increased following L-/R+ stimulation. The observed covariation between neural systems for action and emotion supports the SSH. These findings also have clinical implications. To treat major depressive disorder, clinicians use tDCS and transcranial magnetic stimulation to increase left-hemisphere activity. Our results suggest that treatments developed for right-handers may be harmful for non-right-handers.

A33

INDEPENDENT EFFECTS OF DISTINCTIVENESS AND EMOTIONAL AROUSAL IN SELECTIVE MEMORY FOR EMOTIONAL STIMULI

Carolina Campanella[1], Stephan Hamann[1]; [1]Emory University, Atlanta GA — Episodic memory for emotional stimuli is usually enhanced relative to neutral stimuli, but this enhancement for salient stimuli is also associated with memory costs to background, neutral information, a phenomenon known as the emotional memory trade-off effect. This phenomenon may reflect attentional capture by emotion, reducing resources available to encode background information. Previously, we have demonstrated that distinctive but non-emotional stimuli can also elicit trade-offs. However, the relative roles of distinctiveness and emotional arousal in producing such trade-offs has been relatively unexplored. To examine these questions, we conducted a combined memory and eyetracking study. At encoding, subjects viewed scenes consisting of a central item (either negative, positive, neutral, or visually distinctive but emotionally neutral) against neutral backgrounds. Memory trade-offs occurred for both distinctive and emotional objects. Emotionally arousing items are also typically more distinctive than neutral items. Therefore, selecting relatively distinctive neutral stimuli and less distinctive positive emotional stimuli, allowed us to disentangle these factors. Though less distinctive than neutral items, positive items elicited trade-off effects. Conversely, distinctive items matched with neutral items on arousal also elicited trade-offs, suggesting that distinctiveness is sufficient to induce tradeoffs, independently from arousal. Only eye-movements to distinctive and neutral objects predicted subsequent memory, suggesting that overt shifts in visual attention may play a lesser role in emotional memory enhancement than has been hypothesized previously. These findings suggest distinctiveness and emotional arousal can independently elicit memory trade-offs, highlighting the importance of examining multiple factors in determining the enhancing vs. impairing effect of emotion on memory.

A34

ERROR-FEEDBACK ENHANCES INSULA ACTIVATION AND IMPROVES PERFORMANCE IN INDIVIDUALS WITH NEGATIVE SELF-ASSOCIATIONS Alva Appelgren[1], Sara L Bengtsson[1]; [1]Karolinska Institutet — Human perception and actions are influenced by anticipations on upcoming stimuli, such as perceived ability to perform a task (Bandura, 1977). We have previously found that when primed with associations to 'Clever' errors take on a different meaning than when primed 'Stupid' on a 2-back task: 'Stupid'-associations lead to greater uncertainty as to whether errors had occurred (Bengtsson et al., 2010). This finding lead us to hypothesize that external error-feedback, but not feedback on corrects, would support performance after 'Stupid'-priming, but not after 'Clever'-priming. Here we investigate behavioural and neural effects of the interaction between feedback and prime dependent performance. Thirteen healthy participants (mean age 24±2.4 yrs) took part in this functional magnetic resonance imaging study, approved by the ethics committee in Stockholm. They performed the scrambled sentence task (Bargh and Chartrand, 2000) where synonyms to clever and stupid served as primes. They then performed a 2-back task where external auditory feedback (74 Hz error-beep; 740 Hz correct-beep) was either present or not during errors and the subsequent correct response. The 2x2x2 factorial design systematically combines feedback, phase and prime. The brain imaging data was analyzed in SPM (UCL, UK). Performance was significantly better for 'Stupid'-associations when external feedback was given on errors followed by silence on the subsequent correct, when compared to 'Clever'-associations. This was reflected in increased error-related insula activation followed by enhanced activation in frontoparietal areas on the subsequent correct. Thus, external error-feedback, and internal feedback on corrects, is more beneficial to individuals with active negative trait-associations.

A35

FRONTOSTRIATAL CONNECTIVITY UNDERLIES INDIVIDUAL DIFFERENCES IN TRAIT SELF-ESTEEM Robert Chavez[1], Todd Heatherton[1]; [1]Dartmouth College — The medial prefrontal cortex's (mPFC) involvement in processing information about the self has been well established. However, there is a growing body of research implicating a role for the ventral striatum in self-referential cognition, particularly in the context of rewarding aspects of self. To the extent that positive self-regard reflects aspects of rewarding self-relevance, there seems to be an important role for the integration of information between the ventral striatum and mPFC. In the current study of N=48, the mPFC and ventral striatum were used as seed regions for diffusion tenor imaging (DTI) probabilistic tractography. We found that white matter coherence (as measured by fractional anisotropy) in tracts connecting ventral striatum and mPFC was positively correlated with trait self-esteem but not state self-esteem. DTI has the advantage of being able to reflect stable aspects of the brain's anatomical connectivity, independent of any task demands, current mood, or idle thoughts. The results from our analysis suggest that greater white matter coherence between these regions may contribute to stable individual differences in self-esteem maintenance.

A36

KNOWING YOUR HEART AND YOUR MIND: INTEROCEPTIVE ACCURACY CORRELATES WITH METAMEMORY ACCURACY Elizabeth Chua[1,2], Suzanne Mayers[1], Eliza Bliss-Moreau[3]; [1]Brooklyn College of the City University of New York, [2]The Graduate Center of the City of New York, [3]University of California, Davis — We have the ability to monitor and sense our bodily states (i.e., interoception) and our cognitive states (e.g., metamemory awareness), but little is known about whether these abilities represent a unified process or separate but related capacities. Results from previous functional MRI studies raise the possibility that the mechanisms for monitoring bodily and cognitive states may share neural substrates. The anterior insula has been shown to be involved in interoceptive monitoring, and although this has not been highlighted in the literature, several metamemory studies report insula activation when subjects make confidence judgments about the content of their memories. The goal of this study was to provide an initial test of the hypothesis that there are shared mechanisms for interoceptive and metamemory monitoring. Participants completed a heartbeat detection task in which they had to count their number of heartbeats in a given interval without touching their heart or feeling their pulse. Interoceptive accuracy was calculated by comparing the reported number of beats to the number of beats recorded by a pulse transducer (perfect interoception = 1). Participants also completed a face-name associative recognition memory task in which they gave retrospective confidence ratings. Metamemory accuracy was calculated by examining confidence-accuracy calibration (perfect calibration= 0). Individuals with better interoceptive accuracy also showed better metamemory calibration ($r=-.47$, $p<0.05$). This raises the possibility that there may be a general mechanism for monitoring internal states, likely relying on the insula.

A37

OWNERSHIP, ERPS AND THE SELF-REFERENTIAL ENCODING EFFECT Philip Collard[1], Olav Krigolson[2], Todd Handy[3], David Turk[1]; [1]University of Bristol, [2]Dalhousie University, [3]University of British Columbia — Items owned by self are remembered better than items owned by others. This self-referential encoding effect is present even in hypothetical situations where ownership is newly established. We previously reported that differences in ERP components associated with early visual/perceptual processing and attention for self- and other-owned objects. These findings were presented as indicative of a positive relationship between these neural markers and memory bias. The current inquiry was designed to explore this relationship. We recorded EEG while participants engaged in an ownership task. They sorted common objects into shopping baskets on the basis of a colour cue indicating item ownership (self/other). Self/other differences were observed in N1, P2, N2 and P300 ERP components. Latency and voltage measures from these effects were utilized in a correlational analysis exploring this relationship between memory bias and electrophysiological response. This analysis indicated negative relationship a between electrophysiological differences and memory bias, especially with regards to the P2. However, due to the high level of intercorrelations between the ERP effects we tested the relationship further by performing a regression to extract a single factor for the ERP components that accounted for 65% of their variance. This factor reflected a general positive shift in all the components and was highly predictive of memory bias. This result indicates that the relationship between electrophysiological response and memory bias may be more complex than we had initially proposed.

A38

DECIDING WHETHER OR NOT A SOCIAL ROLE FITS US: AN ELECTROPHYSIOLOGICAL STUDY OF THE TIMING OF ROLE PROCESSING A. L. Fernandez Cruz[1], I. Walpola[1], O. Mohamed Ali[1], R. Rahgoshai, J. B. Debruille[1]; [1]McGill University — Social roles are understood as the various roles one could play within a social environment. Although being a teacher, a basketball player or a parent constitute very different roles, one still has the capacity to imagine and consider oneself playing different roles. This capacity indicates that one has memorized representations of the roles one may or may not be willing to play. Neural indexes of such complex representations are so far unknown. To start exploring them, event-related potentials (ERPs) were recorded while 18 participants were presented with names of social roles and were asked to decide whether or not they could consider themselves representing those roles at any moment in their lives. Roles were divided into categories depending on whether they were favorable (e.g., coach) or unfavorable (e.g., beggar) and whether these were ordinary (e.g., doctor) or extraordinary (e.g., superman). ERP analysis revealed significant differences between the categories in the N400 (250-550 ms) time window. In keeping with the hypothesis that the N400 provides an index of inhibition processes which are triggered by processing at the highest associative level, we suggest that these effects might reflect the inhibition of a representation of ourselves playing a role. The early latency of the beginning of the effect is surprising for such a higher order process but in line with the theoretical framework in which the N400 inhibition hypothesis is included.

A39

CONVERGENT FINDINGS IN PASSIVE AND ACTIVE PROCESSING OF THE DOMINANCE DIMENSION OF EMOTION Matthew Jerram[1], Alyson Negreira[1], David Gansler[1]; [1]Suffolk University — Emotional dominance is the level to which the individual feels they have influence or control of the external environment during the emotional experience. Our laboratory

examined brain activity in response to high and low dominance stimuli in two studies. In Study 1, functional MRI (fMRI) was performed on seventeen right-handed men while they viewed images from the International Affective Picture System (IAPS), chosen based on normative dominance ratings. Participants viewed high and low dominance images in a block design; they were not asked to respond to the images other than to press a button when they observed the picture change. In Study 2, eight right-handed men also underwent fMRI as they viewed images from the IAPS in an event-related design. Participants viewed neutral dominance images; they were asked to interpret the images in such a way that they experienced low dominance in relation to the image (DECREASE). Data for both Study 1 and 2 were analyzed using Statistical Parametric Mapping (SPM8) and freesurfer respectively. For Study 1, contrasts for low>high dominance and high>low dominance were performed. Significant activation for low>high was observed in the right precuneus and in the bilateral insula for the high>low contrast. For Study 2, significant activation was observed in the DECREASE condition in the precuneus bilaterally. Results of Study 1 and 2 show convergence of processing of low dominance in the precuneus, a region already understood to be involved in self-reflection. These results offer insight into neural correlates of emotional dimensions.

A40

NEURAL CORRELATES OF INTEROCEPTIVE ATTENTION AND INTEROCEPTIVE ACCURACY

Ian R. Kleckner[1,2], Jason A. Avery[2], Karen S. Quigley[1], W. Kyle Simmons[2,3], Lisa Feldman Barrett[1,4]; [1]Interdisciplinary Affective Science Lab; Northeastern University; Boston, MA, USA, [2]Laureate Institute for Brain Research; Tulsa, OK, USA, [3]Faculty of Community Medicine; The University of Tulsa; Tulsa, OK, USA, [4]Massachussetts General Hospital; Boston, MA, USA — Embodied theories of emotion posit that visceral sensations are integral to affective experience. The perception of visceral sensations (termed interoception) involves at least two elements – attention (towards or away from internal sensations) and accuracy in detecting those sensations; each of which may play distinct roles in affective experience. To better understand these phenomena, we mapped the neural correlates of interoceptive attention and interoceptive accuracy. To assess interoceptive accuracy, participants completed a heartbeat detection discrimination task outside the MRI scanner. Next, to assess interoceptive attention, participants performed two fMRI tasks: (i) thinking about their heartbeats (interoception), and (ii) detecting luminance changes in a target stimulus (exteroception). In accord with previous neuroanatomical and neuroimaging studies, we observed greater activity during interoceptive attention compared to exteroceptive attention bilaterally within the dorsal mid-insula and in other regions involved in limbic functions. We next identified brain regions where interoceptive accuracy related to interoceptive attention by examining the correlation between activity during the interoception fMRI task and interoceptive accuracy assessed by heartbeat detection. Importantly, we observed that activity within the dorsal mid-insula was positively correlated with interoceptive accuracy. This finding is particularly noteworthy because the interoceptive accuracy task was performed the day before the MRI scan and was therefore independent of the interoceptive attention fMRI task. These findings demonstrate the relationship between activity in the neural systems underlying interoceptive attention and the accuracy of interoceptive perceptions, and will likely have important implications for theories positing a role for visceral sensations in affective experience.

A41

THE REFLEXIVE IMAGERY TASK: A NEW, ROBUST PARADIGM FOR NEUROIMAGING

Allison K. Allen[1], Kevin Wilkins[2], Christina Merrick[1], Ezequiel Morsella[1,3]; [1]San Francisco State University, [2]Boston College, [3]University of California, San Francisco — Advances in neuroimaging have illuminated the subjective aspects of action production (Haggard & Chambon, 2012), primarily 'the sense of agency' and action-related urges. Less research has focused on the subjective aspects of action sets. Sets can operate without influencing conscious content, as in 'imageless thought.' Often, however, sets do influence the contents of consciousness, as when holding action intentions in mind. To investigate this phenomenon, we developed the Reflexive Imagery Task (RIT), in which, as a function of both set and action-related stimuli, participants experience unintended action-related imagery: When instructed to not subvocalize the name of a presented stimulus object, participants invariably fail to suppress the set-related imagery, perhaps because of 'ironic processing' (Wegner, 1994). Based in part on Wegner (1994), the RIT is motivated by the theorizing that, though action-related inclinations can be 'behaviorally-suppressible,' they are often not 'mentally-suppressible' (Bargh & Morsella, 2008). In Study 1 (N = 5), non-naive participants were unable to suppress subvocalizing (speech-related imagery; Levelt, 1989) an object's name when presented with that object (e.g., a triangle) on an average of 97% (SD = .04) of the trials, although object names are arbitrarily related to objects (Levelt, 1989) and one seldom utters object names unintentionally (though this occurs in certain neurological conditions). We replicated the effect with naive participants in Study 2 (N = 20), in which the modal reflexive imagery rate per subject was over 90%. The RIT provides a robust and potentially fecund paradigm for neuroimaging research on action and consciousness.

A42

VARIABILITY CAN BE YOUR FRIEND: INTRAINDIVIDUAL BEHAVIORAL VARIABILITY IS DIFFERENTIALLY ASSOCIATED WITH THE NEURAL CORRELATES OF COGNITIVE FLEXIBILITY AND STABILITY

Diana J.N. Armbruster[1,2], Kai Ueltzhoeffer[1,2], Ulrike Basten[1], Christian J. Fiebach[1,2,3,4]; [1]Goethe University Frankfurt am Main, Germany, [2]Bernstein Center for Computational Neuroscience, University of Heidelberg, Germany, [3]IDeA Center for Individual Development and Adaptive Education, Frankfurt am Main, Germany, [4]Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, The Netherlands — This study investigates the neural correlates of intraindividual variability (IIV) in behavioral performance, specifically whether the relation between behavioral IIV and the efficiency of neural processing might depend on the specific task requirements. Behavioral IIV in response times (RT), i.e. IIV-RT, was assessed in a baseline condition of an fMRI paradigm requiring 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. Behavioral analyses show that subjects with higher IIV-RT have higher RT costs during distractor inhibition, but at the same time commit significantly less errors during task-switching. Furthermore, fMRI results show that subjects with higher IIV-RT activate task-relevant relevant areas, such as the supplementary motor area and the inferior frontal junction, less during task-switching. In contrast, for distractor inhibition, these subjects show higher activation in visual areas. Taken together, these findings suggest that IIV-RT is not necessarily an indicator of poor performance or less efficient processing: High IIV-RT goes along with better performance and more efficient neural processing during task demands requiring cognitive flexibility. When the task requires cognitive stability, however, high IIV-RT persons are not efficient in inhibiting task-irrelevant percepts. Thus, depending on task demands, IIV-RT can be considered as an either advantageous or detrimental processing characteristic.

A43

CREATIVITY TRAINING ENHANCES SELF-DIRECTED ATTENTION AND INFORMATION PROCESSING

Nicholas Bott[1,2], Eliza Kienitz[1,2], Eve-Marie Quintin[1], Manish Saggar[1], Grace Hawthorne[1], Adam Royalty[1], Allan Reiss[1]; [1]Stanford University, [2]Palo Alto University — Creativity is considered to be among the most valued of human cognitive abilities. Previous studies suggest that individuals with greater creative potential have an enhanced ability to attend to tasks and process information. In this study, we tested the hypothesis that a creativity training intervention would increase specific aspects of executive function such as self-directed or focused attention and information processing speed. A 5-week long creativity-training program (CTP) was conducted in collaboration with the Hasso Plattner Institute of Design at Stanford University, and a 5-week long language-training program (LTP) was designed as a control intervention. Thirty-one participants took part in this study, of which 16 (Mean-age(S.D.)=28.9years(5.9); 8F) were randomly assigned to the CTP and the other 15 (Mean-age(S.D.)=28.5years(5.6); 8F) were assigned to the LTP. Self-directed attention and processing speed were measured with the D-KEFS color-word interference test (CWIT), pre- and post-intervention. ANCOVA, with pre-training CWIT as a covariate, revealed higher scores at post-training assessment for CTP compared to LTP on the primary measure of combined completion time for color-naming and word-reading conditions ($F(1, 31)=11.262$, $p=.002$) but not for the inhibition and switching conditions. Our results indicate that, relative to LTP, CTP lead to improved performance on a specific measure

of executive functioning. Improved performance suggests accelerated processing speed and increase in the capacity to self direct attention. Further, this improvement was found to be specific to executive functioning tasks with little cognitive interference. Our findings provide new information about how interventions to enhance creativity affect specific components of neurocognitive functioning.

A44

THE ROLE OF TASK SET STRUCTURE IN THE MECHANISMS OF COGNITIVE CONTROL

Savannah Cookson[1], Erin McPherson[1], Zain Sultan[1], Eliot Hazeltine[2], Eric Schumacher[1]; [1]Georgia Institute of Technology, [2]University of Iowa — Humans show a remarkable ability to control their behavior and perform complex, novel tasks with relative ease. The present research investigates the cognitive mechanisms for this ability. We hypothesize that control operates on a functional framework of task set representations. Task sets in the context of control refer to learned associations between stimuli, responses, and the internalized goals that drive behavior. To investigate this, we conducted a behavioral study that used a precuing procedure. Subjects made manual responses to the identity of face or place stimuli. Prior to the presentation of the target stimulus, a cue indicating the identity of the upcoming stimulus or response (or a neutral cue) was presented. We manipulated task set structure between subjects such that two task sets were represented in one group and one in the other. We hypothesized that participants in the two-task set group would be able to group the stimulus-response mappings into two distinct groups while those in the one-task group would be unable to do so. Precue benefit, calculated as reaction time of the informative cue minus that of the neutral cue, was analyzed using a two-way ANOVA. Behavioral results showed that only the two-task set group was able to use the cue effectively; i.e., they were faster and more accurate when the stimulus and/or response was cued. The one task set group showed little benefit from the cue. These data suggest that humans dynamically create task set representations that guide and control their behavior.

A45

FRONTAL SYSTEMS SUPPORTING THE HIERARCHICAL CONTROL OF TASK SEQUENCES

Theresa Desrochers[1], David Badre[1]; [1]Brown University — In everyday life, we often accomplish goals by conducting sequences of simple tasks, each with its own sub-goal. For example, the general task of making coffee, involves a sequence of sub-tasks, like pouring water and grinding beans. In these circumstances, hierarchical cognitive control may be required to guide action selection based on an overall abstract goal ("make coffee"), as well as the immediate sub-goals ("grind beans"). Recent research has suggested that hierarchical cognitive control is supported by a rostro-caudal organization of fronto-striatal circuits. However, though it is often assumed that this functional organization extends to hierarchical control over task sequences, the evidence has largely come from studies using non-sequential tasks. Thus, it is not known if the same frontal cortical network supports hierarchical control over task sequences. To address this question, we scanned participants while they performed short, memorized sequences of simple categorization tasks. For example, a task sequence might be AABB, where task A is a color categorization (e.g., red or blue) and task B a shape categorization (e.g., circle or square). Behavioral evidence supported the contribution of a hierarchical control process at the beginnings of sequences, as a function of sequence complexity. In fMRI, effects of sequence complexity and sequence position (beginning versus middle) located similar rostral frontal and parietal activations as have been previously observed for non-sequential hierarchical control tasks. Thus, sequential control of behavior may be supported by a similar fronto-striatal organization as has been observed during higher-order control of non-sequential tasks.

A46

EXAMINING THE ROSTRO-CAUDAL FUNCTIONAL ORGANIZATION OF MULTIPLE FRONTAL CORTEX REGIONS RELATED TO GOAL-DIRECTED BEHAVIOR

Matt Dixon[1], Kiearn Fox[1], Kalina Christoff[1,2]; [1]Department of Psychology, University of British Columbia, [2]Department of Psychiatry, University of British Columbia — Goal-directed behavior relies on several regions within the frontal cortex including the lateral prefrontal cortex (LPFC), cingulate cortex, medial prefrontal cortex (MPFC), and insula. Recent work has begun to map the precise functional organization of these areas, with evidence accruing for rostro-caudal gradients. Prior work has typically examined the organization of these regions in isolation with different tasks and theoretical frameworks. In order to better understand the comparative organization and function of these regions, we used fMRI and an anatomical ROI approach to examine their putative rostro-caudal functional organization simultaneously within a single study. Human subjects performed a task composed of several events: (1) rule retrieval; (2) rule maintenance; (3) response execution; (4) monitoring progress towards an overall motivational goal. Our results demonstrated a striking differentiation between rostral and caudal ROIs during response execution and goal monitoring. Response selection activity increased whereas goal monitoring activity decreased along a rostro-caudal axis in the LPFC, cingulate cortex, and MPFC, whereas the opposite pattern was observed in the insula. Linear rostro-caudal functional gradients were frequently observed, suggesting gradual functional transitions between architectonically neighboring regions. Finally, the strongest goal monitoring activity was observed in the dorsal LPFC, consistent with a role in promoting behaviors that maximize long-term rewards. These findings provide evidence for rostro-caudal functional gradients that directly map onto anatomical organization in multiple frontal regions.

A47

REPRESENTATION OF RESPONSE ALTERNATIVES IN MEDIAL FRONTAL CORTEX: MULTI-VOXEL PATTERN ANALYSIS OF THE HUMAN PRESMA IN A GO/NO-GO TASK

John Fedota[1], Jillian E. Hardee[2], Koraly Perez-Edgar[3], James C. Thompson[1]; [1]George Mason University, [2]University of Michigan, [3]The Pennsylvania State University — A debate exists as to the exact role of the pre-supplementary motor area (preSMA), in cognitive control. Recent findings suggest that the preSMA plays a central role in conflict resolution and encodes response alternatives as opposed to simply the presence of conflict. Evidence of neuronal heterogeneity within the preSMA of non-human primates suggests that univariate analysis of functional MRI data may not provide adequate resolution to fully characterize cognitive control-related responses. Here, we use multi-voxel pattern analysis (MVPA) to examine the distributed patterns of activity associated with both successful Go and No-go responses in the preSMA. In a Go/No-go task, univariate analysis showed undifferentiated activation of preSMA in response to both Go and No-go stimuli. However, when an anatomically-defined preSMA ROI was subjected to MVPA, a significant difference in the activation pattern encoded by Go as compared to No-go stimuli was observed. These differences in preSMA activation are consistent with the ongoing maintenance and manipulation of stimulus-action representations as opposed to conflict monitoring.

A48

TRANSCRANIAL DIRECT CURRENT STIMULATION EXERTS SELECTIVE BENEFITS ON EXECUTIVE CONTROL IN A COMPLEX TASK WHETHER PREFRONTAL OR MOTOR CORTEX IS STIMULATED.

Melissa Scheldrup[1], Jon Strohl[1], Jessica Vance[1], Danielle Walker[1], Pamela Greenwood[1], Raja Parasuraman[1]; [1]George Mason University — Transcranial direct current stimulation (tDCS) facilitates learning and retention of certain cognitive tasks (Falcone et al., 2012). We hypothesized that in a complex executive task with strong motor demands (Space Fortress, Gopher et al., 1989), prefrontal cortex (PFC) stimulation would selectively heighten executive control while motor cortex stimulation would selectively heighten motor control. Participants (n=65) were randomly assigned to: (a) .2 mA sham stimulation; (b) 2 mA stimulation of R PFC; (c) 2 mA of stimulation of right motor cortex (RM1); or (d) Left motor cortex (LM1) (cathode on contralateral arm). To achieve the highest total score, players must control a ship using a sensitive joystick (Right hand) while shooting accurately, avoiding targets, and maintaining assets. Participants underwent 1.5 total hours of training, including 30 minutes tDCS stimulation during 4 "emphasis change" trials followed by 5 "total score" trials. Next, tDCS was stopped and performance assessed, both immediately and again after a 1 hour delay. PFC and RM1 tDCS groups improved in two measures of ship control over trials (avoiding large adjustments causing loss of control in the game's frictionless environment), while the sham and LM1 groups did not improve ($p<.015$). Speed, points, and number of missiles fired improved, but not differentially. Conclusions: (a) An executive control

task was learned in 1.5 hours, but only with tDCS stimulation; (b) Effects of tDCS were exerted selectively on executive control; (c) Benefits of tDCS on executive control were seen with stimulation of right but not left hemisphere.

A49

EVENT-RELATED POTENTIALS REFLECT WORKING MEMORY LIMITATIONS IN POST-TRAUMATIC STRESS DISORDER UNDER DUAL-TASK CONDITIONS

Nikki Honzel[1], Timothy Justus[2], Diane Swick[1,3]; [1]Medical Research Service, VA Northern California Health Care System, Martinez, CA, [2]Department of Psychology, Pitzer College, Claremont, CA, [3]Department of Neurology, University of California Davis, Davis, CA — The current experiment examined the extent of central executive impairments in patients with post-traumatic stress disorder (PTSD). A dual-task design was used to determine if impairment in working memory was linked to executive control limitations by examining performance on a memory task alone and in conjunction with a secondary attention task presented during the maintenance period. Participants performed a Sternberg task presenting either one or four items. After a delay, participants indicated whether or not the probe was a member of the previous memory set. In a single-task condition, the Sternberg task was performed on its own. In a dual-task condition, the delay was filled with an arrow flanker task in which participants responded to a central arrow surrounded by distractors. Behavioral analysis found a significant group by task interaction, indicating that PTSD patients were less accurate on the working memory task than the controls, especially in the dual-task condition. Electrophysiological results indicated that both the PTSD group and the controls showed similar brain patterns from 300 ms to 500 ms when discriminating old and new probes in the single-task condition. However, when taxed with the additional flanker task during the maintenance period, the ERPs of the PTSD group no longer differentiated old and new probes. The lack of differentiation in the ERP reflects impaired WM performance under more difficult dual-task conditions. Exacerbated difficulty in performing a WM task with concurrent task demands suggests limited executive control resources in PTSD.

A50

DISSOCIATING SERIAL-RESPONSE AND PARALLEL-ATTENTION COSTS IN TASK SWITCHING

Koki Ikeda[1], Toshikazu Hasegawa[1]; [1]The University of Tokyo — The task switching paradigm has been used to investigate our cognitive inflexibility, measuring the post-switch behavioral impairment called the switch cost. For decades, researchers have been hypothesizing that the cost is caused by two reasons, that is, delayed activation of the new task set and interference from the previous task, and at two loci, attention focusing and response selection. However, a clear dissociation of these factors is difficult and therefore it is largely unknown how they interact and contribute to the overall cost. The present study investigated this problem by recording ERP components indexing attention focusing (the N2pc) and response preparation and execution (the LRP) as a function of stimulus interference and trial numbers after switching. We successfully separated the cost related to attention from that linked to response, and found a stark contrast between them. The cost at the attention level perseverated across multiple trials after switch, and was solely caused by stimulus-based interference. On the other hand, the response-level cost was restricted to the first trial after switch and occurred regardless of interference, suggesting it is a consequence of novel task activation. These results provide a clear picture of the switch cost generation and underlying mechanisms of cognitive flexibility. That is, the shift between two attentional sets occurs quickly, but both sets are maintained in a parallel manner and therefore relatively susceptible to stimulus-driven interference. In contrast, the switching between response sets is only slowly accomplished but discretely controlled, and therefore quite robust against the interference.

A51

RESPONSE CONFLICT AS A MECHANISM FOR MONITORING IN SPEECH PRODUCTION

Daniel Acheson[1,2], Peter Hagoort[1,2]; [1]Neurobiology of Language Department, Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, [2]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, The Netherlands — Recent work suggests that monitoring in speech production may occur via domain-general mechanisms responsible for detecting response conflict. To test this hypothesis, we measured EEG as people engaged in both non-verbal (flanker) and verbal (tongue twisters) tasks designed to elicit response conflict and errors. In the flanker task, people pressed a button corresponding to whether a center arrow was facing left or right, and response conflict was induced with flanking arrows pointing in the same (congruent; >>>>>) or a different (incongruent >><>>) direction. In the tongue twister task, people read sequences of four nonwords three times in which rhymes alternated in an ABAB pattern while onset speech sounds alternated in an ABBA (tongue twister) or an ABAB (non-tongue twister) pattern (e.g., tif deev dif teev vs. tif teev dif deef). Results in the flanker task showed standard markers of response conflict in the form of an increased N2 for incongruent relative to congruent trials as well as an error-related negativity (ERN) for incorrect trials. Behaviourally, more errors were elicited for tongue twisters relative to non-tongue twister trials, and an ERN was observed on incorrect responses. Correlations between the magnitude of the N2 and ERN in the flanker task with the magnitude of the ERN and error rates in the tongue twister task are consistent with a common underlying locus. Adaptation effects preceding and following erroneous trials in production are also presented. These results are consistent with response conflict serving as a cue to monitoring in speech production.

A52

A GENERAL ROLE FOR ANTERIOR CINGULATE CORTEX IN PREDICTING TASK-RELATED EVENTS

William Alexander[1], Joshua Brown[1]; [1]Indiana University, Bloomington — Medial prefrontal cortex, especially dorsal anterior cingulate cortex (ACC), has been widely implicated in error processing and cognitive control. A recent computational model, the predicted response-outcome (PRO) model, interprets ACC activity as reflecting predictions of the likely consequences of actions, and indicating the surprising non-occurrence of a predicted outcome. While the PRO model is able to account for a wide range of effects observed within ACC related to the anticipation and evaluation of task-related feedback, a number of studies have observed ACC activity corresponding to the presentation of task-related stimuli, independent of eventual responses or outcomes indicated by those stimuli. Effects in ACC related to stimulus presentation include increased activity for infrequent tasks, increased activity for cues that reliably predict which of two tasks a subject will perform, as well as a negative ERP component (the mismatch-related negativity) observed when a repeating stimulus pattern is interrupted. Additionally, individual neurons have been observed whose activity increases prior to the presentation of a task cue, as well as single units that respond to cues indicating future rewards. In a new series of simulations, we show that, by extending our interpretation of "outcome" to include any event that can be reliably predicted by preceding cues, the PRO model can account for stimulus-related effects at both the single-unit and systems level.

A53

INHIBITORY CONTROL IS NECESSARY TO SUCCEED NUMBER CONSERVATION: AN FMRI STUDY OF A PIAGETIAN TASK

Gregoire Borst[1,2,3], Nicolas Poirel[1,2,3,4], Gregory Simon[1,2,3], Sandrine Rossi[1,2,3], Arlette Pineau[1,2,3], Olivier Houdé[1,2,3]; [1]University Paris Descartes and Caen, [2]Laboratory for the Psychology of Child Development and Education, CNRS Unit 3521, [3]PRES Sorbonne Paris Cite, [4]Institut Universitaire de France — Although young children can accurately determine that two rows contain the same number of coins when they are placed in a one-to-one correspondence, children younger than 7 years of age erroneously think that the longer row contains more coins when the coins in one of the rows are spread apart. To demonstrate that prefrontal inhibitory control is necessary to succeed at this task (Piaget's number conservation task), we studied the relationship between the percentage of blood oxygen level dependent (BOLD) signal changes in the brain areas activated in this developmental task and behavioral performance on a Stroop task and a Backward Digit Span task. The level of activation of the 9 years old children (i.e., the children who succeed the task) in the right insula/inferior frontal gyrus was selectively related to inhibitory control efficiency (i.e., the Stroop task), whereas the activation in the left intraparietal sulcus (IPS) was selectively related to the ability to manipulate numerical information in working memory (i.e., the Backward Digit Span task). On the other hand, no correlation was found between these brain regions and the behavioral performances for the 6 years old children (i.e., the children who were unable to perform the number-length interference

items). Taken together, these results indicate that to acquire the number conservation, children's brains must not only activate the reversibility of cognitive operations (supported by the IPS) but also inhibit a misleading length-equal-number strategy (supported by the right insula/inferior frontal gyrus).

A54

N2 AS AN INDEX OF IMPAIRED INHIBITORY CONTROL IN SMOKERS

George Buzzell[1], Daniel Roberts[1], John Fedota[1], Craig McDonald[1]; [1]George Mason University — Impaired inhibitory control has been proposed as a hallmark of nicotine dependence and is thought to arise, in part, from synaptic alterations in anterior cingulate cortex (ACC), a primary component of the dopamine reward pathway. The N2 component of the event-related potential (ERP) appears to index an inhibitory control process in paradigms such as the visual go/no-go task. Moreover, as dipole-modeling has suggested that the neural generator of the N2 component can be localized to the ACC, this component may prove useful for investigating impairments of inhibitory control in smokers. Given conflicting reports of whether the N2 is reduced in smokers (as compared to nonsmoker controls), we set out to further examine the suitability of this component as a biomarker for impaired cognitive control in smokers. In the present study, smokers and non-smokers performed a visual go/no-go task while Electroencephalogram (EEG) was recorded. As predicted, the no-go N2 of smokers was significantly smaller than that of nonsmoker controls, while the no-go P3 did not differ between groups. Importantly, behavioral performance (reaction time and accuracy) did not differ between smokers and nonsmokers, which likely reflects the low levels of nicotine dependence (assessed by the Fagerstrom test) in our sample. The observed N2 modulation in the absence of behavioral impairments is unique to the present study and provides evidence for the utility of the N2 component as a sensitive measure of impaired cognitive control in smokers, even in those with low levels of nicotine dependence.

A55

DIFFERENCES IN EXECUTIVE CONTROL EFFICIENCY IN PRESCHOOL CHILDREN IS PREDICTED BY DIFFERENCES IN ACC MORPHOLOGY

Arnaud Cachia[1,2], Grégoire Borst[1,2], Julie Vidal[1,2], Clara Fischer[3], Arlette Pineau[4], Jean-François Mangin[3], Olivier Houdé[1,2,5]; [1]CNRS U3521, Laboratory for the Psychology of Child Development and Education, Sorbonne, Paris, France, [2]Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [3]Computer-Assisted Neuroimaging Laboratory, Neurospin, I2BM, CEA, Gif/Yvette, France, [4]Université Caen Basse Normandie, Caen, France, [5]Institut Universitaire de France, Paris, France — A number of qualities (e.g., self-control, creativity and reasoning) needed by children to be successful in school and later in life are supported by executive control (EC). The prefrontal cortex plays a major role in EC, particularly the anterior cingulate cortex (ACC), which underlies the ability to overcome cognitive conflicts and inhibit a dominant response. Genes, environment (including school curricula) and neuroplasticity affect EC. However, the contribution of early anatomical pre-existing factors to child EC efficiency remains largely unknown. Using anatomical magnetic resonance imaging, we studied whether early neurodevelopmental constraints predicted preschoolers' EC efficiency by investigating the effect of ACC morphology, a stable feature of the brain determined in utero, on a classical behavioral index of EC efficiency (i.e., the Stroop interference score). The ACC morphology of nineteen 5-year-old right-handed preschoolers was classified as 'single' or 'double parallel' type based on the presence or absence of the paracingulate sulcus. Children were then divided into two groups (matched for age, gender and Oldfield handedness score): 8 children with symmetrical ACC morphology (same type in both hemispheres) and 11 children with asymmetrical ACC morphology. The preschoolers' EC efficiency was measured using the 'Animal Stroop task', an adaptation of the Stroop task for preschoolers. Stroop interference scores were significantly lower, and thus EC efficiency was higher, in children with asymmetrical ACC; ACC morphology explained 21% of Stroop interference score variability. Such findings might ultimately shape individualized educational interventions designed to help children overcome their EC deficits, particularly those with symmetrical ACC.

A56

COGNITIVE CONFLICT BY HEALTHY INDIVIDUALS OF HIGH OR LOW IMPULSIVITY: PRELIMINARY RESULTS OF AN FMRI STUDY

Yu Chen[1,2], Zude Zhu[1,2], Shihua Huang[1,2], Wei Zhang[1,2]; [1]Center for the Study of Applied Psychology, South China Normal University, China, [2]Department of Psychology, South China Normal University, China — Individuals with higher impulsivity showed poorer executive function control. To further investigate the neural mechanisms by which the brain detects and resolves cognitive conflict in impulsive young adults, twenty-four participants (ages 19-24, M=20.88 years) with higher or lower impulsivity were recruited in the present fMRI study. They were selected from a tested subject pool with 318 subjects with either shorter or longer stop signal response times (SSRT) than one standard deviation from the mean of the subject pool in the stop signal task, a widely used paradigm to assess impulsivity. The lower (12, 7 male, mean SSRT = 125 ms) and higher impulsivity (12, 6 male, mean SSRT = 333 ms) groups completed the Stroop task, a task which was widely used to dissociate cognitive conflict detection and resolution. For conflict detection and resolution, we separately defined regions of interest (ROIs) across groups to avoid group bias. For conflict resolution, no significant group differences were found. For conflict detection, we found that, the higher impulsivity group showed decreased activity in dorsal anterior cingulate cortex (dACC) and left dorsolateral prefrontal cortex (L.DLPFC) compared with the lower impulsivity group. Furthermore, brain activity negatively correlated with SSRT: the lower brain activity in dACC and L.DLPFC the longer SSRT. Our study suggested that the impulsivity may due to altered conflict detection.

A57

PLASTICITY FOLLOWING VISUAL SPATIAL WORKING MEMORY TRAINING: EVIDENCE FROM AN UNTRAINED VISUAL SPATIAL WORKING MEMORY TASK.

Sharona M. Atkins[1], Michael R. Dougherty[1], Michael F. Bunting[1], Donald J. Bolger[1]; [1]University of Maryland, College Park — Working-memory (WM), the ability to maintain and manipulate information, is a core cognitive function important for everyday life. Recent research suggests that WM is malleable and can be improved through cognitive training. Training-induced improvements have at times been shown to transfer to untrained cognitive tasks, and have long lasting benefits. Neuronal changes following WM training have been found on training specific tasks, localized to regions activated by in-task performance. Previously, we showed that visual spatial WM (vsWM) training, relative to active-control (AC) training, led to decreased activation in the cognitive control network and increased activation in the default mode network, during the training task. These patterns of activation suggest that the brain is more efficient at performing the trained task following training. In the present study, we examined the neural response on an untrained vsWM task (delayed-match-to-sample task) before and after 10 hours of either vsWM training or AC training (composed of math and sentence reading tasks). Post-minus-Pre training for the high load arrays (5,6,7dots) minus control arrays, revealed greater activation for the AC>vsWM in right frontal and cingulate regions, and the left inferior-parietal, whereas vsWM>AC resulted in greater activation in bilateral striatal regions and left inferior-frontal. These results are consistent with our previous findings, but further illustrate that training related changes in neural efficiency generalize to non-trained tasks. The results support the view that WM training can improve cognitive processing on tasks that engage the same neural networks that are targeted by the training tasks.

A58

INTER-HEMISPHERIC FUNCTIONAL CONNECTIVITY IN THE INTRAPARIETAL SULCUS SUPPORTS MENTAL MANIPULATION OF SPATIAL INFORMATION

Signe Bray[1], Ramsha Almas[1], Aiden Arnold[1], Giuseppe Iaria[1], Glenda MacQueen[1]; [1]University of Calgary — The intraparietal sulcus (IPS) is recruited during tasks requiring focused attention, maintenance and manipulation of information in working memory. Working memory paradigms typically show diffuse bilateral IPS engagement, while spatial attention shows a relatively fine topography of visual attention along the IPS, similar to retinotopic maps in visual cortex. In the present study we asked whether overlapping regions are involved in the maintenance and manipulation of information in spatial working memory. Visuotopic map-

ping was performed in 26 participants to define regions of interest along the IPS, corresponding to previously described IPS regions 0-4. In a separate task, we showed that while attending to a briefly flashed target location preferentially engages contralateral IPS, manipulation of spatial information by mentally rotating the target around a circle preferentially engaged ipsilateral IPS. IPS2- 3 were most strongly engaged during the attention task. Activity shifted posteriorly during the manipulation task, during which IPS1 showed the strongest engagement. Additionally, we found that increased activity in ipsilateral IPS during manipulation was related to increased functional connectivity with the contralateral IPS. Consistent with previous reports, some hemispheric asymmetries were also observed: left-IPS showed a stronger contralateral bias during attention, while right-IPS showed a stronger ipsilateral bias during manipulation. These findings elucidate the role of IPS within the working memory network by providing novel evidence for inter-hemispheric interactions supporting the manipulation of spatial information in working memory.

A59

RAPID FLUCTUATIONS IN THE CORTICAL NETWORKS SUPPORTING WORKING MEMORY FOR COLOR AND LOCATION: AN EEG SOURCE LOCALIZATION STUDY.

Daniel Caggiano[1], Alexandra Geyer[1], Jenn Lewis[2], Colin Davey[2], Joseph Cohn[3], Phan Luu[2]; [1]Aptima, Inc., [2]Electrical Geodesics, Inc., [3]Office of Naval Research — It is well known that working memory capacity is limited by both the quantity and the representational modality of information held in memory (e.g. Fukuda, Awh, & Vogel, 2010). More recently, Hampson and colleagues (2006) demonstrated that activity within the default network, which is observed in perceptual-motor tasks with widely different parameters, is also a limiting factor on WM performance. While all of these elements are known to limit task performance, the way in which their neural correlates interact rapidly during WM has not been investigated. To address this critical question, participants performed a variant of an n-back task with a 2 (WM load, 1- vs. 2-back) by 2 (WM type, color vs. location) within-subjects design. All conditions were perceptually identical. EEG was recorded continuously using a 256-channel HydroCel Geodesic Sensor Net (EGI, Eugene, OR). Epoched EEG data were subject to temperal-spatial decomposition. Source localization of significant principal components using LORETA revealed six distinct, correlated networks active during the task that were significantly affected by WM load. Three of these six networks – including a network active throughout the 200ms pre-stimulus interval – involved activity within the posterior cingulate (PCC), a key node in the default network. Interestingly, the only component indicating a significant WM load X WM type interaction, which reached maximal amplitude at approximately 350ms post-stimulus, was one of these three components that included PCC activity. The results suggest a complex interchange among neural networks supporting different aspects of the task that evolves rapidly to support WM decisions.

A60

INVOLVEMENT OF SPEARMAN'S G IN CONCEPTUALISATION VERSUS EXECUTION OF COMPLEX TASKS

Ellen Carroll[1], Peter Bright[1]; [1]Anglia Ruskin University, Cambridge, UK — Recent research suggests that general intelligence or Spearman's g may be explained on the basis of individual differences in the ability to generate an efficient conceptualisation or "task model" of behavioural goals, rather than real time processing demands associated with execution of those goals (Duncan et al., 2008; 2012). We explore the relative contribution of task conceptualisation versus execution to the recruitment of g in task performance. Initially, we correlated performance on a novel speeded response task requiring inhibition of a prepotent response tendency with a measure of fluid intelligence in healthy and neurologically impaired participant groups. Performance was highly sensitive to measured intelligence, with those at the lower end of the g distribution unable to successfully inhibit the task inappropriate response. The only robust effect of neurological impairment was to increase the proportion of participants at the lower end of the g distribution, and this effect was disproportionately associated with frontal lesions. In subsequent experiments the same task-relevant information was presented in either two-rule or four-rule formats to encourage the application of efficient and inefficient task models to performance respectively. Systematic manipulation of task requirements revealed enhanced performance-g correlations in trials requiring inhibition (relative to no inhibition), but only when instructions were presented as four rules. Actual task performance did not differ across two-rule and four-rule conditions. A further experiment provided confirmatory evidence that the way in which task-relevant information is conceptualised is crucial to the recruitment of g, rather than actual processing and storage demands per se.

A61

ELUCIDATING THE RELATIONSHIPS AMONG WORKING MEMORY, SEQUENCE LEARNING, AND CLINICAL SYMPTOMS OF NEURODEVELOPMENTAL DISORDERS

Alison Colbert[1], Jin Bo[1]; [1]Department of Psychology, Eastern Michigan University — Children with neurodevelopmental disorders often show motor learning deficits (e.g. Barnes, 2010), and recent studies suggest the importance of working memory (WM) to motor sequence learning (Bo et al., 2011). Other studies claim WM relates to phenotypic features of neurodevelopmental disorders such as hyperactivity, impulsivity, and inattention (Rapport et al., 2001). The current pilot study examined the relationships among clinical symptoms of neurodevelopmental disorders, WM, and sequence learning in 14 children (8 – 12 years of age). A series of clinical assessments (e.g., Conners 3, Social Responsiveness Scale, Social Skills Rating System), computerized change detection visuospatial (VSWM) and verbal WM (VWM) tasks, and a serial reaction time task (SRT) were employed. We hypothesized that WM would predict learning, and the scales on phenotypic features would correlate with WM and learning performance. Preliminary analyses showed marginal contributions of WM on sequence learning (VWM, $p = .10$; VSWM $p = .08$). Correlations between WM and peer relationships (both $p <= .10$) approached significance. Surprisingly, WM measures were not related to hyperactivity (both $p > .40$) or inattention (both $p > .40$). These results indicate that the influence of WM on social ability and other clinical symptoms, as well as their relationship to motor learning must be further examined. Additional samples and behavioral measures will also be added to better interpret the results. Understanding the relationships among WM, learning, and clinical symptoms of neurodevelopmental disorders is critical to further understand children with neurodevelopmental disorders.

A62

EFFECTS OF PERCEPTUAL GROUPING VARIABLES ON CONTRA-LATERAL DELAY ACTIVITY (CDA) DURING VISUAL WORKING MEMORY TASK PERFORMANCE

Shriradha Sengupta[1], Haoxiang Yang[1], Gregory Colflesh[2], Paul Verhaeghen[1]; [1]Georgia Institute of Technology, [2]University of Maryland Center for Advanced Study of Language — Our study explored how perceptual similarity of colors within a set of objects as well as the distance between these objects influence contra-lateral delay activity (CDA) - an ERP-derived marker of the number of objects retained in visual working memory. Participants remembered a set of either 2 or 4 colored squares; within a set, the squares were either identical (high similarity condition) or different (low similarity condition) in color. Additionally, the squares in each set could be presented adjacent to (high proximity condition) or at a distance (low proximity) from one another. During test, participants were presented with an identical set, or a set in which one of the squares changed color, and indicated match or mismatch with the memory set. Analysis of accuracy showed that participants could detect 4 objects in the high-similarity condition and 2 objects in the low-similarity condition equally well. This effect of similarity of colors was also observed in the corresponding CDA: Retention of 4 objects with 2 colors among them corresponded to lower amplitudes of CDA than retention of 4 objects with 4 different colors. Proximity of the colored squares did not affect behavioral performance for 2 or 4 memory objects. However, CDA was modulated by proximity when there were 2 objects: Lower proximity yielded higher CDA amplitudes. In sum, our results show an important effect of both similarity and proximity on the electrophysiological signature of the number of objects maintained in visual working memory.

A63

CORTICAL CONTROL OF NATIVE LANGUAGE PHONOLOGICAL COMPETITION IN MONOLINGUALS AND BILINGUALS

Kailyn Bradley[1], James Bartolotti[2], Sarah Chabal[2], Arturo E. Hernandez[1], Viorica Marian[2]; [1]University of Houston, [2]Northwestern University — Previous research has explored the neural mechanisms underlying the resolution of phonological competition in monolinguals (Righi, Blumstein, Mertus, & Worden,

2009); however, the effects of language experience on the cortical control of competition have yet to be explored. Eighteen English-speaking monolinguals and seventeen early Spanish-English bilinguals participated in a functional magnetic resonance imaging (fMRI) study designed to elicit phonological competition. Participants heard the auditory presentation of a target word in their native language and were asked to select that object from an array of four images. Monolinguals' search display contained an object that overlapped phonologically with the target word in English (e.g., "wig"/"witch"); bilinguals' display contained an object that overlapped phonologically with the target word in Spanish (e.g., "bolsa"/"boca"). Both groups received a Control condition, in which no objects in the array overlapped phonologically. Results revealed that monolinguals and bilinguals showed different neural activation patterns in response to phonological competition in their native language. Monolinguals activated bilateral medial frontal cortex and the head of the left caudate; bilinguals showed more focused activation in the tail of the caudate bilaterally. The distributed activation pattern in monolinguals suggests a greater demand on executive processes to resolve competition. Bilinguals' localized subcortical activation suggests that both language selection and the resolution of phonological interference are more implicit processes and tax the executive system less. These results suggest that experience with a second language may influence native language processing at the neural level.

A64

COMBINATORIAL EFFECTS WITHIN COMPOUND WORDS DURING VISUAL WORD RECOGNITION

Teon Brooks[1], Daniela Cid de Garcia[1,2], Alec Marantz[1], Liina Pylkkänen[1]; [1]New York University, [2]Universidade Federal do Rio de Janeiro — Convergent evidence from visual word recognition studies supports an early stage of automatic and obligatory decomposition for all morphologically complex words (Rastle et al, 2004; Solomyak & Marantz, 2010). However, there is still little evidence for an obligatory re-composition stage in cognition as proposed by full decomposition models. Studies on basic composition of word phrases suggest activity in the ventromedial prefrontal cortex indexes semantic composition of words (Bemis & Pylkkänen, 2011). The same mechanisms involved in composing between words may be responsible for composing morphemes within words semantically, leading to the prediction of activity in the vmPFC during complex word recognition modulated by the semantic relations between morphemes. Since English compounds vary along a dimension of semantic transparency (transparent: roadside, opaque: hogwash), full decomposition models predict a contrast between transparent and opaque compounds at the composition stage, indexed by activity at the vmPFC, while whole word models would not predict a difference between existing compounds, or between compounds and monomorphemic words in this ROI. In addition, on decomposition models, transparent compounds should pattern with novel compounds (e.g. ladyfork), that must be composed on any model. We use magneto-encephalography while subjects performed a word-naming task on four word types: opaque, transparent and novel compounds and simple orthographic control words (e.g. brothel). The results support predictions of the full decomposition model: transparent and novel compounds showed significantly more activity than orthographic controls between 400-500ms in the vmPFC, while opaque compounds patterned between the other compounds and the controls.

A65

EVALUATING THE IMPACT OF TASK DEMANDS ON EARLY STAGES OF WRITTEN WORD RECOGNITION

Haydee Carrasco-Ortiz[1], Katherine J. Midgley[1], Jonathan Grainger[2,3], Phillip Holcomb[1]; [1]Tufts University, [2]Aix-Marseille University, [3]Centre National de la Recherche Scientifique — Previous research has identified word frequency and word length as important variables impacting early stages of visual word processing. To better understand the temporal dynamics of these variables and whether their influence is modulated by differences in task demands we orthogonally manipulated three variables: word frequency (low vs. medium vs. high), word length (4 to 8 letters) and task (lexical decision vs. semantic categorization) using a large corpus of a thousand words presented to 30 participants. Results showed effects of both word frequency and length emerging within the first 200-300ms after stimulus onset over occipital areas. Shorter and lower frequency words elicited larger negativities compared to longer and higher frequency words. Additionally, ERP amplitudes in the N400 latency range increased as word frequency and length decreased. Critically, there were no early ERP effects of the task variable either as a main effect or in its interaction with length or frequency. This finding is consistent with the hypothesis that initial word recognition processes are relatively impervious to top-down influences resulting from differences in task demands.

A66

LANGUAGE SWITCHING IN MULTILINGUAL READING: IT'S ALL ABOUT BIGRAMS!

Aina Casaponsa[1], Manuel Carreiras[1,2,3], Jon Andoni Duñabeitia[1]; [1]Basque Center on Cognition Brain and Language, [2]Ikerbasque, Basque Foundation for Science, [3]Universidad del País Vasco — How do multilinguals detect the language of a word that they are reading? Recent electrophysiological research has shown that bilingual readers identify the language in 200 milliseconds, as shown in masked priming experiments testing the switch cost effect. The main goal of this study is to understand the underlying mechanisms of this effect, investigating the extent to which multilinguals rely in sub-lexical orthographic regularities of the words to predict the language. In a first ERP experiment, we manipulated the bigrams of the words in the second language (Basque) as a function of their legality in the first language (Spanish). Spanish targets were preceded by unrelated words either in Spanish or Basque. Unrelated Basque words could contain bigram combinations that were either legal or illegal in the target language. Results were clear-cut, showing an astonishingly clear long-lasting switch cost effect in the N250 component for words in the non-target language containing illegal bigrams as measured in the target language, and a clear lack of such an effect for Basque words whose bigrams did also exist in Spanish. A second ERP experiment using the same language combination with a different set of materials and participants completely replicated these findings, and additional behavioral data extended them to single (unprimed) word reading. These pieces of evidence support the hypothesis that multilinguals rely on statistical regularities of the words in order to detect their language. Thus, basic orthographic features of the words guide multilingual language detection, and consequently multilingual visual word recognition processes.

A67

RAPID LANGUAGE ACQUISITION FOR ABSTRACT AND CONCRETE WORDS FROM SENTENTIAL CONTEXT – AN MEG STUDY

Vera Dehmelt[1], Kati Keuper[1,2], Antoni Rodríguez Fornells[3,4], Pienie Zwitserlood[5], Christian Dobel[1,2]; [1]Institute for Biomagnetism and Biosignalanalysis, University of Münster, [2]Otto Creutzfeldt Center for Cognitive and Behavioral Neuroscience, University of Münster, [3]Institució Catalana de Recerca i Estudis Avançats (ICREA), Barcelona, [4]Department of Basic Psychology, University of Barcelona, L'Hospitalet de Llobregat, Barcelona, [5]Department of Psychology, University of Münster — The present study used whole-head magnetoencephalography (MEG) to investigate word learning. Event-related fields to single presentations of new words (i.e. pseudowords) before and after meaning derivation from congruent versus incongruent sentential contexts (learning session) were analyzed to examine processes of mapping new word forms to existing concepts, and how this is modulated by a concept's concreteness. Each mapping occurred only three times. German speakers silently read single presented existing German words (real words) and pseudowords before (pretest) and after (posttest) the learning session. Attenuated responses in the N400m (as magnetoencephalographic counterpart of the N400) from pre- to posttest were seen as indicating integration processes. Using distributed source modeling a main effect of learning was observed in a left temporal region within the N400m time window (380 ms to 500 ms) with a processing advantage for new words presented in congruent contexts, reflecting semantic integration. Real concrete words elicited attenuated N400m's (320 ms to 380 ms), supported by two right hemispheric regions, one more occipito-parietal and one more frontal. Within the same regions an interaction between learning and concreteness for new words was found. New words that gained concrete meaning through presentation in congruent sentence contexts evoked more attenuated N400ms (320 ms to 420 ms) from pre- to posttest than abstract new words. Thus, the process of mapping new word forms to existing conceptual knowledge is fast and modulated by concreteness.

A68

ON THE SAME WAVELENGTH: PREDICTABILITY AFFECTS SPEAKER-LISTENER ALIGNMENT. Suzanne Dikker[1,3], Lauren Silbert[2], Uri Hasson[2], Jason Zevin[3]; [1]New York University, [2]Sackler Institute for Developmental Psychobiology, [3]Princeton University — What brings people "on the same wavelength" in some situations but not others? In this study, we used an inter-subject correlation approach in fMRI[1] to ask whether the ability to infer, or predict, a speaker's intentions might increase neural alignment between a speaker and her listeners' brain activity[2], a possible index of 'mutual understanding'. Methods— For each of 45 trials, one speaker viewed and then described an image. In subsequent sessions, nine listeners saw the images and listened to the speaker's description. Images varied in predictiveness: Some images were highly predictive (HP) of one particular sentence, some allowed multiple descriptions (LP), as assessed through an offline questionnaire (N=54). Whole-brain, voxel-by-voxel correlations between the speaker and listeners' timeseries (36sec/24TRs) were conducted for HP vs. LP items respectively. Results—Speaker-listener correlations were significantly higher for HP items than LP items in brain regions implicated in auditory language processing and lexical-semantic prediction (left-posterior superior temporal gyrus[3]). Inspection of the speaker and listeners' timecourses of activity in pSTG suggests that this difference was due to a combination of factors: (1) a smaller temporal lag between speech planning and language processing for HP items and (2) increased BOLD activity in the listeners for LP items, corroborating prior research on prediction in language comprehension[3]. Based on these results, we argue that prediction not only aids rapid and successful processing of the world around us[4], it also helps to synchronize social behavior, one of the primary goals of human communication. References 1.Hasson-etal.2012.TiCS 2.Stephens-etal.2010.PNAS 3.Friederici.2012.TiCS 4.Bar.2007.TiCS

A69

ARE FREQUENCY AND REGULARITY EFFECTS TASK-DEPENDENT? EVIDENCE FROM ERPS Simon Fischer-Baum[1], Danielle S. Dickson[2], Kara D. Federmeier[2]; [1]Rice University, [2]University of Illinois, Urbana-Champaign — Both meaning and sounds can be generated from letter strings. Many theories of visual word processing assume automatic semantic access and phonological recoding whenever a written word is encountered. However, the relative importance of different reading processes depends on task. For example, generating pronunciations is more important when reading aloud than when reading for meaning. The current study uses event related potentials (ERPs) to investigate whether task-dependent strategic control modulates how visually-presented words are processed. Participants were presented written words in the context of two tasks, delayed reading aloud and proper-name detection. Stimuli varied factorally on word frequency, a measure critical for processing words along the semantic reading route, and on regularity, a measure of the ease of generating the word's pronunciation, controlling for other variables, like orthographic neighborhood and bigram frequency. The effects of frequency (on N400 amplitude) and regularity (on LPC size) were modulated by task. For frequency, differences in N400 amplitude were observed only in the reading aloud task, such that low frequency words elicited a higher amplitude N400. Frequency is often assumed to be an intrinsic property of the semantic reading route; these findings indicate that the role of frequency in reading is task-dependent. For regularity, low frequency, irregular words showed a larger LPC than the other three conditions only in the reading aloud task. This suggests that top-down control plays a role in the phonological processing of written words as well. Taken together, these results demonstrate that task demands affect how written words are processed.

A70

PROCESSING EMOTION AND TABOONESS IN A NATIVE VS. A SECOND LANGUAGE: AN ERP STUDY Allison R. Fogel[1,2], Katherine J. Midgley[1], Nate Delaney-Busch[1], Phillip J. Holcomb[1]; [1]Tufts University, [2]University of Maryland — Bilinguals frequently report that words in a second language (L2) have less of an emotional impact than words in a native language (L1) and that it is easier to swear in L2. This intuition has been corroborated experimentally, most reliably by studies examining skin conductance responses (SCRs), but the processing differences underlying this disparity remain unclear. In monolinguals, the late positive component (LPC) has been shown to be responsive to a word's level of arousal (intensity) but not to its valence (pleasantness). The present study investigated how these dual aspects of a word's emotionality are processed in L2. In Experiment 1, participants performed a semantic categorization task as they read single words that were crossed in levels of valence and arousal. As predicted, highly arousing words evoked a larger LPC than low arousal words in native English speakers but not in L2 English speakers, and no main effect of valence was observed in either group. Experiment 2 added taboo words to the same design. As with the arousal effects seen in Experiment 1, taboo words elicited a robust LPC compared to neutral words in native speakers, while the taboo effect was restricted in distribution in L2 speakers. However, no arousal effects were observed to highly arousing nontaboo words in either group when taboo words were present in the paradigm. These results suggest that L2 words are experienced as less arousing than L1 words and that arousal is processed relative to the surrounding context.

A71

DIFFERENCES IN CORTICAL THICKNESS AMONG DEAF SIGNERS, HEARING NATIVE SIGNERS, AND HEARING NONSIGNERS Stephen McCullough[1], Karen Emmorey[1]; [1]San Diego State University — Both deafness and life-long experience with sign language may alter the neuroanatomical structure of the human brain. We analyzed cortical thickness throughout the brain in deaf users of American Sign Language (ASL), hearing native ASL signers, and matched hearing nonsigners (N = 22 in each group; all right-handed). For each individual, two 3D structural MRI scans were obtained using a 3-Tesla GE Signa Excite MR scanner and then processed using FreeSurfer software to reconstruct white matter and pial cortical surfaces. Cortical thickness measurements from each individual were registered to a standard surface-based coordinate system to compare cortical thickness across groups and to visualize the statistical results. The contrasts between the deaf group and each of the hearing groups suggest that deafness is associated with increased cortical thickness in three left hemisphere regions: the insula, occipital cortex, superior parietal lobule; and two right hemisphere regions: the superior temporal sulcus and the fusiform gyrus. Increased gray matter in these cortical regions may be associated with different attention strategies and visual processing demands for deaf individuals. Compared to hearing nonsigners, hearing signers showed more gray matter in the right postcentral gyrus (near the arm/hand area). Surprisingly, hearing signers had less gray matter than both nonsigners and deaf signers in right MT and right superior temporal gyrus. The reason for decreased gray matter for hearing signers is unclear but may reflect a more distributed network for language processing in sign-speech (bimodal) bilinguals due to more distributed reliance on auditory and visual cortices.

A72

NEURAL CORRELATES OF INTENSIVE NON-NATIVE PHONETIC CATEGORY TRAINING Laura Mesite[1], Stephanie N. Del Tufo[2], Emily Myers[1,2,3]; [1]Brown University, [2]University of Connecticut, [3]Haskins Laboratories — While non-native phonetic category learning is difficult in adulthood, with sufficient training, many adults can discriminate non-native speech contrasts, with selective improvement on between-category compared to within-category contrasts. Previous work suggests that left inferior frontal regions may play an important role in rapid non-native contrast learning, suggesting a role for attention and/or decision processes in short-term gains in sensitivity. What is unknown is whether extensive training leads to increased sensitivity in temporal areas as well. In the current study, adult participants were trained for ten days to categorize non-native phonemes taken from a dental-retroflex continuum. Categorization training led to improvements in discrimination of between-category contrasts for all participants, while behavioral sensitivity to within-category contrasts remained stable. Neural responses to the phonetic contrasts were measured using a short-interval habituation fMRI design before and after training. Before training, no neural areas differentiated between- and within-category trials. After training, right temporal, bilateral inferior frontal, and bilateral inferior parietal clusters responded significantly more for within-category than between-category trials. No regions exhibited the opposite pattern. This stands in contrast to previous studies, which illustrate that between-category trials exhibit more activation than within-category trials for native phonemes (Joanisse et al., 2006; Myers et al., 2009). Taken together, these results suggest that long-term training results in the

involvement of both frontal and temporal areas known to be involved in the perception of native phonetic category structure, albeit with a distinct pattern of activation.

A73

LESION SITES ASSOCIATED WITH PAST-TENSE PRODUCTION DEFICITS IN APHASIA Lotte Meteyard[1], Cathy J. Price[2], Anna M. Woollams[3], Jennifer Aydelott[4]; [1]School of Psychology & Clinical Language Sciences, University of Reading, [2]Wellcome Trust Centre for Neuroimaging, Institute of Neurology, University College London, [3]School of Psychological Sciences, University of Manchester, [4]Birkbeck College, University of London — Determining the neural bases of our ability to generate the past-tense forms of English verbs has proven controversial. The goal of this study was to isolate specific cortical regions that, when damaged, are consistently and persistently associated with the impaired production of the past tense. Twelve patients with a heterogeneous mix of lesion sites in the left hemisphere were asked to generate regular and irregular past-tense forms in response to isolated verb stems and stems presented within a sentence context. In six of these individuals, past-tense production was significantly less accurate for regulars than irregulars. Lesion overlap analysis showed that all six had damage to the left pars opercularis, in the inferior frontal cortex. A seventh patient had difficulty producing both regular and irregular verbs, but was significantly less accurate for irregulars. This was the only patient in our sample where the lesion extended into the left anterior and inferior temporal lobe. Differential performance on regular or irregular verbs was not explained by the presence of articulatory impairments (verbal dyspraxia). The lesion overlap analysis adds to existing data by providing a focal frontal lobe region (the pars opercularis) that is essential for the production of regular verbs; this region has previously been associated with articulatory and phonological processing in fMRI studies of healthy participants. The single patient with temporal lesions who showed a relative impairment for irregular verbs adds to evidence that temporal regions (particularly anterior and inferior) are necessary for the successful production of irregular verbs.

A74

SPEECH PREPARATION IN ADULTS WHO STUTTER Jeffrey Mock[1,2,3], Anne Foundas[2], Edward Golob[3]; [1]Lousiana State University Health Sciences Center, [2]Children's Hospital of New Orleans, [3]Tulane University — Functional neuroimaging studies suggest compromised speech preparation in adults who stutter (AWS). We previously found that sounds delivered during speech preparation elicited an ERP slow wave relative to a control condition. This study tested the hypotheses that slow wave amplitudes and EEG power during speech preparation are attenuated in AWS and are proportional to stuttering severity. Adult subjects (12 AWS, 12 fluent) performed a cue-target delayed naming paradigm under two conditions (speech, control). During the speech condition participants viewed a cue word to prepare their vocal response to a subsequent target picture, which usually matched the cue (90% trials). The control condition was identical except cues were uninformative and vocal responses were infrequent. Between the cue and target a sound (tone, consonant-vowel) was presented at one of two time points (early, late). The main measures were vocal reaction times, auditory ERPs, and EEG power between the cue and target. Reaction times in AWS vs. fluent were comparable to match trials but AWS were longer when targets did not match the cue ($p = 0.002$), suggesting difficultly in updating speech plans. In the fluent group auditory slow waves were more negative in the speech vs. control condition, but were comparable in AWS ($p = 0.029$). Stuttering frequency was correlated to early auditory ERP amplitude ($p < 0.001$) and alpha-beta EEG power ($p < 0.04$) immediately after cue presentation. Overall, results suggest AWS exhibit atypical modulation of auditory cortical activity during speech preparation that is quantitatively related to the degree of impairment.

A75

LONG DISTANCE HARMONY GUIDES PREDICTION IN SPEECH PERCEPTION: ERP EVIDENCE FROM BASQUE SIBILANT HARMONY Philip Monahan[1]; [1]Basque Center on Cognition, Brain and Language (BCBL), Donostia-San Sebastián, Spain — Our native language phonology impacts both behavioral and neurophysiological responses to the speech signal; however, whether we use predictable phonological patterns to facilitate parsing the signal remains poorly understood. We use Basque sibilant harmony as a test case to better understand the underlying mechanisms of phonological prediction. Basque has three contrastive places of articulation (PoA) for sibilant consonants (fricatives s,z,x; affricates ts,tz,tx), and morpheme-internal sibilants agree in their PoA. Thus, given one sibilant, we hypothesize that speakers can reliably predict the PoA of an upcoming sibilant. In a behavioral phoneme-monitoring task, participants (n=30) listened to Basque pseudowords and responded when they heard the sound for which they were monitoring (three conditions: match (same PoA, e.g., usatsu), mismatch (different PoA, e.g., uzatsu) and control (non-sibilant /f/, e.g., ufatsu)). We find a main effect of condition: mismatch items showed longer reaction times than control and match items. To determine the temporal dynamics of phonological prediction, we conducted an ERP experiment. Participants (n=15) passively listened to the same Basque pseudowords. From 100-200 ms post-onset of the second sibilant, we find a main effect of condition. Match items elicited a larger negativity than mismatch items. These results suggest that listeners use their knowledge of the phonological patterns of their language to generate predictions about the content of the incoming speech signal and that these predictions are reflected relatively early in the neurophysiological response.

A76

NEUROCOGNITIVE MECHANISMS OF LEARNING TO READ: PREDICTING PRINT TUNING BY BEHAVIORAL LANGUAGE MEASURES Aleksandra K. Moscicka[1,2], Lea B. Jost[1,2], Margit Raith[1], Urs Maurer[1,2]; [1]Department of Psychology, University of Zurich, [2]Neuroscience Center Zurich, University of Zurich and ETH Zurich, Switzerland — Neural tuning for print is reflected by an increased N1 component of the event-related potential (ERP) for visual words compared to control stimuli. Previous studies showed that print tuning emerged within the first 2 years of reading training in school and was reduced in dysfluent readers. However, several questions have remained. Here, we investigated 1) whether print tuning has already developed by the end of 1st grade, 2) whether word reading fluency predicts print tuning across children with a wide range of reading skills, and 3) whether other behavioral language measures explain additional variance in print tuning beyond word reading fluency alone. A 128-channel EEG was recorded while 68 (Swiss-)German-speaking, monolingual children in 1st grade, performed an immediate repetition detection task with German words and false-font strings. Print tuning was indexed by the N1 difference in the ERPs between German words and false-font strings. In an additional behavioral session we measured word and pseudoword reading fluency, rapid naming, phonological processing, auditory memory span, reading comprehension, and vocabulary. We found print tuning to be highly significant at fronto-central and occipito-temporal electrodes suggesting that it emerged during the first year of reading instruction. More fluent reading was associated with larger print tuning and explained 7.6% of its variance. The most variance of print tuning, however, was explained by word reading fluency and vocabulary together (15%). This indicates that not only reading fluency, but also vocabulary contributed to the development of print tuning, even though the overall explained variance was rather low.

A77

LETTER-STRING-SPECIFIC N170 BROADLY DISTRIBUTES UNDER RAPID PRESENTATION Yasuko Okumura[1], Tetsuko Kasai[1], Harumitsu Murohashi[1]; [1]Hokkaido University — Extensive reading experience develops specialized neural activities for letter string perception. N170 component of event-related potentials (ERPs) is a robust marker of such specialization that typically shows left-lateralized enhancement for letter strings against non-linguistic visual controls. However, considering the normal reading, the N170 has been examined with much slower input rate. In this study, we examined letter-string-specific activities under near-normal reading speed to clarify automaticity and efficiency of such activities. ERPs were recorded from 11 native Japanese speakers. Stimuli were Hiragana words, nonwords, and alphanumeric symbols, consisted of four characters/symbols, with varied space between characters (dense/sparse). This was to examine spatial variance of the above activities. Participants attended to central fixation and detected infrequent blue fixation among rapid stream of the stimuli (100 ms duration with 300-650 ms inter-stimulus interval). As a result, words and nonwords elicited larger N1 (160-220 ms) than symbols at occipito-temporal (P7/8) and parietal (P3/4) sites bilaterally. For word and nonwords, the N1 amplitude was equivalent between dense and sparse conditions, while it was significantly larger in the sparse condition

for symbols. Letter-symbol contrast under rapid presentation was revealed similarly to previous studies but with broader distribution. This suggests that letter-string-specific tuning can take place in various visual-related regions, including dorsal regions and the right hemisphere, and those areas may automatically be employed under perceptually demanding circumstance. An additional finding was that N1 response to character strings was not affected by spatial arrangement of characters, which supports spatial invariance of this specialized activities.

A78

IN THERE A RELATIONSHIP BETWEEN CEREBELLAR VOLUME AND MORPHOLOGICAL PROCESSING IN SECOND LANGUAGE LEARNERS?

Christos Pliatsikas[1], Tom Johnstone[1], Theodoros Marinis[1]; [1]University of Reading — There is increasing evidence that learning a second language (L2) affects the structure of the adult brain, even in late learners of an L2 (Mechelli et al., 2004). For instance, research demonstrates increased grey matter (GM) volume for L2 learners in brain areas associated with learning and retrieval of new words (Lee et al., 2007). However, to date no studies have investigated whether learning and processing the L2 grammar affects the brain volume. In this study, we obtained high-resolution anatomical scans from 22 English native speakers (NS) and 17 late Greek-English learners. The participants also performed a behavioural task including regular inflections (e.g. played), which require rule-based decomposition, and irregular inflections (e.g. kept), which are processed as whole forms. An analysis of brain morphology (Voxel-Based Morphometry-VBM) revealed that, compared to the NS, L2 learners had significantly greater GM volume in the cerebellum, an area linked to implicit grammatical processing in a first language (Paradis, 2004). Additionally, the cerebellar volume of the L2 learners correlated negatively to the reading times for the morphological words only, revealing that the larger the cerebellum, the faster the learners read the words. Our results suggest that learning and processing of grammatical rules in a second language could lead to structural changes in the cerebellum. Lee et al. (2007). Anatomical traces of vocabulary acquisition in the adolescent brain. The Journal of Neuroscience, 27(5),1184–1189. Mechelli et al. (2004). Structural plasticity in the bilingual brain. Nature, 431,757. Paradis, M. (2004). A Neurolinguistic Theory of Bilingualism. Amsterdam: Benjamins.

A79

METAPHOR AND CONCRETENESS: AN ERP STUDY

Megan D. Bardolph[1], Bálint Forgács[1,2], Katherine A. DeLong[1], Ben D. Amsel[1], Marta Kutas[1]; [1]University of California San Diego, [2]Budapest University of Technology and Economics — We conducted an event-related brain potential (ERP) experiment to investigate the role of metaphor in processing concrete and abstract language. Participants read two-word phrases and then judged their meaning relative to a filler word. The two-word phrases were classified as Physical, able to be physically experienced (e.g., "written schedule"); Abstract (e.g., "conditional schedule"); or Metaphorical, meaning that the adjective-noun pair creates a metaphorical (non-physical) phrase from a physical adjective and a noun (e.g., "thin schedule"). Across participants, each noun appeared in each of the three adjective-noun pair conditions. Between 300 and 600 ms, the ERP to the adjective at posterior sites was less negative for the Abstract condition than the Physical and Metaphoric conditions, which did not differ from each other. This confirms known concrete-abstract ERP differences. The ERP pattern for nouns, however, varied with hemisphere: over posterior left hemisphere sites, the ERP to the noun shows the same pattern as for adjectives with greater negativity for Physical and Metaphorical compared to the Abstract conditions. By contrast, over posterior right hemisphere sites only nouns in the Physical condition show a greater negativity relative to the Abstract and Metaphorical conditions, which are indistinguishable. These results suggest that in some area of the brain, a noun appearing in the Metaphorical condition is processed similarly to that in the Abstract condition, despite its pairing with a concrete adjective. The perceived "concreteness" of any particular noun thus appears to be a function of the overall meaning of the adjective noun pairing.

A80

DISCOURSE CONTEXT ATTENUATES ANIMACY VIOLATIONS, BUT NOT OF GENDER-SPECIFIC PRONOUNS.

Adam Blalock[1], Megan Boudewyn[1], Tamara Swaab[1]; [1]University of California, Davis — Previous research has shown that discourse context rapidly constrains semantic processing of incoming words. For example, given cartoon-like stories in which inanimate characters perform animate acts, effects of animacy violations are attenuated (Nieuwland and van Berkum, 2006). Less is known about the build-up of discourse representations over time; namely, at what point do listeners rely more on whether an incoming word fits well with the preceding context than on the meaning of the word itself? It is also unclear if cartoon-like context can override referential animacy violations when gender-specific pronouns refer to inanimate antecedents. In this study we manipulated two types of animacy violations in four sentence stories: 1) Critical words were either animacy-consistent or animacy-inconsistent, and either discourse-consistent or discourse-inconsistent (e.g., "The peach/man was upset… following a context featuring a man or a cartoon-like peach character); 2) gender-specific pronouns were used to refer either to animate or inanimate antecedents . Results showed that cartoon-like discourse context quickly attenuates the N400 amplitude to animacy-violating words, with effects emerging early in the stories. However, discourse context did not attenuate the N400 animacy violation effect when gender-specific pronouns were used to refer to the inanimate character. Therefore, discourse context may have a less robust influence on referential processing than on lexical-semantic processing. In short, these results suggest that lexical-semantic processing of incoming words in discourse is quickly facilitated by context, whereas the establishment of co-reference between a gender-specific pronoun and a non-canonical (inanimate) antecedent may be less easily accomplished.

A81

GENDER DIFFERENCES ON EYE-TRACKING DURING AN IRONY COMPREHENSION TASK

Nathalia Baptista[1], Olivia Lapenta[1], Elizeu Coutinho[1], Paulo Boggio[1]; [1]Mackenzie Presbyterian University — Irony is a specific figurative language. Impaired pragmatic abilities might result in deficits of interpretation leading to socialization difficulties and miscommunication. Gender differences are usually reported for many linguistic aspects. However, the literature showing sex differences on irony comprehension are scarce. Previous studies used written sentences or auditory stimuli to present the scenario and the ironic statement. In real live, irony come along with facial expressions and visual cues. We aimed to investigate the visual strategies used to comprehend irony as well as to verify gender differences on it. A professional cartoonist drew two-panel cartoon strips illustrating people in daily situations which had two endings – ironic or literal. 30 undergraduate students had to judge these stories as ironic or literal. The task was performed using an eye-tracking system. Fixation duration and number of fixations were analyzed considering Area of Interest (AOI) (face expression, context cue, written sentence), Statement (ironic or literal) and gender. We found a significant effect of Gender for the number of fixations; i.e women presented more fixations than men. Also we found a significant effect for the interaction Gender*AOI; i.e men presented a reduced duration time of fixation on the written sentences as compared to women. We did not find significant effects on behavioral performance. Our findings show that the irony comprehension is processed by different strategies between sexes – women scan different details of the scenarios while men drive less attention to the written sentences as compared to the other details.

A82

EFFECTS OF WORKING MEMORY SPAN ON PROCESSING OF LEXICAL ASSOCIATIONS AND CONGRUENCE IN SPOKEN DISCOURSE

Megan A. Boudewyn[1], Debra L. Long[1], Tamara Y. Swaab[1]; [1]University of California, Davis — The goal of this study was to determine whether variability in working-memory capacity and cognitive control affects the processing of global discourse congruence and local associations among words when participants (n = 26) listened to short discourse passages. The final word of each passage was either associated or unassociated with a preceding prime word (e.g. "He was not prepared for the fame and fortune/praise"). These critical words were also either congruent or incongruent with respect to the preceding discourse context (e.g. a context in

which a prestigious prize was won (congruent) or in which the protagonist had been arrested (incongruent)). We used multiple regression to assess the unique contributions of suppression ability (our measure of cognitive control) and working memory capacity on the amplitude of individual N400 effects of congruence and association. Our measure of suppression ability did not predict the size of the N400 effects of association or congruence. But, as expected, the results showed that high working-memory capacity individuals were less sensitive to the presence of lexical associations (showed smaller N400 association effects) ($p<0.05$). Furthermore, differences in working memory capacity were related to differences in the topographic distribution of the N400 effects of discourse congruence ($p<0.05$). The topographic differences in the global congruence effects indicate differences in the underlying neural generators of the N400 effects, as a function of working memory. This suggests additional, or at a minimum, distinct, processing on the part of higher capacity individuals when tasked with integrating incoming words into the developing discourse representation.

A83

CHOOSING FIGURATIVENESS: METAPHOR COMPREHENSION AFTER BRAIN INJURY

Eileen Cardillo[1], Marguerite McQuire[1], Ianni Geena[1], Chatterjee Anjan[1]; [1]University of Pennsylvania — Despite the naturalness and prevalence of metaphor in everyday language, the neural basis of this powerful communication device remains poorly understood. The purpose of this study was to test the hypothesis that traditional aphasia assessments are not sensitive to deficits in metaphor comprehension. Stimuli consisted of moderately novel metaphors of three different types: predicate metaphors based on action verbs (The divorcee sashayed through the paperwork), 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 in a randomized order, 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. Results with healthy adults indicated comparable accuracy across conditions. By contrast, focal lesion patients all scoring within normal limits on the Western Aphasia Battery (Kertesz, 1982) showed different comprehension profiles, including good comprehension on all conditions, a pervasive metaphor comprehension impairment, and selective impairment with particular types of metaphor. We conclude our task captures deficits and subjective difficulties in figurative language comprehension not captured by traditional language assessments and, as such, allows for critical testing of neural hypotheses about metaphor.

A84

PREDICTING DISSOCIATIONS IN BRAIN ACTIVATION PATTERNS DURING LEXICAL DECISION IN THE CONTEXT OF PSEUDOWORD OR CONSONANT STRING FOILS

Ya-Ning Chang[1], Matthew Lambon Ralph[1], Steve Furber[2], Stephen Welbourne[1]; [1]School of Psychological Sciences, University of Manchester, [2]School of Computer Science, University of Manchester — Computational modelling of visual word recognition has successfully simulated a wide range of behavioral data serving as a powerful tool to help the understanding of human cognitive processes. However, relatively little research has been done to account for data from neuroimaging studies of printed word processing. Most of what exists models electrophysiological rather than fMRI derived data (e.g., Laszlo & Plaut, 2012). Recent neuroimaging studies show that left anterior temporal activation, which has been associated with semantic processing (e.g., Rogers et al., 2004), increases when lexical decisions are made more difficult in the context of pseudohomophones (Woollams et al., 2011). This suggests that the extent of the involvement of semantics in lexical decision depends on the nature of nonword foils. To explore this computationally we developed a recurrent connectionist model of single word reading including visual/orthographic processing, phonological and semantic processing. The model could perform naming tasks as well as lexical decision tasks, capturing a number of standard reading effects. The model could also differentiate words from nonwords by integrating measures of polarity across visual/orthographic, phonological and semantic layers. More importantly, the relative contribution of these layers depended on the type of nonword foils. The model was more reliant on semantic information when the nonword foils were pseudowords rather than consonant strings. These results resemble the differential brain activation seen in left anterior temporal lobe for lexical decision tasks. The results support the view that semantic involvement in lexical decision is graded by the difficulty of the decision task.

A85

THE CONSTRAINING AND CLOZE PROBABILITY EFFECTS OF CHINESE CLASSIFIER-NOUN AGREEMENT IN HEALTHY ELDERS AND YOUNG ADULTS

Chia-Ju Chou[1], Hsin-Chi Wu[2,3], Ke-Jui Lin[1], Chia-Ying Lee[1,4]; [1]Institute of Neuroscience, National Yang-Ming University, [2]Department of Physical Medicine and Rehabilitation, Buddhist Tzu Chi General Hospital, Taipei branch, Taipei, Taiwan, [3]School of Medicine, Tzu Chi University, Hualien, Taiwan, [4]Institute of Linguistics, Academia Sinica, Taiwan — Language comprehension involves at least two types of processing. One is the bottom up integrative process which achieves reading comprehension by retrieving and integrating the meaning of individual words that embedded in the sentences. The other one is the top-down predictive processing which emphasizes the usage of the contextual information in predicting the upcoming words. Studies have suggested that older adults remain intact in retrieve the lexical knowledge from the semantic memory but make less effective use of context information for top-down prediction. This study aims to utilize the unique characteristic of Chinese classifier-noun agreement to dissociate the two types of contextual effects, namely the contextual constrain and cloze probability, and to examine whether the aging may exert differential effects on these two processes. Participants, included 24 healthy elders and 18 young adults, perceived a highly expected (high cloze probability), an unexpected (low cloze probability), or an implausible noun followed by either a strongly constrained or a weakly constrained classifier in a plausibility judgment task. The data demonstrated a constraining effect on classifiers in the time window of N400 in young adults, but not in elders. For the following nouns, the young adults showed a graded cloze probability effect on N400 (implausible > low cloze > high cloze), whereas the elders showed a different pattern of cloze probability effect (implausible = low cloze > high cloze). The data supports that the ability to use the contextual information is compromised with age.

A86

AN ERP INVESTIGATION OF REVISING DISCOURSE MODELS DURING READING

Tristan S. Davenport[1,2], Seana Coulson[1,2]; [1]University of California, San Diego, [2]Center for Research in Language — An event-related potential (ERP) experiment investigated the temporal dynamics of discourse model construction during reading. ERPs were recorded as healthy adults read two-sentence stories that varied in plausibility. Critical sentences such as "Without warning, the cowboy was BITTEN by a SNAKE, and cried out for help," were preceded either by a sentence that rendered the event Plausible ("The cowboy was walking through the tall grass,") or Implausible ("The cowboy was driving through the tall grass,"). Verbs (e.g. "bitten") elicited larger N400 in the Implausible contexts than the Plausible ones, but plausibility did not affect N400 responses to the nouns (e.g. "snake"). This result suggests that in the Implausible condition, not only did participants recognize the discourse incongruity at the earliest possible opportunity, but they rapidly revised their discourse models such that the real time processing difficulty of the noun ("snake") was similar in both contexts. After the sentence-reading experiment, participants were given an old/new word recognition test for the critical nouns. During this recognition test, critical nouns ("snake") previously encountered in the Implausible contexts elicited smaller amplitude N400 than nouns seen in Plausible contexts. We suggest that the verbs ("bitten") in our Implausible contexts triggered the rapid revision of participants' discourse models, rendering the real time processing of critical nouns "snake" unproblematic, and leading to lasting ERP memory effects for those nouns.

A87

THE DEMAND FOR COGNITIVE CONTROL IN THE FORMATION OF SOURCE MEMORY: A ROLE OF THE HIPPOCAMPUS

Cheryl Abellanoza[1], Fernando Leal, Karen Garrett, Heekyeong Park; [1]University of Texas at Arlington — Memory and cognitive control are inherently intertwined. Previous fMRI studies have suggested that successful encoding of item-context associations often recruits activity in the hippocampus and the parahippocampus. Here, we investigated whether the demand for cog-

nitive control modulates encoding activity for source memory. Subjects were scanned while they engaged in a semantic encoding task for a list of line-drawing pictures that were presented in one of four different colors. In each study trial, a picture on a colored background was presented in one of three different ways: (1) with no irrelevant stimuli (Picture-Only); (2) with a superimposed letter string (Picture-Letter); or (3) with a superimposed word (Picture-Word). In a subsequent test phase, subjects made recognition judgments on test items and indicated context color for studied items. In accordance with previous findings, studied items accompanied with correct source judgments elicited greater activity in the left inferior prefrontal cortex, the bilateral fusiform regions and the left anterior hippocampus than did items with incorrect judgments. Subsequent source memory effects selective for Picture-Only items recruited activity in the left ventrolateral prefrontal cortex. Importantly, encoding activity for source memory selective for Picture-Letter and Picture-Word items was identified in the left posterior hippocampus, the left parahippocampal cortex, the right putamen, and the left middle occipital gyrus. These findings suggest that the formation of item-context associations embedded in irrelevant stimuli may evoke the demand for cognitive control and that the hippocampus plays a role in source encoding under such demand.

A88

PRE-STIMULUS SUBSEQUENT MEMORY EFFECTS AND THE ENCODING OF ASSOCIATIVE MEMORIES Richard James Addante[1], Marianne De Chastelaine[1], Michael D Rugg[1]; [1]University of Texas at Dallas, School of Brain and Behavioral Sciences, Center for Vital Longevity — There have been several reports that pre-stimulus neural activity modulates episodic memory encoding. Here, we investigated pre-stimulus activity during the encoding of item-item associations, using fMRI to identify neural regions demonstrating pre-stimulus associative memory effects. While undergoing scanning, subjects studied a series of word-word and picture-picture pairs. Prior to the presentation of each study pair, a cue appeared signaling whether the upcoming pair comprised words or pictures. The cue-pair interval varied between 1 and 5 sec, permitting pre- and post-stimulus activity to be separately estimated. The study task was to judge which of the two denoted objects would fit inside the other. Test items comprised item pairs that were either presented in the same (intact) or different (rearranged) pairings, along with pairs comprised of new items. Subjects indicated if each test pair was intact, rearranged, or new. The critical fMRI contrast was between study activity associated with pairs that went on to be correctly judged intact and those which were incorrectly judged as rearranged. Material-independent pre-stimulus subsequent memory effects were evident in several cortical regions, most notably in those belonging to the 'dorsal attention network', namely, right intra parietal sulcus and lateral prefrontal cortex. These findings indicate that, as in the case of single-item encoding, successful encoding of item-item associations is modulated by pre-stimulus neural activity. The loci of the present effects suggest that they reflect the benefit to encoding accruing from the engagement of controlled attention in anticipation of an upcoming stimulus event.

A89

DIMENSIONS OF CONTENT UNDERLYING STIMULUS-INDEPENDENT THOUGHT AND RELATIONSHIPS TO RESTING-STATE CONNECTIVITY Jessica Andrews-Hanna[1], Andrew Reineberg[1], Amy Turner[1], David Howett[1], Marie Banich[1,2]; [1]University of Colorado Boulder, [2]University of Colorado Denver — Humans spend a remarkable amount of time engaged in thoughts unrelated to the immediate perceptual environment. Despite the significance of these "stimulus-independent thoughts" (SITs), the dimensions of content characterizing SITs, and their relationship to resting-state functional connectivity (rs-fcMRI) remain poorly understood. To seek insight into these questions, we developed a novel thought sampling paradigm during which 77 adults generated numerous SITs and rated each SIT along several dimensions of content. Exploratory principle components and cluster analyses revealed four distinct content dimensions: 1) personal significance, 2) episodic specificity, 3) social orientation, and 4) valence. On average, participants reported SITs that were highly personally-significant, moderately specific, somewhat socially-oriented, and positive in valence. To determine how these content dimensions influence patterns of connectivity during the "resting state" (a context promoting the occurrence of SITs), 50 of the 77 participants were scanned in a separate 6-minute resting-state session. Across participants, SIT content was correlated with patterns of rs-fcMRI between brain regions comprising the default network (DN) and the adjacent limbic system. Results revealed relationships between the content of one's SITs and his/her patterns of rs-fcMRI. For example, individuals who reported more episodic/specific thoughts exhibited greater rs-fcMRI between the medial temporal lobe (MTL) subsystem and the midline core of the DN. Conversely, individuals who reported more socially-oriented thoughts exhibited heightened rs-fcMRI between the dorsal medial PFC and the MTL subsystem. These results implicate SIT as an active internal mode of cognition comprised of multiple content dimensions that relate to patterns of rs-fcMRI in content-specific ways.

A90

DISTINCT PROFILES OF IMPAIRED ASSOCIATIVE MEMORY AND UNDERLYING CEREBRAL NETWORKS IN ALZHEIMER'S DISEASE Christine Bastin[1], Mohamed Ali Bahri[1], Fabienne Collette[1], Sarah Genon[1], Jessica Simon[1], Bénédicte Guillaume[2], Rachel Diana[3], Andrew P. Yonelinas[4], Eric Salmon[1,5]; [1]University of Liege, Belgium, [2]Centre Hospitalier du Bois de l'Abbaye et de Hesbaye, Belgium, [3]Virginia Tech, USA, [4]University of California Davis, USA, [5]CHU Liege, Belgium — Binding allows the integration of features within stimuli and the encoding of relations between distinct stimuli into complex memories. The current study investigated the impact of Alzheimer's disease (AD) on conjunctive and relational binding in long-term episodic memory. Thirty patients with mild Alzheimer's disease (AD) and 24 healthy older adults performed a source memory task where items were associated to a background color. In one condition, relational binding was promoted by the instruction to associate the item with another object of the same color as the background. In the other condition, color had to be integrated as an item feature (conjunctive binding). In the patients, performance in each condition was correlated with cerebral metabolism measured by fluorodeoxyglucose-positron emission tomography. The results showed that AD patients had an impaired capacity to remember the color associated to each item, with disproportionate deficit in conjunctive memory. Performance in each condition correlated with metabolic activity in distinct regions. Poor conjunctive memory was related to hypometabolism along the collateral sulcus. Functional connectivity analyses of resting-state functional magnetic resonance images in a subset of patients confirmed that these regions belong to an anterior medial temporal lobe-ventral visual network. In contrast, there was a correlation between relational memory scores and metabolism in the anterior medial prefrontal cortex, which was functionally connected to the posterior cingulate cortex in the default mode network. These findings point to heterogeneous alteration of relational and conjunctive long-term binding in Alzheimer's disease associated to the dysfunction of regions within distinct functional networks.

A91

EPISODIC MEMORY, ELEMENTAL SPATIAL AND TEMPORAL BINDING, AND THE MEDIAL TEMPORAL LOBE. Christopher Benjamin[1,2,3], Michael M. Saling[3,4], Amanda G. Wood[5], David C. Reutens[6]; [1]Semel Institute, University of California Los Angeles, CA, USA, [2]Harvard Medical School, Boston, MA, USA, [3]University of Melbourne, VIC, Australia, [4]Austin Health, VIC, Australia, [5]University of Birmingham, England, [6]Centre for Advanced Imaging, The University of Queensland, Australia — Associative processing is a central process in episodic memory relying heavily upon mesial temporal lobe (MTL) structures. Recent research has suggested the MTL may support a number of other higher cognitive functions that tax associative processing such as navigation and imagination. In this study we examined the neural correlates of two key types of associative processing common to these tasks, spatial and temporal binding, and the influence of MTL damage associated with mesial temporal lobe epilepsy (TLE). This was accomplished using fMRI and a novel task requiring participants to hold simple visual stimuli in memory over short periods of time. Participants included 14 typical adults (mean age 36.4 years [sd. 10.5 years]) and a group of 14 patients with a clinical diagnosis of left temporal lobe epilepsy (TLE) and left hippocampal atrophy on MRI (mean age 34.3 years [sd. 6.6 years]). In the typical group, spatial binding was associated with bilateral parahippocampal activation (right > left) and joint spatial-temporal binding with relative left hippocampal/parahippocampal deactivation. In the left TLE group this relationship was disturbed so that participants used right hemisphere and

extra-MTL regions to a greater extent. Results are discussed with reference to models of parahippocampal specialization and the potentially hierarchical organization of the MTL.

A92

RIGHT-HEMISPHERE MEMORY: LATERALISATION EFFECTS OF MATERIAL, MODALITY, NOVELTY, VERBALISATION AND SEX

Adam Bentvelzen[1], Genevieve McArthur[1], Nicholas Badcock[1], Blake Johnson[1], Megan Willis[3], Stuart Lee[4], Greg Savage[1,2]; [1]ARC Centre of Excellence in Cognition and its Disorders (CCD), Macquarie University, [2]School of Psychology, Macquarie University, [3]Australian College of Applied Psychology, [4]Monash Alfred Psychiatry Research Centre, Monash University — Neuropsychological measures of verbal memory appear to characterise the impact of left temporal lobe damage, but nonverbal measures do not reflect right temporal lobe damage reliably, possibly due to their ability to be verbalised. Cognitive neuroscience models of right hemisphere processing in the healthy brain could usefully inform development of clinical memory tests of lateralised functions. We measured event-related EEG during encoding and recognition memory in two experiments. In Study 1 it was found that learning spatial patterns was related to greater right hemisphere bias (RHB) in event-related desynchronisation, while auditory nonwords demonstrated a left hemisphere bias (LHB). Surprisingly, RHB was shown by visual nonwords and LHB by auditory melodies, suggesting that the modality (visual or auditory) of novel materials has a stronger effect on hemispheric lateralisation than the material (verbal or nonverbal). Focusing on visual tasks, Study 2 compared effects of memory task (verbal versus spatial) to task-irrelevant visual form processing (letter strings, novel characters, and hybrid letters-in-spatial-patterns) on hemispheric biases. Spatial learning resulted in greater RHB than verbal learning, despite identical visual forms. However, novel visual form also increased RHB for spatial memory, while spatial form decreased RHB for verbal memory. There were sex differences in the strength of hemispheric biases and in use of verbal labels to aid memory, although label use did not predict hemispheric biases. These findings are consistent with the view that multiple factors contribute to RHB in memory and hold promise for the development of reliable clinical measures to assess right hemisphere impairment.

A93

ASSOCIATIVE RECOGNITION IN AMNESIA: CROSSING STIMULUS DOMAINS MATTERS, TEMPORAL SEPARATION DOES NOT

Alyssa Borders[1], Mariam Aly[1], Andrew Yonelinas[1]; [1]University of California, Davis — It is well established that the hippocampus plays a critical role in binding different aspects of an event to form episodic memories. Previous studies have suggested that the hippocampus may be preferentially involved in binding information from different domains (e.g., visual and auditory stimuli) or binding temporally discontiguous information (e.g. sequentially presented objects). In the current study, we examined whether the role of the medial temporal lobe in associative recognition memory varies depending on domain (within or across domain associations) and temporal separation (simultaneous or sequential presentation). Patients with either selective hippocampal lesions or more extensive MTL lesions were tested on three associative recognition tasks. In the within-domain condition, participants studied fractal-fractal pairs that were simultaneously presented. In the across-domain conditions, participants studied fractal-sound pairs that were presented simultaneously in one condition and sequentially in the other. At test, participants made recognition judgments on intact and rearranged pairs. The patients were impaired in all of the conditions relative to controls; however, they were significantly more impaired in the across-domain conditions than in the within-domain condition. There was no significant difference in performance between sequentially and simultaneously presented across-domain associations. The same overall pattern of results was apparent in both the hippocampal and MTL patient groups. These findings suggest that the MTL, and specifically the hippocampus, is particularly important in binding information across sensory domains. There was no evidence that increasing the temporal separation increased hippocampal dependence.

A94

RECOGNITION MEMORY FOR CONCRETE AND ABSTRACT PICTURES: AN ERP STUDY WITH SCHOOL-AGED CHILDREN

Olivier Boucher[1], Matthew J. Burden[2], Gina Muckle[3], Sandra W. Jacobson[2], Joseph L. Jacobson[2]; [1]Université de Montréal, [2]Wayne State University, [3]Université Laval — Recognition memory for concrete, nameable pictures is typically faster and more accurate than for abstract pictures. A dual-coding account for these findings suggests that concrete pictures are processed into verbal and image codes, whereas abstract pictures are primarily encoded in image codes. Recognition memory relies on two successive and distinct processes, namely familiarity and recollection. Whether these two processes are similarly or differently affected by stimulus concreteness remains unknown. This study examined the effect of picture concreteness on visual recognition memory processes using event-related potentials (ERPs). In a convenience sample of school-aged children involved in a study on child development, participants (N = 96; mean age = 11.3 years; all right-handed) were assessed on a continuous visual recognition memory task in which half the pictures were easily nameable, everyday concrete objects, and the other half were three-dimensional abstract, sculpture-like objects. Behavioral performance and ERP correlates of familiarity and recollection (respectively, the FN400 and P600 repetition effects) were measured. Behavioral results indicated faster and more accurate identification of concrete pictures as new or repeated in comparison to abstract pictures. ERPs were characterised by a larger repetition effect on P600 amplitude for concrete than for abstract images, suggesting increased brain activity during the active recollection of concrete pictures in memory. Hemispheric differences were observed over anterior inferior electrodes within the FN400 latency interval, with the repetition effect more pronounced over the left hemisphere for concrete stimuli, which may reflect a facilitating effect from early verbal/semantic processing.

A95

CONCEPT FAMILIARITY, FREQUENCY JUDGMENTS, AND SEMANTIC KNOWLEDGE AFTER ANTERIOR TEMPORAL LOBE RESECTION THAT SPARES THE HIPPOCAMPUS

Stefan Köhler[1,2], Ben Bowles[1,2], Ken McRae[1,2]; [1]Department of Psychology, Western University, [2]Brain and Mind Institute, Western University — In dual-process models of recognition memory, the perirhinal cortex plays a specific role in familiarity assessment during recognition, which is distinguished from the selective contributions of the hippocampus to the recollection of episodic detail. Bowles and colleagues (2007) observed selective impairments in familiarity assessment for verbal stimuli in an individual (NB) who had undergone a rare surgical resection of left anterior temporal lobe structures, with partial removal of perirhinal cortex but sparing of the hippocampus. Here, we investigated whether NB's impairments extend to situations in which familiarity must be assessed with reference to experience accumulated over the life-time, rather than with respect to a specific laboratory episode (as is typically done in studies of recognition memory). In familiarity ratings obtained for 541 living and non-living basic-level concepts, NB's expressed familiarity levels clearly differed from those of matched control participants; they were also less consistent when examined again in a second session. We sought further insight into this impairment by assessing her ability to make other types of semantic judgments on the same concepts, and by testing her ability to make frequency judgments based on varying numbers of exposure in a laboratory setting. We found only limited evidence for impairments in other semantic tasks, including in graded judgments of typicality. However, NB was impaired in making frequency judgments for repeated laboratory exposures. The reported pattern of impairments suggests that judgements of familiarity are particularly sensitive to the perturbations in conceptual knowledge that result from unilateral anterior temporal-lobe lesions.

A96

ELECTROPHYSIOLOGICAL AND BEHAVIOURAL MARKERS MAY EXPLAIN SOURCE MEMORY DECLINE ASSOCIATED WITH OLDER ADULTS

Noeleen Brady[1], Richard Roche[1]; [1]Department of Psychology, National University of Ireland, Maynooth. — Source Memory is a person's ability to remember any aspects of context which may be associated with an event. When placing events into the appropriate context, older adults have more difficulty than younger, suggesting that ageing causes a natural decline

in source memory. The current study examined source memory retrieval between young (18-30 years, n=14) and older (55+ years, n=14) adults at computer-based source memory tasks including the Opposition task, the Where-Who-What task (WWW) and a Source Modality task. During the Opposition task participants learned a list of words. In the test, new and old words are repeated at different stages (lags). In the WWW task, locations, faces and words were paired. During the test, two of the elements were paired correctly and incorrectly. In the Source Modality task, pictures and auditory words were presented. In the test, the presented stimuli change modality. Electrical brain activity was measured with an electroencephalogram (EEG) while participants completed the tasks. The data from the memory tasks were analysed regarding accuracy and response times when giving a correct or incorrect response. The groups were compared with the young showing higher accuracies and faster response times. In addition, key components of the event-related potentials (ERPs) were analysed, and compared, to identify differences in processing between the groups. ERP components for Source Memory tasks include a P100 at electrodes P7 and P8 with young adults showing larger amplitudes. Future implications will include an intervention to reduce the effects of source memory decline in ageing.

A97

AGE-RELATED IMPAIRMENTS IN ACTIVE LEARNING STRATEGIES THAT DEPEND ON ANTERIOR HIPPOCAMPAL-CORTICAL NETWORK FUNCTION

Kelly Brandstatt[1], Joel Voss[1]; [1]Northwestern University — Age-related memory deficits could stem partly from reduced engagement of learning strategies that are more prevalent in younger individuals. We tested this hypothesis by manipulating the ability for younger and older individuals to engage in self-directed strategies when learning objects and their locations. Subjects viewed object collections through a viewing window that was self-controlled in an active-learning condition, thus permitting self-directed learning strategies. In contrast, subjects watched window movements in a passive condition that were recorded from the active viewing of other subjects. Two experiments involving 40 older (50-70 years) and 20 younger (18-30 years) subjects differed according to whether the passive condition was yoked to the active viewing of younger versus older subjects. In both experiments, passive study led to similar subsequent recognition and recall performance for older and younger subjects, suggesting that younger and older subjects perform alike when learning strategies were limited via passive study. Older and younger subjects benefitted from active learning. However, recognition and recall were improved for younger subjects, but only recognition was improved for older subjects. Our previous fMRI findings indicate that active-learning enhancements of recall versus recognition differentially involve hippocampal-prefrontal versus posterior hippocampal-cortical networks, suggesting that learning strategies are impaired by age-related neuropathology of hippocampal-prefrontal networks. Likewise, older adults less frequently used strategies observed in the viewing behavior of younger subjects and that were linked to hippocampal-prefrontal networks. These findings suggest that age-related memory decline could result from decreased strategy use, and that age-related hippocampal-prefrontal neuropathology changes the nature of learning strategies.

A98

ACTIVELY UPDATING MEMORY VIA RETRIEVAL OVERRIDES ORIGINAL EVENT MEMORY EVEN WHEN CONTEXT IS REINSTATED

Donna J Bridge[1], Joel L Voss[1]; [1]Northwestern University Feinberg School of Medicine — Event memory changes due to retrieval (retrieval-induced distortion, RID), either because (1) retrieval alters the original memory, or (2) new and dominant traces are formed without modification of the original memory. We examined neural processing using a RID paradigm to test these two possible mechanisms. Participants studied objects at specific locations within a scene. Then, we manipulated RID during an updating phase. Participants actively retrieved object locations or passively studied predetermined locations during updating. Active and passive locations diverged from originally studied locations, providing the opportunity for RID. Moreover, updating occurred with different scenes than original study, thus allowing us to determine retention versus modification of original event information. Memory for object locations was tested, whereby participants chose among the original location, the updated location, and an equidistant lure location, with objects presented in either the original or updated context. Retrieved locations were often selected in favor of the original locations, indicating RID. Remarkably, active updating caused RID even when memory was tested with the original scene background, indicating that retrieval modified memory even when the original context was reinstated. This was not the case for passive study, indicating that active retrieval is key for updating. We previously observed electrophysiological distinctions during retrieval for objects that were subject to RID versus those that were not, suggesting that RID stems from neural processing during retrieval. fMRI findings from the current paradigm will be discussed with respect to influences of active retrieval on modification versus retention of original event information.

A99

REPRESENTATIONAL SIMILARITY ANALYSIS REVEALS COMMONALITIES AND DIFFERENCES IN THE SEMANTIC PROCESSING OF WORDS AND OBJECTS

Barry Devereux[1], Alex Clarke[1], Andreas Marouchos[1], Lorraine K. Tyler[1]; [1]University of Cambridge — Understanding the meanings of words and objects (e.g. "apple") requires the activation of underlying conceptual representations. Such representations are assumed to be coded such that meaning can be evoked regardless of the input modality. However, the extent to which meaning is coded in modality-independent or amodal systems has not been fully explored. We address this issue in an MVPA fMRI study investigating the neural processing of 60 concepts, presented separately as words and pictures. For both modalities, participants gave a category-level name for each stimulus. Activation maps for each word and picture were extracted and used as input for multivariate searchlight-based representational similarity analyses (RSA). Three representational dissimilarity matrices (RDMs) were computed capturing (a) low-level visual properties of the words, (b) images, and (c) the semantic category structure common to both. We found strong correlations between the visual RDM and dissimilarity patterns in early visual cortex for both words and objects. For the category RDM, there was an extensive left-lateralized network of significant correlations with the object data, including the left fusiform and lingual gyri, lateral occipital cortex, left posterior middle temporal cortex (LpMTG) and left angular gyrus (LAngG). The word data showed significant correlations more anteriorly into left MTG, as well as in the left inferior parietal lobule, but no significant correlations in the fusiform. As with the object data, there were also significant correlations in LpMTG and LAngG, suggesting these regions may form part of a core semantic network activated for semantic representations of both words and objects.

A100

INCREASING GLUTAMATE EFFICACY AT THE NMDA RECEPTOR ENHANCES THE CONSOLIDATION OF DECLARATIVE MEMORY DURING SLEEP BUT NOT DURING WAKEFULNESS

Gordon B Feld[1,2], Susanne Diekelmann[1,2], Jan Born[1,2]; [1]University of Tuebingen, [2]University of Luebeck — Consolidating newly encoded information is facilitated by sleep, but so far the neurochemical mechanisms involved in this process are only poorly understood. Plastic changes, such as NMDA-receptor-mediated long term potentiation, play a key role in virtually all forms of learning. Consolidation of memory traces is accomplished through plastic processes that are triggered by repeated reactivation of learning-related neuronal firing patterns during sleep. In two placebo-controlled counterbalanced within-subject experiments, differing in that the retention interval either contained sleep before wakefulness or only wakefulness, we increased efficacy of glutamate-transmission at the NMDA-receptor by administering d-cycloserine (DCS) and studied the role of glutamate signaling related plasticity for consolidation of memories. Before receiving 175 mg of DCS or placebo, the participants performed a finger-sequence-tapping task (procedural memory) and a word-pair-association task (declarative memory). When receiving DCS, memory performance compared to placebo was significantly increased for the declarative task only if the participants were allowed to sleep after learning, but not if they stayed awake. There was no differential effect of DCS on procedural memory. Thus, we can conclude that NMDA-receptor-related plastic processes play an important role specifically for the sleep-dependent consolidation of declarative memory.

A101

THE CRITICAL ROLE OF POSTERIOR TEMPORAL CORTEX IN THEMATIC OBJECT KNOWLEDGE: EVIDENCE FROM LEFT HEMISPHERE STROKE.

Solène Kalénine[1], Alexis Kington[2], Laurel Buxbaum[2]; [1]Univ Lille Nord de France, F-59000 Lille, France, [2]Moss Rehabilitation Research Institute, Philadelphia, USA — Recent neuroimaging data indicate that identification of thematic relationships between object pictures, such as spoon–yogurt or dog-leash, selectively activates the posterior temporo-parietal cortex, compared to the identification of taxonomic relationships, such as spoon-knife or dog-bear (Kalénine, Peyrin, Pichat, Segebarth, Bonthoux, et al., 2009). However, whether the posterior temporo-parietal cortex is critical for (versus simply associated with) the retrieval of thematic knowledge from visually-presented objects is still an open question. To resolve this issue, performance in thematic and taxonomic object categorization was tested in 33 left hemisphere stroke participants using the object picture-matching task from Kalénine et al. (2009). Regression and voxel-based lesion-symptom mapping analyses of thematic categorization scores, controlling for taxonomic performance, revealed that the posterior temporal cortex (Brodmann Area 37) is critically involved in thematic knowledge retrieval from object pictures. This finding is consistent with recent data from aphasic patients showing a critical involvement of the posterior temporo-parietal cortex in thematic knowledge retrieval from auditory nouns (Mirman and Graziano, 2012), and provides further evidence in favor of neuroanatomically and functionally distinct thematic and taxonomic semantic systems (Schwartz, Kimberg, Walker, Brecher, Faseyitan, et al., 2011).

A102

ERPS REVEAL FASTER ACTIVATION OF GRASP THAN SKILLED USE INFORMATION DURING OBJECT PROCESSING

Chia-lin Lee[1,4], Hsu-Wen Huang[2,3], Kara Federmeier[3], Laurel Buxbaum[4]; [1]National Taiwan University, [2]National Taiwan Normal University, [3]University of Illinois, [4]Moss Rehabilitation Research Institute — Recent evidence suggests incidental activation of action manipulation information during passive viewing of objects. For example, an event-related potential (ERP) study by Kiefer and colleagues (2011) found that object perception and recognition, indexed by effects on early sensory responses and the N400, were facilitated by prior presentation of an object affording similar actions. Data from our lab and others support a distinction between two action subtypes. Whereas grasp-to-move actions based on object structural attributes become active rapidly but transiently upon sight of an object, skilled use actions dependent on knowledge of object identity and function show slower activation and decay (Lee et al., 2012). It is thus possible that these action types contribute differentially to early and late action-related facilitation of object processing. To test this, we measured ERPs to manipulable objects (e.g., calculator) preceded by objects grasped similarly but used differently (e.g., bar of soap), used similarly but grasped differently (e.g., keyboard), or manipulated with completely different actions (e.g., earring). We found priming effects over anterior regions of the scalp during an early time window (100-300ms) driven by 'grasp' primes only and a reliable N400 priming effect for both 'use' and 'grasp' primes. Our results are consistent with prior findings showing that object processing is facilitated when action features are primed. Furthermore, our findings extend embodied theories of cognition by demonstrating that although both action types modulate object recognition, only structure-based information important for grasping affects the early perceptual processing of objects.

A103

A NEURAL SIMILARITY SPACE FOR BELIEFS

Anna Leshinskaya[1], Juan Manuel Contreras[1], Alfonso Caramazza[1,2], Jason P. Mitchell[1]; [1]Harvard University, [2]University of Trento — Knowledge of the world includes concepts that lack sensory referents—for instance, the mental attributes of people. The aim of the present project was to locate brain regions which can encode such concepts, specifically of belief systems. During functional magnetic resonance imaging (fMRI) scanning, participants viewed names of social groups (e.g., Atheists, Evangelicals, Economists) and compared their mental attributes: either their level of Spiritualism (spiritual to materialist) or their Political Orientation (liberal to conservative). Behavioral piloting was used to pre-determine the position of each group on each dimension, and to ensure the two dimensions were orthogonal. Using multivoxel pattern analysis in a wholebrain searchlight, we identified brain regions whose activation patterns were similar when thinking about groups with similar beliefs, and different when thinking about groups with different beliefs, depending on the attended dimension. This type of response would be expected for brain regions that carry information about types of belief traits. Such a pattern was found in portions of dorsomedial prefrontal cortex, precuneus, and right temporoparietal junction. These regions were adjacent to regions involved in theory of mind, as localized in the same participants. The findings imply that this set of brain regions can represent conceptual knowledge of mental attributes. Because mental attributes are not perceived by the senses or given by any sensory property, the representations in these regions must be highly abstract. More generally, these regions may contribute to our ability to represent abstract, conceptual information about the world.

A104

DIFFUSION SPECTRUM IMAGING EVIDENCE OF DISTINCT WHITE MATTER PATHWAYS IN VENTROLATERAL PREFRONTAL CORTEX

Jennifer Barredo[1], David Badre[1]; [1]Brown University — Left ventrolateral prefrontal cortex (VLPFC) supports the cognitive control of memory retrieval. Univariate and functional connectivity evidence from fMRI suggests that different subregions of VLPFC may participate in distinct cortical networks that support separable cognitive control functions. Specifically, midVLPFC (inferior frontal gyrus [IFG] pars triangularis) correlates with a dorsal fronto-parietal network, whereas anterior VLPFC (IFG pars orbitalis) correlates with a ventral fronto-temporal network. However, it remains open whether the subregional differences suggested by these distinct functional networks are supported by the underlying white matter connectivity. We used high-angular resolution diffusion spectrum imaging to address whether the microstructural organization of white matter connectivity differs between subregions of VLPFC. First, a seed-based analysis tested gross differences in connectivity between aVLPFC, midVLPFC, and posterior VLPFC (pars opercularis). Though all VLPFC subregions connected to similar target regions, we found that aVLPFC was more densely connected to temporal cortex while mid- and posterior VLPFC connections were more prevalent to parietal targets. Next, we conducted a connectivity-based parcellation of VLPFC using parietal and temporal seed regions. This secondary analysis identified several smaller zones within mid-VLPFC: an anterior and ventral zone that projects to temporal cortex through the uncinate fasciculus along with fibers from proximal aVLPFC, and a medial and dorsal zone where parietal projections are the most dense. These results generally support models of functional heterogeneity within VLPFC, while revising the specificity of putative functional boundaries beyond gross anatomical divisions.

A105

BUILDING CONNECTOMES FROM THE COCOMAC DATABASE USING COCOTOOLS

Robert Blumenfeld[1], Daniel Bliss[1], Fernando Perez[1], Mark D'Esposito[1]; [1]Helen Wills Neuroscience Institute, University of California, Berkeley — Neuroanatomical tracer studies in non-human primate macaque monkey are a valuable resource in the cognitive neurosciences. These data serve to ground theories of cognitive function in plausible anatomy and, with the emergence of graph-theoretical analyses in the neurosciences, there is high demand for these data to be synthesized into large-scale "connectomes". However, properly reviewing this literature is difficult, time-consuming and error-prone and computational and database solutions are needed to construct connectomes for graph-theory analysis. We have developed an open-source Python toolbox, called "CoCoTools" which gives users the ability to easily gather, compile and synthesize annotated connectivity data from macaque neuroanatomy for making plots and for performing graph-theory analyses. To do this, CoCoTools seamlessly interfaces with the CoCoMac database, which houses an annotated record of nearly the entire macaque corpus (1905-2005) and implements tested coordinate-free registration algorithms, which allow for studies with different parcellation/labeling schemes from across the literature to be synthesized and translated onto a single graph. For making plots, CoCoTools contains flexible graph utilities and for graph-theory analyses, CoCoTools can integrate with NetworkX, which is a powerful and freely-available Python graph-theory library. Here, we demonstrate the capabilities of CoCoTools and show that using CoCoTools to translate all of the data stored in CoCoMac produces reasonable end-stage connectomes. Additionally, we

describe the creation of a hybrid connectome that leverages data from the most informative cases in CoCoMac and we compare the topological properties of this graph to other "single-space" graphs derived from CoCoTools.

A106

A WHOLE-BRAIN ANALYSIS OF CORTICAL ASYMMETRIES Christine Chiarello[1], David Vazquez[1], Adam Daily[1], Adam Felton[1], Christiana Leonard[2]; [1]University of California, Riverside, [2]University of Florida, Gainesville — Functional brain asymmetries are numerous, but, aside from a few areas such as the planum temporale, there is limited knowledge about the extent to which the cerebral cortex is structurally asymmetrical. The goal of this study was to examine structural asymmetries across the entire cortex and to identify which anatomical features of the cortex display the greatest left/right asymmetries. Asymmetry in cortical surface area, volume, thickness, and curvature (secondary and tertiary folding) was computed for each FreeSurfer cortical parcellation in a sample of 200 healthy young adults. Asymmetries for surface area and volume were robust and strongly correlated (r = .72), and were statistically significant for over 85% of the regions: large leftward asymmetries were observed for superior temporal, frontal and central opercular, ventral occipital-temporal, and superior parietal regions, and large rightward asymmetries were obtained for the anterior cingulate, angular gyrus, and posterior occipital areas. Asymmetries for thickness were considerably smaller, and greater right than left cortical thickness was observed for 70% of brain regions. Thickness asymmetry was positively correlated with volume (r = .47), and weakly negatively correlated with surface area (r = -.17), asymmetries. Curvature asymmetries were also very small, and significant for only 48% of regions. Curvature was weakly correlated with both surface area (r = .15) and volume (r = .14) asymmetries. These data suggest that most regions of the cortex are reliably asymmetrical, with asymmetry manifested by increased surface area and volume, but not increased secondary/tertiary folding.

A107

RELATIONSHIP BETWEEN CARDIORESPIRATORY FITNESS AND HIPPOCAMPAL SUBFIELDS ANATOMY IN HEALTHY OLDER ADULTS Mark Fletcher[1], Rachel Boyd[1], Kathy Low[1], Nils Schneider-Garces[1], Andrew Freeman[1], Edward Northrup[1], Rachel Hopman[1], Christine Ventrella[1], Benjamin Zimmerman[1], Chin Hong Tan[1], Gabriele Gratton[1], Monica Fabiani[1]; [1]University of Illinois at Urbana-Champaign — There is substantial evidence indicating that both aging and fitness influence hippocampal size (Erickson et al. 2011). In a previous study, we (Fletcher et al., 2012) employed Free-Surfer® to examine brain anatomy in a sample of 55 older adults (ages 55-87), and showed general effects of age and fitness in sub-cortical gray matter regions, including the medial temporal lobe, basal ganglia, and hippocampus. Our data also indicated an association between fitness and scores on the modified mini-mental status examination. The current study analyzes our data further to determine which subfields of the hippocampus are affected by aging, fitness, and education. Although there were several subfields whose normalized volumes correlated with age and fitness, when all three of these parameters were entered in a multiple regression model, age but not fitness effects remained significant. In addition, raw correlations of age and fitness with hippocampal subfield volumes were strongly correlated across areas (r=-.55). Interestingly, there was also an area (the fimbria) showing effects of education independent of age and fitness. These data suggest that fitness and aging may have largely overlapping and difficult to distinguish effects on the hippocampus.

A108

3D ANATOMY OF THE CORPUS CALLOSUM IN EARLY- AND LATE-BLIND SUBJECTS FROM SURFACE MULTIVARIATE TENSOR-BASED MORPHOMETRY Liang Xu[1], Olivier Collignon[4], Gang Wang[1], Yue Kang[2,3], Franco Lepore[5], Jie Shi[1], Yi Lao[2,3], Anand Joshi[3], Yalin Wang*[1], Natasha Lepore*(* = equal last author contribution)[2,3]; [1]Arizona State University ,Tempe, [2]Children's Hospital Los Angeles, CA, USA, [3]University of Southern California, [4]University of Trento, [5]University of Montreal — Studying the respective impact of congenitally (CB) versus lately acquired blindness (LB) on the anatomy of the corpus callosum (CC) provides a unique model to probe how experience at different developmental periods shapes the structural organization of the brain. We used a new framework that we recently developed to understand shape change of the corpus callosum in blind adults from T1-weighted MRI. Our data set consists of 14 early-blind, 11 late blind and 20 sighted control subjects. While other studies have looked at surface differences in the mid-sagittal cross-section of the CC, we use its full 3D shape. We manually trace the CCs, generate a conformal grid on their surface and automatically segment them into superior and inferior patches. We estimate the thickness at each vertex between the two patches using a harmonic field. All CCs are fluidly registered to a common template. The deformation tensors from the registration give the direction and size of the changes in surface area at each vertex of the grid between the template and each subject. We combine the area changes and thickness information into a vector at each vertex to be used as a metric for the statistical analysis. Results revealed significant differences in several regions of the CCs between both blind groups and the sighted group, although to a lesser extend in LB when compared to CB. These results demonstrate the crucial role of the developmental period of visual deprivation in re-shaping the structural architecture of the CC.

A109

POST-CHEMOTHERAPY BRAIN MATTER CHANGES IN FEMALE BREAST CANCER PATIENTS Chris Lepage[1], Carole Scherling[2], Nancy Wallis[1], Rocio A. López Zunini[1], Joyce MacKenzie[3], Barbara Collins[3], Andra M. Smith[1]; [1]University of Ottawa, [2]University of California, [3]Ottawa Civic Hospital — Cognitive decline is a common complaint of breast cancer survivors following adherence to adjuvant chemotherapy regimens. The authenticity of this purported sequela remains to be unanimously accepted in the scientific community and its interaction with brain structure remains largely unexplored. This study aimed to examine neurophysiological changes attributable to chemotherapy exposure by investigating brain matter volumes before and after chemotherapy treatment while also examining neuropsychological performance over time. Female breast cancer patients (n = 20) and matched cancer-free controls (n = 20) underwent structural imaging and completed neuropsychological tests before the patients underwent chemotherapy and again following regimen completion. Structural images were acquired using a 1.5 Tesla Siemens Magnetom Symphony magnetic resonance scanner. VBM8 was used to conduct voxel-based morphometry to compare white matter and grey matter volume differences both within and between groups. Independent samples t-tests were used to compare the domain scores between groups on the neuropsychological battery. Compared to the healthy control group, the breast cancer group showed reduced volumes in the left anterior cingulum, in the left middle occipital lobe, in the left superior parietal lobe, and bilaterally in the caudate. Consistent with other studies of neuropsychological functioning in breast cancer survivors exposed to chemotherapy, analysis of the neuropsychological data revealed that the patient group performed more poorly compared to the control group, specifically in measures of executive functioning and working memory. The results of this study afford credence to the authenticity of 'chemo-fog'.

A110

DISTURBED CORPUS CALLOSUM MICROSTRUCTURE IN THE PRESENCE OF NORMAL VOLUME CHARACTERIZES PATIENTS WITH ADULT ADHD A. Marten H. Onnink[1], Marcel P. Zwiers[2], Martine Hoogman[2,3], Jeanette C. Mostert[2,4], Cornelis C. Kan[4], Jan Buitelaar[1,5], Barbara Franke[1,4]; [1]Radboud University Nijmegen Medical Centre, Donders Institute for Brain, Cognition and Behavior, Nijmegen, The Netherlands, [2]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behavior, Nijmegen, The Netherlands, [3]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands, [4]Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands, [5]Karakter Child and Adolescent Psychiatric University Centre, Nijmegen, The Netherlands — Background: Microstructural changes and volume reductions in the corpus callosum (CC) are implicated in childhood ADHD. There are however indications that, in adulthood ADHD, reduced white matter integrity is persistent whereas CC volume normalizes. Our goal was to investigate this in a relatively large adult ADHD sample. In addition to commonly used fractional anisotropy (FA) and mean diffusivity (MD), we calculated parallel (axial diffusion; AD) and perpendicular (radial diffusion; RD) diffusivities to white matter tracts which may offer additional information regarding tissue microstructure. Methods: White matter integrity and volume of the CC were investigated in 87 adult ADHD patients

and 98 matched controls. We used diffusion tensor imaging in conjunction with tract-based spatial statistics to examine FA, MD, AD and RD within the genu, body and splenium of the CC. Volumetrics of the CC and its subdivisions were determined using FreeSurfer software. Results: The body of the CC showed lower FA ($p = .005$) and higher MD ($p = .019$) and RD ($p = .008$) values in ADHD patients, compared to controls. Volume of the CC did not differ between the groups ($p = .633$). Conclusions: Our findings show that callosal volume becomes normal while disturbed white matter integrity of the CC is persistent in adult ADHD. Abnormalities in the body of the CC, the subdivision that contains the commissural fibers connecting the somatosensory, auditory and motor areas may play an important role in the pathophysiology of ADHD.

A111

COMPLEX REGIONAL PAIN SYNDROME (CRPS) CAUSES FINGER AGNOSIA AND DYSCALCULIA VS Ramachandran[1], Baland Jalal[1]; [1]Center for Brain and Cognition, University of California at San Diego — We report a striking example of peripheral nerve injury possibly causing brain (CNS) changes that result in cognitive/perceptual deficits. Following a small injury to a finger (e.g., metacarpal bone fracture) there is inflammation, swelling, redness (hyperemia), pain and reflex immobilization ("paralysis") of the finger. After the fracture heals in a few weeks all changes reverse in 95% of cases. But in some cases pain persists unabated; pain, swelling, redness and paralysis then spread to involve the whole hand; indeed sometimes the whole arm (CRPS). Based on a suggestion we made in the 90's it has been shown by several groups that mirror visual feedback (MVF) can be used to create "false" feedback that the "paralyzed" hand can be moved with impunity. This partially alleviates the pain and even reverses the paralysis, swelling and temperature permanently. These effects suggest that CRPS involves a strong CNS component (e.g., McCabe, 2003). We report data on two patients with CRPS in their right hands. Upon conducting several tests we found strong indications of finger agnosia and dyscalculia (their medications did not affect other cognitive skills) and mild apraxia in these patients. We suggest that the painful immobilization retrogradely produces a functional lesion in the inferior parietal lobule (long implicated in apraxia). This lesion "spreads" into adjacent cortical regions disrupting finger representation and even higher "cognitive" capacities like arithmetic and judgment of chirality of ears, eyes, and feet etc. If these preliminary findings are confirmed they would represent a powerful example of body/mind interactions.

A112

TRANSCRANIAL MAGNETIC STIMULATION PROVIDES CAUSAL EVIDENCE FOR "WHAT" AND "WHERE" PATHWAYS IN HUMAN AUDITORY CORTEX Jyrki Ahveninen[1], Samantha Huang[1], Aapo Nummenmaa[1], John W. Belliveau[1], An-Yi Hung[1], Iiro P. Jääskeläinen[2], Josef P. Rauschecker[3], Stephanie Rossi[1], Hannu Tiitinen[2], Tommi Raij[1]; [1]Harvard Medical School – Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, [2]Department of Biomedical Engineering and Computational Science (BECS), Aalto University, Espoo, FINLAND, [3]Laboratory of Integrative Neuroscience and Cognition, Department of Neuroscience, Georgetown University Medical Center — Although evidence for distinct activations of object-identity and audiospatial features is accumulating, the existence of parallel "what" and "where" pathways in the human auditory cortex (AC) has been questioned due to inconsistent neuroimaging evidence. Here, in a full factorial design, we utilized MRI-guided paired-pulse transcranial magnetic stimulation (TMS, 2.5 ms interval) to induce transient deactivations of AC during sound localization and identification tasks. Subjects were presented with Reference/Probe sound pairs. In the localization task, subjects discriminated whether Probe arrived from 5° to the left or 5° to the right relative to Reference (25° to the right). In the identification task, subjects discriminated whether the amplitude-modulation frequency of Probe (1/6 octaves±40 Hz) was higher or lower than that of Reference (40 Hz). Fifty percent of the trials did not include TMS and therefore provided baseline reaction time (RT) data. For the other 50% of trials, bilateral TMS was delivered 55–145 ms after the Probes, at either the anterior or posterior non-primary ACs. TMS targeting was confirmed with electromagnetic forward computations on each individual's cortical surface. The results showed a significant interaction between the task (location vs. identity) and TMS target (anterior vs. posterior): TMS to posterior ACs delayed RTs significantly more during localization than identification performance, whereas TMS to anterior ACs delayed RTs more during identification than localization. This double dissociation provides direct causal support for the dual pathway model of human non-primary AC.

A113

COMPLEX INPUT CREATES COMPLEX NETWORKS Michael Andric[1], Uri Hasson[1]; [1]University of Trento — Continuous auditory inputs can vary on multiple dimensions. Whether there exists a stable functional network arrangement that processes inputs with different properties, or, alternatively, if the network arrangement itself dynamically changes in response to an input property is unknown. Our current investigation targets this question. We show that the brain's network arrangement demonstrates significant systematic re-organization as a function of a pivotal feature of the input – its regularity. To examine whether network organization tracks input regularity we presented participants (N=21) with four types of auditory series, while recording fMRI signals at 4T. The auditory series (150 s each) consisted of rapidly presented tones (3.3Hz). The series varied in their regularity, formalized here by conditional entropy determining transitions between tones. To assess changes in network topography across the four conditions, we analyzed every voxel's connection to every other voxel (connection thresholded at Pearson's $r > 0.5$). From these per-condition connectivity matrices we identified network modularity ("Q", Newman & Girvan, 2004), a measure of the network's arrangement into modules, or densely intra-connected communities. A group level analysis showed that network modularity was highest for the most random series and lowest for the most ordered series. Thus, the brain's modular arrangement simplifies when input regularity increases. This simplification is seen in the brain's arrangement into fewer, but more globally connected, networks. In other words, complex input creates complex networks.

A114

ORTHOGONAL ACOUSTIC DIMENSIONS DEFINE AUDITORY FIELD MAPS IN HUMAN CORTEX Brian Barton[1], Jonathan H. Venezia[1], Kourosh Saberi[1], Gregory Hickok[1], Alyssa A. Brewer[1]; [1]University of California, Irvine — Introduction: To date, human tonotopy studies have not agreed on the organization of core auditory cortical areas. Recently, an orthogonal dimension to tonotopy, known as periodicity, has been observed in cat primary auditory cortex (Langner et al. 2009) and the primate midbrain (Baumann et al. 2011). Periodicity refers to the preferred temporal receptive field over which an auditory neuron integrates, measured by presenting broadband noise to the auditory system at different modulation rates. Methods: Tonotopy and periodicity were measured independently in humans, using the fMRI travelling wave method that is the field standard in visual field mapping studies, modified into a sparse-sampling paradigm. Subjects were asked to attend to 5s of narrow- or broadband noise at 60dB on each trial and indicate whether a change of 3dB at the midpoint of stimulus presentation was up or down. Tonotopy was measured using narrowband noise centered on frequencies of 400, 800, 1600, 3200, and 6400 Hz with a bandwidth of 100Hz, amplitude modulated with a frequency of 8Hz. Periodicity was measured using broadband noise at modulation frequencies of 2, 4, 8, 16, 32, 64, 128 and 256 Hz, with a bandwidth spanning our narrowband noise range (300-6500Hz). Results: Our findings extend previous work done in cat and monkey to human, and we evaluate organizational models that were developed in these model species. Our findings match human cytoarchitecture and provide an organizational framework that not only clarifies the auditory core, but may apply throughout the hierarchy of the human auditory system.

A115

EFFECTS OF DECODED-EEG NEUROFEEDBACK ON AUDITORY PERCEPTUAL LEARNING Alex Brandmeyer[1], Makiko Sadakata[1], Loukianos Spyrou[1], James McQueen[1,2,3], Peter Desain[1]; [1]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, [2]Behavioural Sciences Institute, Radboud University Nijmegen, [3]Max Planck Institute for Psycholinguistics — Multivariate pattern classification methods are increasingly utilized in cognitive neuroimaging research to analyze high-dimensional data at the single-trial level. The present study made use of decoded EEG signals to provide participants with online feedback regarding ongoing passive auditory perception of tone stimuli presented in oddball sequences. Ten par-

ticipants completed behavioral pre- and post-tests which measured their individual frequency discrimination threshold at 500 Hz. Following initial threshold measurements, participants viewed silent movies while EEG was measured during passive listening to oddball sequences containing a 500 Hz standard stimulus and a deviant stimulus presented at the individually measured threshold. The deviant trials in these sequences are known to elicit the mismatch negativity (MMN) component of the auditory evoked potential, which reflects ongoing pre-attentive sensory memory processes. Data collected during initial EEG measurements was used to train a linear logistic regression classifier, which was subsequently employed to decode ongoing brain responses in four online-feedback blocks. Feedback was presented as a continuous gaussian blurring of the films viewed by participants on the basis of classifier output for the previous ten deviant trials. Results indicated an overall reduction in individual thresholds between pre- and post-test measurements. An analysis of classifier performance revealed differences in MMN response amplitudes in deviant trials belonging to data subsets split on the basis of the classifier's online binary decisions. The results suggest that decoding of evoked responses can track ongoing fluctuations in sensory memory processes, and can induce perceptual learning effects in a passive listening setting when utilized for feedback.

A116

CROSS-SENSORY ACTIVATION OF 'CLOVER LEAF' CLUSTERS IN HUMAN AUDITORY AND VISUAL CORTEX Alyssa Brewer[1], Brian Barton[1], Jonathan H. Venezia[1], Kourosh Saberi[1], Gregory Hickok[1]; [1]University of California, Irvine — A primary organizing principle of visual cortical organization is the visual field map: neurons with visual receptive fields next to one another in visual space are located next to one another in cortex, forming one complete representation of visual space. Similarly, we have shown that auditory cortex is organized into auditory field maps: neurons with auditory receptive fields that prefer a unique combination of spectral and temporal acoustic dimensions lie next to similarly specialized neurons. Here we investigate the cross-sensory activation of visual field mapping stimuli within auditory field maps and vice versa. We first defined visual field maps V1-hV4 using fMRI and population receptive field (pRF) modeling (Dumoulin & Wandell, 2008). Eleven auditory field maps were defined independently in these same subjects, using tonotopic and periodotopic stimuli with the fMRI travelling wave method modified into a sparse-sampling paradigm (Barton et al, 2012). We then measured activation of visual field maps V1-hV4 by the auditory stimuli and activation of the 11 auditory field maps by the visual stimuli. We find significant activation by auditory stimuli in visual field maps V1-hV4 and significant visual activation of the 11 core and belt auditory field maps. Such similar, efficient organization may be ideal for combining visual and auditory information into a single percept.

A117

CHOICE PROBABILITY ACROSS AUDITORY CORTEX Joshua Downer[1], Jessica Verhein[1], Kevin O'Connor[1], Mitchell Sutter[1]; [1]University of California, Davis — Recent evidence suggests that the function of auditory cortex extends beyond that of a simple feature extractor (e.g. Kilian-Hütten et al 2011; Jaramillo & Zador 2011). Recent work in our lab has linked the activity of single neurons in primary auditory cortex to the perceptual decisions of rhesus macaques (Niwa et al 2012). In order to address whether and to what extent such a correlation might be explained by somatosensory, motor or cognitive influences, we trained a single rhesus macaque in a choice task to discriminate between a standard and test noise stimulus based on the presence of amplitude modulation (AM). The animal indicates detection of AM with an upward joystick movement after stimulus offset, and the absence of AM with a downward movement. Our preliminary analysis using a "choice probability" measure (Britten et al 1996) reveals an effect of the animal's choice on firing rate in both core and belt auditory cortex. At the population level, neurons are significantly more active on AM detection trials, during the test, standard and response periods. At the multi-unit level, a significant proportion of "units" show higher activity on detection trials during the test stimulus and response period only. Effect sizes appear largest during the response period. These results contribute to the evolving view of auditory cortex as involved in, not only auditory sensation, but also decision making.

A118

THE COMPENSATORY MECHANISM OF AUDITORY-MOTOR INTEGRATION IN SPEECH PERCEPTION Yi Du[1,2], Bradley Buchsbaum[1], Cheryl Grady[1], Claude Alain[1,2]; [1]Rotman Research Institute, Baycrest Centre for Geriatric Care, Toronto, Ontario, Canada, [2]University of Toronto, Ontario, Canada — The motor speech system which is recruited in speech production is also implicated in speech perception as a compensatory mechanism. However, how the involvement of motor speech system is influenced by perceptual difficulty in identifying speech sound is still unclear. This study used event-related functional magnetic resonance imaging (fMRI) to measure brain activities in auditory-motor integration areas when young participants listened to speech syllables masked by broadband noise at different signal-to-noise ratios (SNRs). We found that participants' accuracy of identifying syllables increased linearly with the chosen SNRs. Both the General Linear Model (GLM) analysis and the whole-brain multivariate pattern-based analysis (MVPA) revealed different activity patterns in the left premotor cortex by either silently speaking or listening to syllables with different articulatory features (bilabial/lip-related /ba/ and /ma/ vs. alveolar/tongue-related /da/ and /ta/). The MVPA also yielded articulation-feature-specific (lip vs. tongue) patterns in the Broca's area, the left inferior parietal lobule and the left superior temporal gyrus during speech perception task. More importantly, the activities in all those areas increased with declining recognition accuracy and decreasing syllable SNR with an articulation feature specificity. The results support the articulation feature account in categorical speech recognition and provide evidence for adaptive recruitment of the auditory-motor integration function as a compensatory mechanism in achieving successful speech perception.

A119

RELATING AUDITORY PERCEPTUAL ABILITIES TO DEGRADED SENTENCE COMPREHENSION IN CHRONIC STROKE Paul Fillmore[1], Sigridur Magnusdottir[2], Helga Thors[1], Taylor Hanayik[1], Daniel Fogerty[1], Julius Fridriksson[1]; [1]University of South Carolina, Columbia, SC, [2]University of Iceland, Reykjavik, Iceland — There has been a long-standing effort in auditory brain research to relate patterns of hemispheric dominance for language and musical stimuli to a dependence on the spectral and temporal components inherent in these stimulus classes. Despite a great body of work on the topic, many contradictory results exist in the literature, and the picture is still far from clear. Much recent work has focused on functional neuroimaging methods in healthy individuals; however neuropsychological methods which relate brain damage to behavior can also play a key role in identifying brain areas crucial for particular cognitive operations. In the present study, we tested chronic stroke patients with both left and right hemisphere damage on a set of non-linguistic auditory perceptual tasks, as well as on sentence comprehension tasks in several degraded listening conditions. Tasks were presented in an adaptive thresholding context, so as to ascertain patients' true level of within-task competence. We found that both spectral and temporal task performance was highly correlated with sentence comprehension abilities, both for speech in noise (in which primarily spectral cues are degraded) and time-compressed speech (in which primarily temporal cues are degraded); double dissociations in task type and sentence type were not observed. All patients had elevated thresholds, but few differences between left and right hemisphere patients were noted. In terms of localizing neural modules associated with task performance, we found that impaired sentence comprehension was generally associated with left posterior parieto-temporal lesions, while patterns for the non-linguistic tasks were more variable.

A120

DIFFERENCES IN REPETITION SUPPRESSION ACROSS SENSORY SYSTEMS IN 6-MONTH-OLDS: USING NIRS TO COMPARE INFANT AND ADULT NEURAL FUNCTION Lauren Emberson[1], Holly Palmeri[1], Grace Cannon[1], Richard Aslin[1]; [1]University of Rochester — Near infrared-spectroscopy (NIRS) is uniquely poised to facilitate investigations into the neural systems supporting infant functional neural organization by providing many of the benefits afforded by fMRI (e.g., unambiguous spatial location of neural responses) without the same methodological hurdles (e.g., rigid head stabilization). We aim to use established paradigms from the cognitive neuroscientific literature to probe functional neural activity

in 6-month-old infants. These paradigms provide strong hypotheses for neural function, allowing a clear comparison between infants and adults. Here, we investigate repetition suppression (RS) in 6-month-olds. We compared responses in temporal and occipital cortices (determined using a database of infant structural MRIs) to auditory (familiar words) or visual (smiling faces) stimuli (1sec SOA). Uni-modal blocks were either repeated (a single stimulus presented 8 times) or variable (8 different stimuli). In two experiments (N = 27), we found that, consistent with previous results in adults: 1-Auditory stimuli produce responses in temporal cortex and repetition produces an attenuated response; 2-Visual stimuli produce responses in occipital cortex. However, diverging from established patterns in adults: 3-Repetition does not modulate visual responses in occipital cortex; 4-In Experiment 2, we increased the perceptual difference between visual stimuli but replicated identical responses in occipital cortex to repeated and variable conditions; 5-While there is crossmodal activation (e.g. occipital responses to auditory stimuli), the magnitudes are inconsistent across the two experiments. These results suggest that, unlike adults, the infant auditory and visual systems respond differently to repetition and the visual system is less easily modulated by repetition.

A121

NON-SYMBOLIC NUMBER REPRESENTATIONS PREDICT ARITHMETICAL ABILITY IN YOUNG, PRE-MATH CHILDREN

Linda P.M. Essers[1], Lisa M. Jonkman, Erik van Loosbroek; [1]Maastricht University — Number representations can be measured by using the Distance Effect (DE): When comparing two numbers, we respond slower if they are numerically close together than if they are far apart. Relationships between the behavioral DE and arithmetical ability have been found for children as young as six years. Our goals were twofold: (1) We tested whether we could replicate this relationship at a younger age, before formal math teaching; (2) using EEG, we examined the sequence of cortical number processes in children and what role they play in arithmetic. Thirty-nine five-year-old children performed number comparisons on Arabic digits and dots below 10 while behavioral responses and EEG were measured. Behaviorally, DEs were found for dots and digits. Smaller reaction time increases with decreasing number distance went along with better arithmetic, but only for dots ($r>.37$). DEs were found in EEG event-related potentials on the amplitudes of the early peak P1 (~125ms), on the following N1 (~220ms) for dots and digits, and on the late P2p (~340ms) for dots only. A relationship with arithmetical ability was only found for the non-symbolic-P2p-DE: Smaller P2p-amplitude increases with decreasing dot number distance were accompanied by better arithmetic. While studies with older children found a relationship between symbolic DE for digits and arithmetic, our study found a non-symbolic basis for arithmetical ability that seems to involve relatively late brain processes that may include access to number representations. The absence of a clear symbolic relationship in five-year-olds may imply that symbolic number representations are still developing.

A122

SHORT-TERM MUSICAL TRAINING ENHANCES PRE-ATTENTIVE AUDITORY PROCESSING IN OLDER ADULTS

Gavin Bidelman[1], Sylvain Moreno[2,3], Yunjo Lee[2], Aline Moussard[2], Claude Alain[2,3]; [1]University of Memphis, [2]Rotman Research Institute, Baycrest Centre, [3]University of Toronto — Psychophysiological studies demonstrate that long-term music experience refines brain-behavioral mechanisms and provide robust enhancements to auditory function. The hearing advantages gained during musicianship afford the possibility that music training might serve as an effective remediation and/or training tool to strengthen declining listening abilities later in life. To date, studies documenting music-induced auditory benefits have been restricted almost entirely to examinations of young adults with decades of music experience. Here, we aimed to determine whether or not short-term music training could positively influence auditory processing in older listeners. Older adults (age: 58-82 years) matched in age, education, and IQ assigned to either a music or a visual art (i.e., active control) training group. Each cohort received classroom instruction in their respective activity by a professional teacher over a period of three months. Pre-attentive auditory processing was assessed before and after training using two oddball sequences consisting of a either music or speech sound contrast. Relative to controls, music students showed increased mismatch negativity (MMN) peaking with shorter latency when evoked by musical stimuli suggesting that short-term music training enhances the automatic differentiation of trained auditory sounds. In response to speech contrasts, decreased MMN activity was observed but only in the music group which may indicate a down regulation in underlying neural mechanisms when processing auditory information not practiced during the course of training. Results demonstrate that experience-dependent auditory plasticity can persist late into life and that intense short-term music training may offer a viable way to improve listening abilities in older adults.

A123

REMOTE ODOR MEMORY IN GENETICALLY AT RISK APOE E3/4 AND E4/4 INDIVIDUALS WITH ALZHEIMER'S DISEASE

Stephanie Oleson[1], Claire Murphy[1,2]; [1]San Diego State University, [2]University of California, San Diego — Alzheimer's disease (AD) is a neurodegenerative disorder characterized by progressive memory impairment and presence of amyloid plaques and neurofibrillary tangles. The associated neuropathology originates in brain areas responsible for olfaction, which suggests olfactory tasks as useful predictors of early pathology. A strong genetic risk factor for AD is the ε4 allele of the apolipoprotein E (ApoE) that has been associated with increased cognitive and olfactory deficits. Furthermore, homozygous ApoE ε4/4 individuals diagnosed with AD are known to have heightened amyloid burden and a more rapid rate of cognitive decline. Deficits in remote memory retrieval for odors have been demonstrated in patients with AD, but no published studies have examined remote odor memory in genetically at risk AD patients. Remote odor memory was assessed for 32 ε4/4 and ε3/e4 age-gender matched AD patients through familiarity ratings of common odor stimuli given as part of a larger task. Homozygous ε4/4 individuals produced significantly lower odor familiarity ratings ($p=.009$), compared to the heterozygous group, while the two groups did not differ significantly in MMSE scores ($p>.88$). The current findings suggest that remote odor memory may be more impaired in AD ε4/4 homozygotes relative to other AD patients. This deficit may be indicative of unique neuropathology associated with ε4/4 individuals and suggests the usefulness and sensitivity of odor tasks in detecting those at risk for AD. Supported by NIH grant AG004085-25 to CM. We gratefully acknowledge the UCSD ADRC for subject recruitment (P50 AG005131-28) and the SDSU Lifespan Human Senses Laboratory for patient testing.

A124

ENHANCED AUDITORY CHANGE DETECTION IN MUSICALLY TRAINED SCHOOL-AGED CHILDREN: A LONGITUDINAL EVENT-RELATED POTENTIAL STUDY

Vesa Putkinen[1], Katri Saarikivi[1], Pauliina Ojala[1], Mari Tervaniemi[1,2], Minna Huotilainen[1]; [1]University of Helsinki, [2]University of Jyväskylä — Adult musicians show enhanced auditory event-related potentials (ERPs) reflecting their highly tuned auditory discrimination skills. We investigated longitudinally how this enhancement emerges during school-age by comparing the mismatch negativity (MMN) and P3a responses of children who play a musical instrument to those of age-matched children with no musical training. ERPs were recorded from 133 children at ages 7, 9, 11, and 13 to various changes in both physical and more musical auditory features. The musically trained children showed larger increase in MMN and P3a amplitudes with age than the control children especially for the musical sounds. No group differences in response amplitudes were seen at the early stages of the training. Therefore, our results strongly indicate that the superior neural auditory discrimination and attention reflected by the enhanced MMN and P3a in musically trained individuals are due to training and not pre-existing differences between musicians and non-musicians.

A125

DISOCCIATING AGE-RELATED PATTERNS OF NEURAL ACTIVITY ALONG THE VENTRAL VISUAL STREAM DURING FACE AND OBJECT PROCESSING

Jenny Rieck[1], Derek Beaton[1], Ian McDonough[1], Hervé Abdi[1], Denise Park[1]; [1]University of Texas at Dallas — The ventral-visual pathway is responsible for identification and recognition of visual stimuli. It extends from primary occipital cortex (which processes of low-level perceptual information) to ventral-temporal cortex (which parses information into high-level semantic representations). Young adults show highly specialized patterns in ventral-temporal cortex when viewing images of faces and houses, but older adults show less specialized (i.e., "dedifferentiated") patterns. Currently, it is unclear where this age-related dediffer-

entiation begins in the ventral-visual pathway. In the present study, we used functional magnetic resonance imaging to characterize patterns of neural dedifferention along several anatomically defined regions of the ventral-visual pathway. While in-scanner, younger (N=35) and older adults (N = 35) from the Dallas Lifespan Brain Study passively viewed grayscale images of human faces, primate faces, cat faces, houses, chairs, and scrambled images. We used a derivative of partial least squares to investigate regional differences in the patterns of neural activity associated with the six image categories. Results revealed regional and age differences in neural patterns associated with viewing each image category. Neural patterns in younger adults discriminated between face categories earlier in the visual pathway (i.e., inferior occipital) than in older adults. Additionally, older adults showed a trend towards less specialized neural patterns in low-level occipital regions (i.e., calcarine and lingual). These data suggest that neural dedifferentiation found in the ventral-visual pathway begins early in the processing stream and affects both early sensory processing and higher-level semantic regions.

A126

THE EFFECTS OF HEALTHY AGING ON MENTAL IMAGERY AS REVEALED BY EGOCENTRIC AND ALLOCENTRIC MENTAL SPATIAL TRANSFORMATIONS

Raffaella Rumiati[1], Luca De Simone[1], Nela Marusic[1], Roberto Eleopra[2], Barbara Tomasino[3]; [1]SISSA - International School for Advanced Studies, [2]"S. Maria della misericordia" Udine, [3]"E. Medea" — Previous studies have suggested that mental rotation can be accomplished by using different mental spatial transformations. When adopting the allocentric transformation individuals imagine the stimulus rotating in the picture plane, while when adopting the egocentric transformation they rely on sensorimotor mechanisms. How these mental transformations evolve during healthy aging has received little attention to date. Here we aimed at investigating how visual (i.e., allocentric) and sensorimotor (i.e., egocentric) imagery abilities change with normal aging. Fifteen elderly and 15 young participants were prompted to solve two different laterality tasks using either an allocentric or an egocentric frame of reference. Participants had to judge either the handedness of a visual hand (egocentric task) or the location of a marker to be either on the left or right side of the same visual hand (allocentric task). When performing the egocentric task, elderly participants were less accurate and slower for biomechanically awkward hand postures (i.e., lateral hand orientation). The findings revealed that healthy aging is associated with a specific degradation of the brain sensorimotor mechanisms necessary to accomplish egocentric mental transformations. Moreover, failure to find a difference in mentally rotating left or right hands suggests that aging does not necessarily evolve to impair non-dominant hand sensorimotor programs.

A127

HOLISTIC FACE PROCESSING OF OWN- AND OTHER-AGE FACES IN YOUNG AND OLDER ADULTS: EVENT-RELATED POTENTIAL EVIDENCE FROM THE COMPOSITE FACE TASK

Holger Wiese[1], Ulrike Kachel[1], Stefan R. Schweinberger[1]; [1]University of Jena — Participants more accurately remember own-age relative to other-age faces (own-age bias, OAB). The present study tested whether this effect is related to more efficient holistic processing of own-age faces. Young adult and older participants performed a composite face task with young and old faces, in which they indicated whether the upper half of two subsequent composite faces was identical or not. The lower half of the second face was always different, and face halves were horizontally misaligned in 50% of the trials. Both participant groups were more efficient to correctly identify same upper halves in the misaligned relative to the aligned condition, and this composite face effect (CFE), a marker of holistic face processing, was stronger for young faces. Analysis of event-related potentials revealed strong misalignment effects in the N170, which were more pronounced for young faces in both groups. Critically, in the subsequent N250r a stronger misalignment effect for young faces was detected in young participants only. Since N250r may reflect the facilitated access of a perceptual representation of a previously presented face, this finding is interpreted to reflect young participants' more efficient representation of own-age faces as a whole, which may contribute to their OAB in memory.

A128

ANTERIOR-POSTERIOR AND LATERAL-MEDIAL CHANGES IN P200 AMPLITUDE DURING A SELF-EVALUATION TASK

Joel Alexander[1], Tesalee Sensibaugh[1], Justin Karr[2], Eric Serres[1], Tyler Grindstaff[1], Ronald Alexander[3]; [1]Western Oregon University, [2]University of Victoria, [3]Wartburg College — The current study differentiated the influence of a self-evaluation task on anterior and posterior cortical regions by comparing latencies and amplitudes of the p200 event-related potential.The current study included 32 participants (xage=21.71, sage=3.08; 50% female) all of whom completed three stages. An ERP auditory oddball discrimination task between a target (15% occurrence) and standard (85% occurrence) was included across all stages. The stages included 1) the standard oddball task, 2) the oddball task with a secondary counting task, and 3) the oddball task with a secondary self-evaluation task (i.e., participants indicated if they were surprised by the occurrence of the target tone in the series). Previous research has explored the impact of a self-evaluation task on the p300 component of the event-related potential (ERP), observing an increase in amplitude towards the cortical midline (Alexander et al., 2005; Grindstaff et al., 2011). The heightened level of cortical resource allocation at the central brain may indicate increased parietal involvement in a self-evaluation task compared to other lobes. In contrast, the current study found the p200 amplitude was similarly more responsive to the self-evaluation task, yet with a different pattern involving not just anterior- posterior, but lateral-medial aspects, $F(6.95, 208.34) = 3.27$, $p = .003$, $\eta 2 = .10$. In contrast to the p300 study data, the p200 did not show increased latency effects with the increased demands of self-evaluation. The higher-order perceptual processing, modulated by attention that the P200 is purported to represent, clearly has a unique precursor response compared to the P300.

A129

THE GENETICS OF MORAL JUDGMENT: INFLUENCES OF THE OXYTOCIN RECEPTOR AND ARGININE VASOPRESSIN RECEPTOR 1A GENES

Regan Bernhard[1], Jonathan Chaponis[2], Richie Siburian[2], Patience Gallagher[2], Roy Perlis[2], Joshua Greene[1]; [1]Harvard University, [2]Psychiatric and Neurodevelopmental Genetics Unit, Massachusetts General Hospital — Two studies examine the relationship between common variation in the Oxytocin Receptor and Arginine Vasopressin Receptor genes (OXTR and AVPR1a) and patterns of moral judgment. Subjects responded to a standard set of moral dilemmas pitting the rights of the individual against the greater good. Previous research has shown that judgments favoring individual rights (deontological judgments) are preferentially supported by automatic emotional responses while judgments favoring the greater good (utilitarian judgments) are preferentially supported by controlled cognition. Because the above genes have been implicated in social decision-making, trust, affiliation, and pair bonding, we hypothesized that they may also modulate the emotional processes that promote deontological judgment over utilitarian judgment. In Study 1, 239 subjects were genotyped for 62 SNPs in 12 genes, tagging common variation in OXTR and AVPR1a. We identified associations between OXTR SNP rs237889 and AVPR1a SNP rs1042615 and moral judgment such that each additional copy of the minor allele of each of these SNPs resulted in a reduction of utilitarian judgments (beta = -.05077, uncorrected $p < .05$ and beta = -.05536, uncorrected $p < .01$, respectively). Study 2 attempts to replicate the Study 1 results, which would not survive correction for multiple comparisons. A preliminary analysis of Study 2 data ($N = 192$) suggests effects consistent with Study 1's results for both target SNPs. These findings provide preliminary evidence that variants of the Oxytocin Receptor and Arginine Vasopressin Receptor genes moderate moral judgment.

A130

NEURAL MARKERS OF DECISION CONFIDENCE

Annika Boldt[1], Nick Yeung[1]; [1]University of Oxford — Empirical evidence has accrued suggesting that we are able to evaluate our own thoughts and actions by means of both error detection and confidence judgements. This study investigates the neurocognitive foundations of these metacognitive judgements, specifically in the context of perceptual decision making. Electroencephalography (EEG) studies have identified the error positivity (Pe) as a measure indicating whether or not human subjects are aware of having made an error in simple decision tasks. Error detection, we believe, can also be interpreted as

a binary confidence judgement with reversed polarity. If this holds, the Pe should provide an inverse index of confidence. Our study used a dot count perceptual decision task with two difficulty levels. After indicating their decision, participants signalled their confidence on a 6-point scale. There was a clear modulation of the error positivity (Pe) by confidence. This effect was independent of objective accuracy. Furthermore, we suggest ways to predict confidence on a single-trial level, using Pe amplitude as a proxy. The rationale of this approach is to measure confidence without explicitly asking participants for their confidence rating, which could be useful in future research as an efficient and unobtrusive index of metacognitive confidence.

A131

EFFECTS OF ACUTE STRESS ON ECONOMIC DECISION MAKING UNDER UNCERTAINTY

Magdalena Buckert[1,2], Christiane Schwieren[2], Brigitte Kudielka[3], Christian Fiebach[1,4,5]; [1]Goethe University Frankfurt; Frankfurt am Main, Germany, [2]University of Heidelberg, Heidelberg, Germany, [3]University of Regensburg, Regensburg, Germany, [4]IDeA Center for Individual Development and Adaptive Education, Frankfurt am Main, Germany, [5]Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen, The Netherlands — Many decisions have financial implications and economic theory provides a good framework for studying decision making processes. Economic decisions are often made in stressful situations, e.g., at the stock market, but the effects of stress on economic decision making have not been systematically investigated so far. The present study examines how acute stress influences economic decision making under risk using financially incentivized lotteries. We varied the domain of decision making (gains only, losses only, or mixed) as well as the advantageousness of the risky prospect. Importantly, no feedback was provided to isolate risk taking from learning processes. In a sample of 74 healthy young participants, 55 of whom underwent a stress induction protocol (Trier Social Stress Test for groups), we observed increased risk seeking for gains in those reacting to the stressor with a marked endocrine stress response (i.e., cortisol responders). This result shows that acute psychosocial stress affects economic decision making under risk independent of learning processes and points to the importance of cortisol as a mediator of this effect.

A132

THE C957T DRD2 POLYMORPHISM PREDICTS DECISION-MAKING PERFORMANCE IN THE IOWA GAMBLING TASK

Kaileigh A. Byrne[1], Darrell A. Worthy[1], Jessica A. Cooper[2], Alex Kline[2], John E. McGeary[3], Christopher G. Beevers[2], W. Todd Maddox[2]; [1]Texas A&M University, [2]University of Texas at Austin, [3]Brown University — Our study assesses the role of the DRD2 gene C957T single nucleotide polymorphism on performance in the Iowa Gambling Task (IGT). Allelic variation in DRD2, a striatal D2 receptor gene, has been linked to individual differences in avoidance learning. Specifically, individuals with the T/T genotype exhibit greater avoidance learning than individuals with C/T and C/C genotypes. The IGT detects differences in individuals' responsiveness to losses and gains in decision-making. Participants repeatedly choose a card from four different decks on 100 trials. Two decks (A& B) offer low probability, high value rewards while the other two decks (C&D) give high probability, low value rewards. The high probability reward decks also give larger losses and are disadvantageous long-term. To maximize earnings, participants must evaluate the gains and losses over the course of each draw. Genetic and IGT performance analyses reveal that individuals with the T/T genotype outperform both C/C and C/T genotypes. Modeling analyses indicate enhanced loss aversion in T/T genotypes. These analyses demonstrate that T/T carriers avoid the high-loss decks more that individuals with a DRD2 C allele suggesting that the DRD2T/T genotype predicts heightened sensitivity to negative outcomes. Because T/T carriers have increased D2 receptor density in the striatum, they are more sensitive to learning when dopamine levels are low. Thus, it appears that striatal dopamine levels directly influence avoidance learning. Moreover, this learning enhances their decision-making performance in situations that require the identification and avoidance of losses.

A133

IDENTIFYING SYMBOLS OF THE CONSUMER MARKETPLACE FROM HUMAN BRAIN ACTIVITY

Yu-Ping Chen[1], Leif Nelson[1], Ming Hsu[1]; [1]University of California, Berkeley — Recent research, guided by formal economic models, has made rapid progress in understanding the neural basis of value representation. These idealized models, however, rely on well-defined and stable preferences in a human population that is famously fickle, and prone to influence from subtle signals like brands, which may be unrelated to intrinsic value. Here we investigate the neural basis of brand perception by building on the well established semantic associations related to brands, widely known as "brand personality." During functional imaging, participants thought about the characteristics and personalities of 44 well-known brands (e.g., McDonald's, Louis Vuitton, Apple). Post-scanning, they characterized each brand on the brand personality scale, which describes each brand as a set of five orthogonal personality dimensions. We used multi-voxel pattern analysis to predict the cognitive states of the participant using their neural responses to the brands and their latent associations. To train the model, we reconstruct the relationship between the personality dimensions and the brain activation. With those we were able to predict the brain activations associated with the brands outside the training set. Once trained, we evaluated our model by comparing the predicted fMRI images and the actual data. Our model successfully distinguished pairs of previously unseen brands with accuracies significantly higher than chance. With this paper, we take a first step to understanding how abstract entities like brands influence our preferences and decisions.

A134

INDIVIDUAL DIFFERENCES IN NUMERACY PREDICT NEURAL ACTIVATION DURING FRAMING EFFECTS

Christina Chick[1], Valerie Reyna[1]; [1]Cornell University — Framing effects illustrate inconsistency in decision making. When choosing between two options of equal expected value, people tend to prefer the sure option when options are described as gains, but the risky option when options are described as losses. In this study, 29 fMRI participants completed a risky choice framing task . Framing problems were presented with three variations on the risky option: The standard version (e.g., "1/3 chance 600 saved or 2/3 chance no one saved"), the quantitative complement only (e.g., "1/3 chance 600 saved"), or the qualitative complement only (e.g., "2/3 chance no one saved"). These three versions of the risky option are predicted to cue different cognitive processes, resulting in different framing decisions. Individual differences in numeracy (ability to apply numerical concepts) were measured using the cognitive reflection test (CRT; Frederick, 2005) and subjective numeracy scale (SNS; Fagerlin, 2008). We used a multivariate approach to identify interactions between numeracy and brain activity during framing decisions. Participants who scored higher on CRT and SNS showed increased activation in DLPFC and inferior parietal lobule when making decisions counter to their general tendency (i.e., non-framing decisions). However, those effects occurred only when the risky option was phrased as "1/3 chance 600 saved." When the risky option was phrased in the standard version or as "2/3 chance no one saved," these participants showed increased caudate activation when making non-framing decisions. These results support a cognitive process model for the framing effect and show how individual differences in numeracy modulate this process.

A135

FUNCTIONAL SIMILARITY BETWEEN PERCEPTUALLY DISCRETE OBJECTS IS MODULATED BY DISTINCT CORTICAL NETWORKS

Evangelia G. Chrysikou[1], Gavin K. Hanson[1], William O. Wright[1]; [1]University of Kansas — Neuroimaging studies exploring the cortical organization of semantic knowledge have revealed distributed networks in ventrotemporal and inferior parietal cortex that support the representation of different properties of object concepts (e.g., color, shape, mode of manipulation). Studies with healthy adults and semantic dementia patients have further implicated anterior temporal cortex in the representation of object function. Although research has shown that ventrotemporal and inferior parietal regions support object similarity judgments on the basis of perceptual properties (e.g., shape), the neural mechanisms that support functional similarity of objects, particularly in the context of specific goals, have not been fully explored. Here, we used functional magnetic resonance imaging (fMRI) to examine whether decisions about object functional similarity are

modulated by the presence of impromptu goals and supported by ventral temporal networks. Participants read a series of goals (e.g., to start a fire), followed by an object that could be used to satisfy this goal (e.g., newspaper). They then selected which of two target objects (e.g., pen or pencil) matched the first object in the context of the presented goal (e.g., a pencil [made of wood] and a newspaper [made of paper] can be used to start a fire). Target objects varied in how typically they were associated with a given goal. Analysis of regions of interest as determined by independent task localizers revealed contributions of frontotemporal networks in determining functional similarity for objects, particularly in low-typicality trials. These results extend past research implicating this region in the representation of object function.

A136

HANDEDNESS AND CREATIVITY: MIXED HANDEDERS MORE CREATIVE

Adam Felton[1], Thomas Holtgraves[2], David Vazquez[1]; [1]University of California Riverside, [2]Ball State University — The cognitive and behavioral consequences of (consistent and mixed, not left and right) handedness are still unclear. The purpose of this study was to investigate the relationship between consistent and mixed handedness and creativity. It was hypothesized that mixed handers would perform better than consistent handers, presumably due to increased hemispheric connectivity. Handedness was assessed with the Edinburgh handedness inventory. Participants completed two convergent creativity tasks, which differed on level of difficulty. A median split was performed on the absolute values of handedness scores to create separate consistent (N=46) and mixed (N=44) groups. Mixed handers performed significantly ($p = .019$, $\eta=.246$) better on the composite creativity task overall (M=6.36, SD=3.17) compared to consistent handers (M=4.87, SD=3.05). Creativity differed as a function of degree of handedness and task difficulty. There was a significant ($p=.003$, $\eta=.310$) difference between mixed (M=3.7, SD=2.23) and consistent (M=2.41, SD=1.76) handers on the less difficult creativity task and no significant difference between the groups on the more difficult task. The results suggest that handedness may reflect an underlying neurological difference that may be related to semantic organization and creativity.

A137

NORMALIZATION OF BRAIN FUNCTION FOLLOWING EIGHT WEEKS OF MATH TRAINING IN CHILDREN WITH DEVELOPMENTAL DYSCALCULIA

Teresa Iuculano[1], Miriam Rosenberg-Lee[1], Jennifer Richardson[1], Caitlin Tenison[1], Lynn Fuchs[2], Vinod Menon[1,3,4]; [1]Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, [2]Department of Special Education, Vanderbilt University, [3]Department of Neurology and Neurological Sciences, Stanford University School of Medicine, [4]Program in Neuroscience, Stanford University School of Medicine — Developmental Dyscalculia (DD) is a learning disability characterized by a specific difficulty in acquiring mathematical skills in the context of normal intelligence and age-appropriate school education, strongly impacting academic and professional success. Here we investigate the behavioral and neural correlates of mathematical training in 15 children with DD and 15 typically developing children (TD), matched on age, IQ, and reading abilities. All children completed an 8-week one-on-one behavioral math training program with functional brain imaging data collected before and after training. During fMRI scanning children verified addition equations (e.g. 2+3 = 5). Training improved performance, especially in the DD group: prior to training children with DD were significantly less accurate than their TD peers (mean accuracies 73% and 83% respectively; $p < .05$), but did not differ after training (87% and 91%; $p = .4$). Across time points, both groups activated brain areas commonly associated with numerical tasks including the bilateral anterior intraparietal sulci and the left fusiform gyrus, as well as brain regions involved in domain-general cognitive control including the superior frontal gyrus and the insular cortex. Prior to training, children with DD showed hyper-activation in the left angular gyrus extending to the intraparietal sulcus, the dorsolateral prefrontal cortex and superior frontal gyrus, while after training activation levels in these regions did not differ from TD children. These results suggest that 8-weeks of math training can normalize brain function in regions important for math problem solving, attention and working memory.

A138

NEUROBEHAVIORAL INFLUENCE OF CONTROL ON THE EXPRESSION OF INDIVIDUAL DIFFERENCES IN PROBLEM SOLVING CAPACITY

Kenneth Kishida[1,2], Eun Joo Kim[3], Ann Harvey[1,2], P. Read Montague[1,2,4,5]; [1]Virginia Tech Carilion Research Institute, [2]Virginia Tech, [3]Yonsei University, [4]Wellcome Trust Centre for Neuroimaging, [5]University College London — Autonomy is highly valued in American culture. The ability to make choices and determine one's own fate is a defining feature in many democratic societies and is a value that percolates throughout our educational and workplace environments. However, the neurobehavioral impact of choice and the feeling of control is unknown. Here, we designed a cognitive performance experiment with the purpose of determining the impact of control and choice on the expression of individuals' problem solving capacity. During each trial of a 92-trial functional magnetic resonance imaging (fMRI) task – the "Choice-IQ Task" – participants were asked to choose between two problem sets (e.g., set A or set B) with prior knowledge of the likelihood that their choice would be executed. The likelihood that the participant would control the question set was parameterized (probability: {0, 0.25, 0.5, 0.75, 1.0}) and signaled to the participant on each trial with a visual cue. In the event that the participant would not control the situation the participants were instructed that the computer would determine the question set to be solved. During the fMRI-scanned Choice-IQ Task, participants answered questions from Catell's Culture Fair Intelligence (CCFI) Test Scales 2A and 2B. Prior to scanning, participants performed CCFI Test Scale 3A using paper and pencil with standardized testing procedures for an estimate of their Intelligence Quotient and thus an estimate of their expected performance on scales 2A and 2B. 103 participants performed the fMRI-scanned Choice-IQ Task. Behavioral analyses suggest control is beneficial to some while harmful to others.

A139

BEYOND ALPHA: THE BETA BANDS INDEX ORIGINALITY DURING DIVERGENT THINKING

Timothy George[1], Henk Haarmann[1], Kristin Grunewald[1], Joseph Dien[1], Polly O'Rourke[1]; [1]University of Maryland, Center for the Advanced Study of Language — While research in the neural signature of originality as indexed by EEG spectral power has established a connection between increased power in the alpha band (often limited to the right hemisphere or frontal lobes) and greater originality during divergent thinking, little evidence of an association between beta band activity and originality has been found. In the current experiment, EEG was recorded while participants performed the insight problem task in which they are presented with a brief scenario ("a light in the darkness") and asked to generate as many explanations as possible within three minutes. Event-related synchrony (ERS) was calculated with a pre-task eyes-open baseline as the reference period and a 1-second interval ending 250ms before each button press signaling a new idea as the activation period. Responses were categorized as high or low originality based on participants' self-ratings. Results in the low alpha band showed that high originality was associated with greater ERS in the frontal lobe which confirms the importance of frontal alpha in verbal creativity. In the mid beta band, high originality responses were associated with increased ERS in the left hemisphere only. In the high beta band, ERS was greater for low originality responses. These results are consistent with previous findings suggesting the mid and high beta bands are sensitive to different aspects of lexico-semantic processing that would necessarily come into play during the generation and production of ideas. These findings provide a new neural signature of originality and underscore the linguistic component of divergent thinking.

A140

NEURAL PREDICTORS OF INDIVIDUAL DIFFERENCES IN MATHEMATICAL KNOWLEDGE ACQUISITION IN EARLY GRADE SCHOOL CHILDREN

Anna Swigart[1], Kaustubh Supekar[1], Dietsje Jolles[1], Miriam Rosenberg-Lee[1], Caitlin Tennison[2], Lynn Fuchs[3], Vinod Menon[1]; [1]Stanford University, [2]Carnegie Mellon University, [3]Vanderbilt University — The ability to acquire mathematical skills quickly is critical for academic and professional success. In early grade school, developing a thorough knowledge of simple arithmetic facts provides a foundation upon which to build more complex math skills. However, little is known about the neural mechanisms that drive some children to acquire these skills faster than others. Here we use

a cognitive training paradigm to investigate whether pre-training behavioral and brain measures can predict training-induced performance gains in arithmetic skills. Twenty-four third-grade children (ages 7-9) underwent structural and resting-state functional MRI prior to an intensive one-on-one eight week math training program. A significant shift in problem solving strategy use from counting to fact retrieval was observed with training. After training, performance (speed and accuracy) on a math verification task increased significantly, with some children showing much greater improvement than others. No behavioral measures, including standardized measures of IQ or mathematical abilities, predicted performance gains with training. In contrast, pre-training hippocampal volume predicted greater improvements in math performance. Furthermore, higher intrinsic functional connectivity between the hippocampus and several brain areas, including left dorsolateral and ventrolateral prefrontal cortices and basal ganglia, also predicted performance gains. These novel findings suggest that individual differences in the gray matter volume and connectivity of brain regions associated with memory formation are associated with math learning outcomes in children. Moreover, measures of neural structure and function may provide a more accurate prediction of response to intervention than behavioral measures.

A141

OBJECTIVE AND SUBJECTIVE NUMBER REPRESENTATIONS IN THE DORSAL AND VENTRAL STREAMS

Vy A. Vo[1], Courtney Lussier[1], Jessica F. Cantlon[1]; [1]University of Rochester — Neuroimaging, neuropsychological, and neurophysiological studies have localized the "number sense" to the intraparietal sulcus (IPS). Here, we test how the brain transforms visual information into a subjective number representation. Specifically, we test for a dissociation between actual (objective) and perceived (subjective) number in the dorsal and ventral streams. Subjects performed a rapid event-related number naming task in the scanner, alternating between runs of naming digits and naming the number of dots in a visual array. To identify the regions of interest, each subject also completed a localizer scan. In the localizer, subjects performed a matching task that required them to compare the numerical value of dot arrays to digits, and a baseline condition in which they identified whether a scrambled stimulus appeared to the left or right of fixation. The localizer yielded a neural response pattern that included regions of the ventral stream (e.g., lateral occipital cortex, or LOC) and the IPS. We tested neural responses to the number naming task within the LOC and the IPS. In the IPS, the amplitudes of the neural responses to dot arrays were best predicted by a combination of the subjective (named) numbers and the objective numerical values of the dot arrays. In contrast, neural responses in LOC to the dot arrays were only predicted by objective numerical value. The data implicate a hierarchical model of number coding wherein object-processing regions in the ventral stream pass information to dorsal regions (the IPS) which then compute a subjective number estimate.

Poster Session B

B1

RESTING STATE EEG IN CHILDREN AGES 3 TO 7 WITH AND WITHOUT ADHD

Kelly Kehm[1], Katrina Bridgman[1], Margaret Sheridan[1,2]; [1]Boston Children's Hospital, [2]Harvard Medical School — Previous studies have utilized resting state EEG to characterize adults and children who meet criteria for ADHD. However, these studies have not examined children under the age of 8 years, a time period in development which appears important for the emergence of a stable ADHD diagnosis. This study aims to establish an EEG signature for young children who meet diagnostic criteria for ADHD. Comparing children between the ages 3 to 7 who meet criteria for ADHD (N=18) to age and gender matched controls (N=18), we found significant differences in resting state EEG. When controlling for Verbal and Performance IQ, results indicate a significant main effect of age in electrodes over parietal cortex for power in high frequency bands, with ADHD children exhibiting significantly greater relative beta power (F=5.43, p= .026) and marginally greater gamma power than controls (F=3.05, p=.091). This main effect of diagnosis was moderated by an age x diagnosis interaction. Across the span of 3-7 years of age, children with ADHD exhibit more relative beta (F= 5.8, p= .02) and gamma (F=3.2, p= .082) power contributing to total power, whereas controls have the opposite pattern (decreasing contributions of high frequency across this age range). These findings are in contrast with observations from previous studies where decreased contributions for higher frequency bands for older children with ADHD were observed and may indicate that there are non-linearities in EEG across early and middle childhood. This study is an ongoing effort to identify diagnostic neural markers in young children with ADHD.

B2

DEVELOPMENTAL CHANGES IN NEURAL SUBSTRATES OF SPATIOTEMPORAL PROCESSING IN ADULTS AND CHILDREN WITH THE FRAGILE X PREMUTATION

So-Yeon Kim[1], Ryu-ichiro Hashimoto[2], Tony J. Simon[1], Susan M. Rivera[1]; [1]University of California, Davis, [2]Tokyo Metropolitan University, Tokyo — Mutations of the fragile X mental retardation 1 (FMR1) gene are the genetic cause of fragile X syndrome. Expanded CGG repeats (> 200) result in methylation of the FMR1 gene, causing cognitive impairments. Although carriers of premutation alleles (55–200 CGG repeats) have been regarded as cognitively unaffected, mouse models of the premutation have demonstrated that the carriers reveal atypical spatiotemporal processing. To date, no studies have investigated developmental changes in neural substrates of spatiotemporal processing in individuals with the premutation. Using fMRI and a multiple object tracking task, we examined neural correlates of spatiotemporal attention in children (age: 8-12) and adults (age: 20-40) with the premutation and age-matched neurotypical controls. Participants were asked to actively track moving targets in an array of distractors ("tracking") or to passively look at the array ("passive viewing"). To identify neural correlates of spatiotemporal attention, we contrasted neural response of tracking to that of passive viewing. Consistent with previous findings, fronto-parietal areas, including SPL, precuneus, and FEF, were involved in tracking versus passive viewing in all groups. However, we found a significant interaction between age and diagnostic group in activation of parietal areas associated with tracking. Specifically, while no difference was found between control and premutation adults, children with the premutation showed significantly reduced activity in left SPL and precuneus. These results suggest that early developmental differences in spatiotemporal processing are present in individuals with the premutation, and underscore the importance of studying children to understand the natural history of neurocognitive impairments in this population.

B3

WHITE MATTER INJURY IS ASSOCIATED WITH VISUAL SEARCH BEHAVIOR INDEPENDENT OF GENERALIZED SLOWING IN AGING

Samuel N. Lockhart[1], Alexandra E. Roach[1], Steven J. Luck[1], Joy Geng[1], Laurel Beckett[1], Owen Carmichael[1], Charles DeCarli[1]; [1]University of California, Davis — A fundamental controversy is whether cognitive decline in aging can be explained entirely by decreased processing speed, or whether specific neural changes are responsible for some aspects of cognitive decline, independent of slowing. Advancing age is also associated with asymptomatic cerebrovascular disease. We investigated whether age- and vascular-related differences in white matter injury (white matter hyperintensities [WMH]) mediate age-related differences in visual attentional control, hypothesizing that WMH exert effects on complex attentional control beyond just cognitive processing speed differences. We tested young and cognitively healthy older adults on visuospatial search tasks indexing top-down and bottom-up attentional control. Aging was associated with increased slowing and with impaired search; white matter injury was independently associated with visual attention impairments. Consistent with models that attribute cognitive aging to reduced brain network connectivity, these results conclusively demonstrate that clinically silent white matter injury contributes to declines in cognitive performance, independent of global cognitive slowing.

B4

LARGE SCALE SEARCH: INHIBITION, ATTENTION, AND SPATIAL WORKING MEMORY

Kate Longstaffe[1], Bruce Hood[1], Iain Gilchrist[1]; [1]University of Bristol — Developing the ability to perform complex tasks such as navigation requires executive functions of inhibition, attention and memory. To study the development of these processes during large scale search, we tested 80 adults and 140 children (aged 6-12) in a search laboratory with a large array of LED light switches embedded in the floor. Participant's task was to press the green light switches to locate a pre-selected target that turned red when pressed. Visual search literature shows salient events capture attention (Yantis & Jonides, 1984, Theeuwes, 1994). The salience of search locations was manipulated by having some switches flashing and some static. Children were more likely to search at flashing locations, even when explicitly informed that the target was equally likely to be at any location. Participant's attention was captured by perceptual salience, leading to an automatic bias to explore these targets, and the magnitude of this effect did not vary with age. However, there was a strong developmental trend in the number of times children revisited previously examined locations. This body of work shows that both adult and child participants attend to salient targets more frequently during large scale search, and that this attention toward salient targets can be mediated by tasks that reduce or increase spatial memory load. The developmental trajectory for ability to remember previously visited locations and limit revisits shows a development in spatial working memory occurring separately from perceptual inhibition. This suggests individual executive sub-processes may play different roles during search, with different developmental trajectories.

B5

AGE-RELATED DIFFERENCES IN THE FUNCTIONAL NEUROANATOMY OF TOP-DOWN ATTENTIONAL CONTROL DURING VISUAL SEARCH

David Madden[1], Simon Davis[2], Roberto Cabeza[3]; [1]Duke University Medical Center, [2]University of Cambridge, [3]Duke University — Neuroimaging studies of younger adults have established that a network of frontoparietal cortical regions is critical for visual search performance, particularly when target detection is vulnerable to distraction. Behavioral studies have indicated that although some aspects of search performance undergo decline during human aging, other aspects such as top-down control remain stable. The goal of this study was to investigate adult age-related differences in top-down attentional control during visual search, measured by functional magnetic resonance imaging (fMRI). Participants were 21 healthy, older adults (60-87 years of age) and 21 younger adults (19-29 years of age). The task was a highly efficient form of visual search, in which the target was always a shape singleton (e.g., a vertical bar target among circle distractors). Both younger and older adults were successful in using top-down attention (target predictability) to improve search performance. However, the older adults exhibited a disproportionate vulnerability to distraction from a highly salient distractor (color singleton), and target predictability did not provide any protection from distraction for either age group. Analyses of the fMRI data yielded two distinct but overlapping cortical

networks related, respectively, to detection of the target and distraction from the color singleton. Variation in activation within these networks, particularly in superior parietal cortex, suggests that a salient distractor engages response competition mechanisms that are vulnerable to age-related decline. Although top-down attentional guidance remains available to support target detection, during later adulthood, a highly salient distractor may engage response competition mechanisms that are less amenable to attentional control.

B6

CONFLICT ADAPTATION AND CUEING EFFECTS IN YOUNG, MIDDLE-AGED, AND OLDER ADULTS ON THE SIMON TASK Paula M. McLaughlin[1], Susan J. E. Murtha[1]; [1]York University — Conflict adaptation is the ability to adjust conflict resolution based on previously experienced conflict (a trial sequencing effect). Although few studies have examined age-related changes in conflict adaptation, previous research has shown that older adults are less efficient at task-switching (dynamically shifting between tasks that require distinct cognitive processes) relative to younger controls. As such, older adults should be more sensitive to trial sequencing effects and show increased conflict adaptation. The present study explored conflict adaption in young (ages 18-25), middle-aged (ages 40-54), and older (ages 65-82) adults, and examined whether age-related changes can be mitigated with auditory cues. Participants were administered a cued Simon task and were required to indicated the color of a target presented on the left/right of a fixation point by pressing a left/right response key. The target location was either congruent or incongruent with the response key, with the Simon effect referring to faster reaction times on congruent relative to incongruent trials. Our results showed an age-related increase in the Simon effect when the previous trial was congruent (no conflict resolution required). Consistent with previous research, a reverse Simon effect was observed when the previous trial was incongruent and conflict resolution was required. This conflict adaptation effect was exaggerated with increasing age. Interestingly, these age-related increases in trial sequencing effects were reduced when participants were provided with informative auditory cues that oriented attention. Our findings support the frontal hypothesis of aging, and suggest that age-related deficiencies in mental flexibility can be mitigated with exogenous support.

B7

HOW DOES EXOGENOUS ORIENTING OF ATTENTION MODULATE VISUAL CONSCIOUSNESS? Dimitri Bayle[1], Antoni Valero-Cabre[1], Ana Chica[2], Catherine Tallon-Baudry[3], Paolo Bartolomeo[1,4]; [1]CRICM and Université Pierre et Marie Curie (UPMC), Paris, France, [2]Department of Experimental Psychology. University of Granada, Spain., [3]Laboratoire de Neurosciences Cognitives, INSERM-ENS U960, Paris, France, [4]Department of Psychology, Catholic University, Milan, Italy — The relationship between attention and consciousness is highly debated. If endogenous attention has been widely studied, the role of exogenous orienting of attention has been less explored. Recent studies demonstrate that exogenous attention is important for conscious perception modulation. However, it remains unknown whether exogenous attention alone is sufficient to triggered conscious perception and what are the neurophysiological mechanisms implicated. We explore here the neural correlates of exogenous attention and consciousness during visual processing. We recorded magneto-encephalographic (MEG) signals while subjects were engaged in the detection/discrimination of near-threshold stimuli presented in peripheral visual field. A non-informative peripheral cue was briefly presented; follows by a near-threshold grating presented for 16ms in one hemifield. Subjects were asked to discriminate the grating orientation and to subjectively determine if the target was absent or present. Cued target was more often reported as seen(59%) than uncued target(50%). However, signal detection theory analysis showed no d' difference between cued and uncued targets, thus suggesting that visual sensitivity was not enhanced by non-predictive cues. On the other hand, response criterion was more liberal for cued targets (lower c criterion) than for uncued targets. Preliminary MEG analyses show that beta and gamma oscillations responses over the motor cortex were increased for seen than for unseen target, before the subjects' response. Taken together, our results indicate that exogenous attention alone is not sufficient for enhancing visual sensitivity. It can, however, modify our subjective reports by making our criterion choice more liberal, perhaps by modifying brain activity in motor-related regions.

B8

THE OSCILLATORY DYNAMICS OF WILLED ATTENTION. Jesse Bengson[1,2], Todd Kelley[1,2], Ron Mangun[1,2]; [1]Center for Mind and Brain, [2]UC-Davis — A fundamental question for understanding voluntary attention is how the brain willfully allocates attention (Taylor et al., 2008; Hopfinger et al., 2010). In the present study, participants engaged in a trial-by-trial spatial attention paradigm in which the neural correlates of instructed (cued) attention were directly compared with willed (choice) attention, where subjects chose where to attend. For willed attention, we observed that a choice to attend to the left or right was predicted by the laterality of alpha power over the occipital cortex prior to the attentional choice. In the post-cue interval, we observed a significant increase in frontal theta power and a reduction in occipital alpha power for the choice trials relative to cued trials. Across participants, we also observed that the degree to which the pre-choice alpha laterality predicted subsequent decisions, covaried with the post-choice specific reduction of occipital alpha power. Furthermore the fMRI contrast of choice versus cued trials revealed a network of activation for willed attention that included the left and right Anterior Insula (aINS), left Middle Frontal Gyrus (MFG), and the Anterior Cingulate Cortex (ACC). Interestingly, the only site of choice-trial specific BOLD activation that covaried with the effect of pre-choice alpha power on decisions was the right aINS. These findings illustrate the oscillatory dynamics of willed attention and provide a functional link between pre-choice alpha laterality, post-choice alpha power and the right aINS.

B9

THE VISUAL BINDING PROBLEM AND THE EFFECTS OF ORIENTING ATTENIONAL CUES IN VISUAL SHORT TERM MEMORY Joshua Chauvin[1], Nick Myers[1], Kia Nobre[1], Glyn Humphreys[1]; [1]University of Oxford — An ongoing problem in cognitive neuroscience relates to the way in which visual features are processed, bound, and maintained as unified percepts in Visual Short Term Memory (VSTM). In particular, it remains unclear to which extent focused or unfocused attention modifies the maintenance of feature bindings on change detection tasks in VSTM. The following study examined the effects of orienting attention to a VSTM representation and the degree to which different types of attentional cues (invalid, neutral, and valid retro-cues) affect the binding of visual information. Participants decided if a probe image was previously presented to them as an object in a memory display. Each probe either carried one feature from an item in the display (the feature condition) or it contained two features from different stimuli (the form-colour conjunction condition). It was found that validly cueing attention to the location of an item in memory selectively reduced errors in the conjunction condition. The results suggest a positive role for attention in maintaining feature binding.

B10

SPATIAL AND NON-SPATIAL PROCESSING OF FEATURE CONJUNCTIONS: AN EVENT -RELATED FMRI STUDY Emma Cheetham[1], John Evans[1], Chris Chambers[1]; [1]Cardiff University — Feature binding is crucial for cohesive perception. Spatial attention has been traditionally regarded as integral for successful binding, however the role of temporal selection is less clear. Using event-related fMRI, we explored the different processing streams engaged when subjects explicitly perform temporal, spatial and feature-based visual judgements. In particular, we asked whether there is a unique neural signature associated with spatial or temporal attention over and above that of a feature conjunction task. We also sought to test the existence of a 'when' pathway that is functionally separate from the well-characterized dorsal and ventral routes of the visual system. Critically, and unlike previous studies, we held the task difficulty and stimuli constant throughout all conditions. Whole brain analysis and retinotopic mapping during spatial attention revealed an expected neural network including V1, bilateral intraparietal sulci, and bilateral inferior frontal gyri. We found no evidence, however, of an anatomically specialized mechanism for temporal attention relative to spatial attention, nor did we observe any unique neural signature for resolving feature conjunctions relative to spatial or temporal

attention. Taken together, these findings provide no evidence for a unique, anatomically distinct system for feature binding, which may instead be coordinated by networks that control visuospatial attention.

B11

TRUNK-RIGHT ORIENTATION IMPROVES FOCUSED ATTENTION TASK PERFORMANCE AT FAR-ECCENTRIC LOCATIONS OF THE VISUAL FIELD

Jiaqing Chen[1], Sohaib Mohammad[1], Matthias Niemeier[1,2]; [1]University of Toronto, [2]Center for Vision Research, York University — Body schema is indispensable for sensorimotor control and learning, but it remains unclear whether it is associated with cognitive functions. Data from patients with spatial neglect support this view; yet observations in healthy participants are inconsistent. Here we conducted 3 sets of experiments examining influences of trunk position (30° left, straight ahead, 30° right) on different forms of spatial cognition. The first set (Experiment 1A and 1B) probed spatial attention which required participants to detect Gabors appearing at random intervals and locations. The second set examined spatial working memory using a change-detection paradigm (Experiment 2A) and a two-back paradigm (Experiment 2B). The third set (Experiment 3A, 3B, and 3C) examined the effects of valid or invalid cues on spatial shifts of focused attention: Participants quickly responded to a target that appeared left or right of the fixation point, preceded by a cue on the same or opposite side. In none of the experiments did trunk turns alter performance in the left vs. right visual field in an ipsiversive fashion as expected based on reports in neglect patients. However, trunk-right position improved performance at far-eccentric locations of the visual field in one spatial attention experiment (1A) and one working memory experiment (2B). Our results demonstrated that proprioceptive manipulations of the body schema did not modulate spatial cognition in the same fashion as reported in neglect patients, probably because spatial neglect reflects a state of the lesioned brain that is importantly different from that of the normally functioning brain.

B12

VISUAL WORKING MEMORY CAPACITY MEDIATES THE SPEED OF ATTENTIONAL REDEPLOYMENT

Gregory Christie[1], John McDonald[1]; [1]Simon Fraser University — According to the theory of automatic attentional capture the most salient item in a scene will always attract attention first, even if the item is a task-irrelevant distractor. However, three lines of evidence complicate this theory: (i) recent ERP results from studies investigating the N2pc, a neuro-electric index of attentional selection, have demonstrated that observers can prevent capture by salient distractors if the features of the distractor are fixed over trials; (ii) when task relevant, salient items elicit an earlier N2pc than less-salient items; (iii) individuals with greater visual working memory capacity (K) can override capture by salient distractors. Here, we asked if salience would influence the order of attentional selection when two items – one more salient than the other – we equally task relevant. Participants completed a visual search task in which they evaluated the contents of both a highly salient color singleton (typically used as a distractor) and a less salient shape singleton. Although not specifically instructed to do so, attention, as indexed by the N2pc, was reliably deployed first to the more salient color target and subsequently to the less salient shape target. Importantly, high-K observers were faster to disengage attention from the salient target and redirect it towards the less salient target. These results confirm: (i) that visual salience does indeed dictate the order of attentional selection, all other things equal; and (ii) that the relative importance of physical salience towards selection is mediated by innate differences in visual working memory capacity.

B13

REDUCED CORTICAL MEG ACTIVITY ASSOCIATED WITH RE-ORIENTING VISUOSPATIAL ATTENTION IN PATIENTS WITH TRAUMATIC BRAIN INJURY

Corby L. Dale[1,2], Tracy L. Luks[1], Leighton Hinkley[1], Anne M. Findlay[1], Phiroz E. Tarapore[1], Shelly R. Cooper[1], Sara C. LaHue[1], Hana A. Lee[1], Suzanne M. Honma[1], Danielle Mizuiri[1], Srikantan S. Nagarajan[1], Pratik Mukherjee[1]; [1]University of California, San Francisco, [2]Northern California Institute for Research and Education — Traumatic Brain Injury (TBI) often produces chronic deficits in cognitive function that affect patients' quality of life. To investigate attention-related neural activity differences associated with TBI, we measured whole-head magnetoencephalography (MEG) signals during a cued visuospatial attention task. MEG data from nineteen patients with mild-to-moderate symptomatic TBI and eighteen healthy control participants were analyzed using an adaptive spatial filtering technique (NUTMEG, http://bil.ucsf.edu/nutmeg), and co-registered to individual brain anatomy prior to normalizing images for within- and between-group comparisons. We examine high gamma band activity (63-117 Hz) arising from Incongruently- versus Congruently-cued target stimuli. Using Family-wise Error (FWE) correction for comparisons across voxels, in healthy participants we observe activations in Left Middle Frontal Gyrus (LMFG) from 100 to 175 ms, followed by largely-concurrent Right hemisphere activity from 175 to 300 ms in areas of Inferior Parietal Sulcus (RIPS), Insula, Putamen, and Superior Temporal Cortex and, subsequently, at ~325ms Left Inferior Frontal Cortex for a 50 ms period. In these regions, TBI patients exhibited reduced activity relative to healthy participants and, as a group, showed no alternate compensatory pattern of activity that survived the FWE correction threshold. Linear discriminant analyses revealed that activity levels in just 2 of these 5 regions, LMFG and RIPS, reliably predicted injury status. Furthermore, activity in LMFG showed negative correlation with both the Head Injury Symptom Checklist for post-concussive syndrome (HISC-PCS) and a measure of Cognitive Failures. These results suggest reduced activation due to TBI within a frontotemporal high-gamma oscillatory network subserving spatial attention.

B14

AMYGDALO – PREFRONTAL CONNECTIVITY PREDICTS NONCONSCIOUS ATTENTION BIAS TO THREAT

Joshua Carlson[1], Jiook Cha[1], Eddie Harmon-Jones[2], Lillianne Mujica-Parodi[1], Greg Hajcak[1]; [1]Stony Brook University, [2]University of New South Wales — Increased attentional bias to threat is gaining recognition as a causal factor in the development anxiety. Yet, little is known about the anatomical pathway by which threat biases attentional processing and the influence of genetics on this relationship. Here, we reconstructed the entire amygdalo–prefrontal white matter tract (i.e., uncinate fasciculus; N=40) using diffusion tensor weighted MRI to test the hypothesis that greater fiber integrity correlates with greater nonconscious attentional bias to threat as measured by a backward masked dot-probe task. Structural equation modeling was used to test the relationship between amygdala–prefrontal track integrity, brain-derived nerve growth factor genotype (BDNF–Val66Met), and attentional bias to nonconscious threat. Greater structural integrity within the amygdala–prefrontal tract is associated with a greater bias in attention to nonconscious threat. Further, the results suggest that the BDNF-Val66Met polymorphism influences the integrity of the amygdala–prefrontal pathway and, in turn, attentional bias to nonconscious threat. In a separate sample (N=15), we then addressed the extent to which nonconscious attentional bias to threat is associated with amygdala –anterior cingulate cortex (ACC) intrinsic functional connectivity. Additionally, we explored the relationship between functional and structural amygdala–ACC connectivity. Within the uncinate fasciculus, we found significant foci, near the ACC, in which fiber integrity predicted both facilitated attentional bias to nonconscious threat and enhanced amygdala–ACC functional connectivity. Collectively, our structural and functional results suggest that, in high bias individuals, prefrontal cognition and attentional processing is "biased" by nonconscious threat signals relayed from the amygdala via the uncinate fasciculus.

B15

EFFECTS OF AUDITORY EMOTIONAL DISTRACTION WHILE DRIVING: AN ELECTROPHYSIOLOGICAL APPROACH

Michelle Chan[1], Anthony Singhal[1]; [1]University of Alberta — Roadside billboards containing negative and positive emotional content have been shown to influence driving behavior by modulating attention; however, the impact of auditory emotional distractions on driving has not been investigated. Our objective was to examine the behavioral and event-related potential (ERP) effects elicited by words of varied emotional valence during driving in a dual-task paradigm. ERPs were recorded while participants listened to sets of neutral, negative, and positive words that were presented alone and while participants operated a driving simulator. Negative distractions were shown to impair driving performance to a greater extent than positive distractions. ERP amplitudes to the distractions were reduced during driving compared to non-driving, revealing a division of cognitive resources under dual-task demands. Negative slow wave (NSW) amplitudes were

reduced to emotional compared to neutral distractions, presumably reflecting less recruitment of working memory resources when processing emotion. These effects were more clear-cut over frontal compared to central electrodes, suggesting at least two different neural generators of NSW. This was accompanied by a larger late positive potential (LPP) elicited by emotional compared to neutral distractions. Overall, these results indicate that auditory emotional distractions are distinctly processed in the brain and can differentially influence driving performance depending on valence (negative versus positive). One implication of these findings is that driver distraction can be mitigated by reducing auditory sources of distractions, particularly those high in negative emotional content.

B16

TOWARDS A COMPUTATIONAL UNDERSTANDING OF HOW THE BRAIN LEARNS TO PREDICT PAIN

Luke Chang[1], Marieke Jepma[1], Tal Yarkoni[1], Tor Wager[1]; [1]University of Colorado — Understanding the neural computations underlying how expectancies are developed has received surprisingly little attention despite their central role in theories of learning, behavior, and value. Although many studies have used reinforcement learning models to localize brain regions that correlate with learned value, they do not typically treat the brain as a learner and model the learning process in different brain systems. Thus, they cannot capture differences in learning rates across the brain. Here, we implemented a novel method of estimating model parameters by treating brain regions as learners and directly fitting reinforcement learning models to fMRI data. Twenty-seven participants learned associations between visual cues and different levels of heat pain applied to their left forearm. Each cue was associated with a different distribution of noxious heat intensity. On each trial, participants indicated which of two cues they believed was associated with the lowest pain. Then, the computer selected one of the two cues, and participants experienced the associated painful stimulation and rated the intensity of the pain they experienced. We fit a Rescorla-Wagner reinforcement-learning model directly to each voxel's activation at the time of pain administration, by training it on participants' subjective pain ratings. Voxels that encoded expected pain—with different learning rates depending on the brain region—were identified using a model comparison procedure, and included bilateral amygdalae, ventral striatum, and medial prefrontal cortex. Cross-validated support vector machine analyses showed that activity in these 'expectancy systems' accurately predicted participants' avoidance decisions.

B17

THE ROLE OF EMOTION AND ATTENTION IN SEMANTIC PROCESSING: EVIDENCE FROM N400

Dorothee Chwilla[1], Johanne Tromp[1]; [1]Donders Institute for Brain, Cognition and Behaviour — Does emotional state affect language processing? Little yet is known about the interface between language and emotion. With regard to semantic processing we have shown that emotional state modulates the standard N400 effect. In particular, the N400 cloze probability effect was strongly reduced in a sad mood compared to a happy mood (Chwilla, Virgillito, & Vissers, 2011). In the present study we explored the relation between emotion and attention in language comprehension. To this aim we combined an emotion manipulation (inducing a sad mood versus a happy mood) with an attention manipulation (comparing a deep semantic processing task with a shallow processing task) and studied the effects on the N400 cloze effect. The key question was whether the effects of emotional state and attention are additive or interactive. The main findings were as follows: The mood induction was successful. For N400 a three-way interaction between emotional state, attention and cloze probability was observed. For the happy mood condition a task by cloze interaction reflected an N400 effect in the semantic task versus absence of an N400 effect in the shallow processing task. Unexpectedly, for the sad mood condition a clear N400 effect occurred across tasks. Follow up analyses confirmed that an N400 effect for the shallow task was present for the sad mood but not for the happy mood condition. The present study reveals different N400 patterns as a function of emotional state and attention, indicating that the effects of emotional state are not fixed but context-dependent.

B18

IMPROVING SOCIAL COGNITION IN HEALTHY AGING VIA COMPUTERIZED COGNITIVE TRAINING

Sawsan Dabit[1], Mor Nahum[1,2], Thomas Van Vleet[1,3]; [1]Brain Plasticity Institute, San Francisco CA, [2]University of California, Berkeley, CA, [3]Department of Veteran Affairs, Martinez CA — Declines in multiple cognitive domains have been well documented in healthy aging. Recently, it has been shown that a segment of this population also exhibits declines in social cognition (e.g., affect recognition, theory of mind, social perception; see Kemp et al. 2012). Since computerized cognitive training has been efficacious in improving cognitive function in healthy aging (e.g. Lussier et al. 2012), we reasoned that social cognition might also benefit from similar methods. The goal of the investigation was to test feasibility of a novel, Internet-based social cognition training program. Healthy aging subjects (n=5; mean age: 78±8 years) completed 10-hours of training within 3 weeks. Participants were assessed before and after training using a standard battery of social cognition measures: Theory-of-Mind (Faux Pas test), face perception (Penn Facial Recognition test) and emotion recognition and management (MSCEIT battery). We found that subjects fully complied with the training regimen, and made improvements on most exercises, including those targeting face recognition ($p<.03$), memory for faces ($p<.02$), and gaze detection ($p<.05$). Following training, improvements were noted on the delayed recall of faces (9% improvement on the Penn total scale, $p<.03$), on the Faux Pas Theory-of-Mind test ($p<.03$), and on the 'perceiving emotions' subscale of the MSCEIT test (n.s.). No improvements were found on the immediate recall of faces or on the 'managing emotions' MSCEIT subscale. We conclude that computerized social cognition training is feasible in healthy aging individuals, and that as little as 10-hours of training shows promising trends of improved social cognition abilities.

B19

FAIRNESS CONSIDERATIONS IN INCARCERATED INDIVIDUALS WITH AND WITHOUT PSYCHOPATHY: INVESTIGATING THE ROLE OF CONTEXT AND INTENTIONALITY USING A MODIFIED ULTIMATUM GAME

Ellen de Bruijn[1], Sina Radke[2], Inti Brazil[2,3], Inge Scheper[3], Berend Bulten[3]; [1]Leiden University, the Netherlands, [2]Radboud University Nijmegen, the Netherlands, [3]Pompestichting Nijmegen, the Netherlands — Incarcerated individuals with psychopathy have often committed violent crimes against another person. Although these clear violations of social norms may suggest a biased moral reasoning in psychopathy, findings on utilitarian decisions remain unclear. We assessed social decision-making based on different aspects of fairness considerations in 18 criminal offenders with psychopathy, 14 criminal offenders without psychopathy and 18 matched healthy individuals who played the role of responder in a modified Ultimatum Game. Specifically, we focused on the effects of the context in which a particular monetary offer was made and the role of intentionality behind these offers. Selected offers were paired on each trial with a varying unselected alternative, thus establishing the context in which the offer was proposed. Also, all offers were either made intentional (i.e. the unknown proposer selects one of the two available offers) or unintentional (i.e. the computer randomly selected one alternative). As expected, unfair offers were most often rejected when the alternative offer was fair and when the unfair offer was made intentionally. Offenders without psychopathy did not adjust their behavior based on the available unselected alternatives. Importantly however, individuals with psychopathy did demonstrate a similar rejection pattern to that of healthy individuals as both groups took the context in which an offer was proposed into account. Therefore, social decision-making seems to be specifically impaired in offenders without psychopathy. The current outcomes are in line with some of the core features of psychopathy that require knowledge about social conduct and cognitive perspective-taking (e.g., manipulation or deception).

B20

ANGELS AND DEMONS IN SEMANTIC MEMORY: A FULLY CROSSED ERP INVESTIGATION OF AFFECTIVE AND SEMANTIC PRIMING

Nathaniel Delaney-Busch[1], Emily O'Carroll[1], Phillip Teves[1], Gina Kuperberg[1,2]; [1]Tufts University, [2]Martinos Center for Biomedical Imaging, Mass. General Hospital — Semantic priming describes the faster response to target words preceded by semantically associated versus unassociated words. Affective priming describes the faster response to emotional words pre-

ceded by words of the same versus opposite emotional valence. A large event-related potential (ERP) literature suggests that semantic priming results in facilitated lexico-semantic processing, reflected by an attenuation of the N400. The ERP signatures of affective priming, however, have been more mixed, and most studies have not fully controlled for semantic relationships. We carried out an ERP study that fully crossed semantic (Associated vs. Unassociated) and affective (Same Valence vs. Opposite Valence) priming. Participants explicitly judged semantic association of each word-pair (SOA: 250ms). If both affective and semantic priming influence lexico-semantic processing, they should both lead to N400 modulation (with an additive interaction if they act through independent neurocognitive mechanisms, and a non-additive interaction if they act non-independently). If, however, affective priming has no independent influence on lexico-semantic processing, this would predict no affective N400 effect and no interaction between Association and Valence. Our findings support the second hypothesis. We saw no N400 effect of affective priming, either for associated emotional words (e.g. "devil…demon" vs. "angel…demon") or unassociated emotional words (e.g. "venom…demon" vs. "antidote…demon"). Further, the magnitude of the N400 semantic priming effect on neutral targets (e.g. "curved…bent" vs. "slick…bent") was similar to that on emotional targets (e.g. "angel…demon" vs. "antidote…demon"). These results suggest that, at least under task and experimental conditions that encourage semantic associative processing, affective priming does not influence lexico-semantic processing.

B21

VALUE OF A MEMORY: POSITIVE AFFECT AND NEURAL RESPONSES EVOKED BY AUTOBIOGRAPHICAL MEMORIES

Megan E. Speer[1], Jamil P. Bhanji[1], Mauricio R. Delgado[1]; [1]Rutgers University — The retrieval of an autobiographical memory can bring back emotions tied to the original experience, such as the positive feelings brought back by remembering grandma's apple pie. The positive emotion evoked by such memories may suggest a potential intrinsic value or reward in retrieving positive experiences about the self. The goal of this study was to examine whether positive autobiographical memories enhance positive emotions and engage neural circuitry involved in reward processing. To test this, 19 healthy participants described and gave subjective emotion ratings for specific episodic memories of positive (e.g., family vacation) and neutral (e.g., commuting to work) content. Three days later, participants underwent an fMRI session where they received visual word cues (e.g., family vacation) and were asked to retrieve the same episodic memories. They also completed a gambling task where they earned monetary rewards. Participants reported greater emotional arousal and positive affect associated with the recollection of positive compared to neutral memories. In accordance, preliminary fMRI analysis suggested an enhanced response for positive compared to neutral memory recollection in several regions previously involved in affective processing, including the striatum, orbitofrontal cortex, and anterior cingulate. Further, voxels in the ventral striatum that processed monetary rewards in the gambling task also distinguished between positive and neutral memories. These findings suggest that an abstract reward, reminiscing about positive past experiences, produces internally generated positive emotions, which may be rewarding in and of itself.

B22

WORKING MEMORY TRAINING IMPROVES ATTENTION CONTROL IN DYSPHORIA

Nazanin Derakhshan[1,2], Max Owens[1]; [1]Birkbeck University of London, UK, [2]St John's Research Centre, St John's College, University of Oxford, UK — Impaired filtering of irrelevant information from working memory is thought to underlie reduced working memory capacity for relevant information in dysphoria. The current study investigated whether training related gains in working memory performance on the adaptive dual n-back task could result in improved inhibitory function. Efficacy of training was monitored in a change detection paradigm allowing measurement of a sustained event-related potential asymmetry sensitive to working memory capacity and the efficient filtering of irrelevant information. Dysphoric participants in the training group showed training related gains in working memory that were accompanied by gains in working memory capacity and filtering efficiency compared to an active control group. Results provide important initial evidence that behavioural performance and neural function in dysphoria can be improved by facilitating greater attentional control.

B23

NEURAL CORRELATES OF A REWARD SOURCE MEMORY ADVANTAGE IN HEALTHY VOLUNTEERS AND ITS ABSENCE IN MAJOR DEPRESSIVE DISORDER

Daniel Dillon[1,2], Ian Dobbins[3], Diego Pizzagalli[1,2]; [1]McLean Hospital, [2]Harvard Medical School, [3]Washington University in Saint Louis — Healthy adults frequently show a positive memory bias that is absent in depressed individuals, but the neural mechanisms underlying this group difference are unclear. To illuminate this issue, 21 controls and 21 depressed adults completed a recognition memory experiment during functional magnetic resonance imaging (fMRI). At encoding, drawings were followed by reward or zero outcomes. During testing, old and new drawings were presented under a reward cue or a zero cue. The controls showed a reward source memory advantage, but this positive memory bias was absent in the depressed group. Critically, the controls also generated stronger encoding responses to reward vs. zero outcomes in the left ventral putamen, right parahippocampus, and left hippocampus, but the depressed group did not. Moreover, right prefrontal cortex and left parietal cortex showed stronger activation during successful remembering from the reward vs. zero source in controls vs. depressed participants. Finally, a reward cue-framing effect was observed: across the groups, recognition decisions were rendered more quickly and accurately under the reward cue vs. the zero cue, coinciding with potentiated activation of the hippocampus, caudate, and putamen. These novel findings indicate that poorer explicit memory for positive material in depression reflects blunted responses to positive stimuli in the striatum and medial temporal lobes during encoding, which are accompanied by reduced fronto-parietal activation during retrieval. Because the ability to form and retrieve pleasant memories contributes to the positive self-regard that sustains healthy individuals, these results provide new insight into the neural mechanisms implicated in depression.

B24

DIFFERENTIAL RELATIONSHIPS OF AFFECTIVE AND MOTIVATIONAL STYLES WITH FRONTAL LOBE GRAY MATTER VOLUMES

Sanda Dolcos[1], Yifan Hu[1], Alex Iordan[1], Sarah Whoo[1], Florin Dolcos[1]; [1]University of Illinois at Urbana-Champaign — Affective and motivational styles influence people's expectations about the world and the most adaptive ways to interact with it. For instance, positive affect (PA) leads to pleasurable, and Negative Affect (NA) to unpleasurable engagement with the environment. Related to this, a behavioral activation/approach system (BAS) has been associated with increased sensitivity to rewarding and appetitive stimuli, and a behavioural inhibition/avoidance system (BIS) with guiding behavior away from nonrewarding and aversive stimuli. At a higher level of integration, Promotion regulatory focus (RF) increases sensitivity to rewards, and Prevention focus increases sensitivity to losses. Functional neuroimaging studies suggest a hemispheric lateralization of emotional valence and approach /avoidance behaviors and goals in the frontal cortex, with the left side being linked to positive, and the right side to negative valence. An open question is whether similar relationships also exist at structural level. We investigated this issue in 45 healthy adults who completed the BIS/BAS, RF, and the Positive and Negative Affect Schedule questionnaires, and underwent structural MRI scanning. Analyses focused on frontal regions volume extracted using automated parcellation. The results showed positive correlations between PA and left frontal areas and between BAS-Drive and bilateral frontal areas. Negative correlations were found between BIS and right frontal and left fronto-polar areas. Preliminary analyses also identified sex-related differences in the orbitofrontal cortex. Overall, these findings partially fit the hemispheric asymmetry identified by functional neuroimaging studies, and provide novel evidence linking larger cortical volumes in dissociable frontal area with approach, and smaller volumes with avoidance behavioral tendencies.

B25

NEURAL MECHANISMS OF READING FACIAL EMOTIONS IN YOUNG AND OLDER ADULTS

Natalie Ebner[1], Marcia Johnson[2], Håkan Fischer[3]; [1]University of Florida, [2]Yale University, [3]Stockholm University — The ability to read and appropriately respond to emotions in others is central for successful social interaction. Young and older adults are better at identifying positive than negative facial expressions and also expressions of young rather than older faces. Little, however, is known about the neural processes associated with reading different emotions, particularly in faces of different ages, in samples of young and older adults. During fMRI, young and older participants identified expressions in happy, neutral, and angry young and older faces. The results suggest a functional dissociation of ventromedial prefrontal cortex (vmPFC) and dorsomedial prefrontal cortex (dmPFC) in reading facial emotions that is largely comparable in young and older adults: Both age groups showed greater vmPFC activity to happy compared to angry or neutral faces, which was positively correlated with expression identification for happy compared to angry faces. In contrast, both age groups showed greater activity in dmPFC to neutral or angry than happy faces which was negatively correlated with expression identification for neutral compared to happy faces. A similar region of dmPFC showed greater activity for older than young faces, but no brain-behavior correlations. Greater vmPFC activity in the present study may reflect greater affective processing involved in reading happy compared to neutral or angry faces. Greater dmPFC activity may reflect more cognitive control involved in decoding and/or regulating negative emotions associated with neutral or angry than happy, and older than young, faces.

B26

DIFFERENTIAL NEURAL PROCESSING OF NEGATIVE STIMULI IN INDIVIDUALS EXPERIENCING FACILITATION VS. INTERFERENCE IN AN EMOTIONAL STROOP TASK

Lesa K. Ellis[1], Jaiya R. Choles[1], Emilee R. Naylor[1,2], Danielle J. Green[1], Russell E. Costa[1], Jennifer Simonds[1]; [1]Westminster College, [2]University of Oregon — Emotional Stroop tasks are frequently used to examine interference effects resulting from presentation of negative stimuli, as measured via longer response times (RTs) compared to those for neutral stimuli. However, some studies have reported that individuals may display shorter RTs to emotional versus neutral stimuli, suggesting a facilitation effect of emotion in those individuals. Electrophysiological studies of Emotional Stroop tasks have reported enhanced early posterior negativity (EPN) effects for emotional versus neutral stimuli, indicative of automatic processing of emotional stimuli, while also reporting larger late positive potential (LPP) for negative versus neutral stimuli, suggesting sustained attentional processing of negative stimuli. We compared event-related potentials (ERPs) in individuals showing facilitation versus those showing interference from emotional stimuli. Seventy-eight individuals completed an Emotional and Counting Stroop task and conditional RTs were used to divide participants into two groups: one that exhibited facilitation effects (n = 42) and one that exhibited interference effects (n = 36) to negative emotional stimuli. ERP analyses revealed similar heightened EPN effects associated with emotional stimuli (both negative and positive) for both groups. However, a significant emotion by group interaction was also observed for LPP in both centro-parietal and right anterior electrode sites, such that individuals experiencing interference effects to negative stimuli showed greater LPPs for negative words compared to neutral words, while individuals experiencing facilitation effects did not. Results suggest that while all participants experienced a degree of automatic processing of emotional stimuli, only those experiencing interference effects exhibited sustained processing of negative stimuli.

B27

ORAL CONTRACEPTIVE PILLS ALTER RESTING STATE FUNCTIONAL CONNECTIVITY

Nicole Ertman[1], Lisa Kilpatrick[2], Azaadeh Goharzad[3], Larry Cahill[1]; [1]University of California, Irvine, [2]University of California, Los Angeles, [3]California State University, Fullerton — At rest, brain activity can be characterized not by an absence of organized activity but instead by spatially and temporally correlated patterns of activity. In this experiment, we investigated whether and to what extent resting state functional connectivity is modulated by sex hormones in women. Sex hormones have been shown to have important effects on task-related activity, but few studies have investigated the extent to which they can influence the behavior of functional networks at rest. These hormones are dramatically altered by the use of hormonal contraception, which is used by approximately 100 million women worldwide. However, potential cognitive side effects of hormonal contraception have been given little attention. Here, we collected resting state data for naturally-cycling women and women using combined oral contraceptive pills (COCPs) and evaluated the differences in resting state activity between these two groups using Independent Components Analysis. We found that in an executive control network, the anterior cingulate cortex (ACC) in naturally-cycling women showed higher functional connectivity to the network as a whole when compared to the ACC in women using COCPs. Because the ACC is important for some forms of higher-order cognitive and emotional processing, changes in the relationship of this structure to the functional networks with which it interacts may have important consequences for attention, affect, emotion regulation, and a number of other processes the anterior cingulate cortex has been associated with.

B28

EYE TRACKING AND MEMORY FOR THREAT IN REPRESSIVE COPING

Lauren L. Alston[1], Andrea T. Shafer[1], Anthony Singhal[1], Esther Fujiwara[1]; [1]University of Alberta — People with a repressive coping style under-report physiological stress and display early vigilance followed by attentional avoidance of threat. Repressors also show reduced memory for threat. Unclear is how their attention patterns relate to later memory. To test how early threat vigilance changes into avoidance and if both translate into later memory, repressive (REP) or non-repressive (NREP) participants were monitored with eye-tracking during incidental encoding of neutral and negative pictures. To provide opportunity for attentional avoidance, pictures were either presented alone or alongside scrambled pictures. Memory was tested thereafter. Electrodermal responses to an acute stress induction were acquired before the experiment, along with subjective reports, to validate questionnaire-based coping styles. REP had similar skin conductance responses to stress as NREP, but underreported negative emotions (anger, frustration, helplessness). Overall viewing durations were similar across groups. Negative images were fixated earlier and longer than neutral pictures and images presented alone were fixated earlier and longer than picture presented together with scrambled pictures. In REPs, this vigilance was strongest, but only emerged with solitary pictures. When presented with distractors, REPs were faster to look away than NREPs. That is, we found vigilance as well as avoidance for threat in REP. While all participants showed an advantage in memory for negative over neutral pictures, this effect was attenuated in REP. Viewing time predicted later memory for negative pictures in NREPs but not REPs. Reductions in negative memories in REP are likely not mediated by either vigilance or avoidance in visual attention, but retrieval-based strategies.

B29

DECODING THE ANTICIPATION OF MONETARY AWARDS: A MULTIVARIATE PATTERN ANALYSIS

Daniel F. Arteaga[1], Gregory R. Samanez-Larkin[2], Joshua W. Buckholtz[2,3], Michael T. Treadway[2], David H. Zald[2]; [1]School of Medicine, Vanderbilt University,, [2]Vanderbilt University, [3]Vanderbilt Brain Institute, Vanderbilt University — The anticipation of potential rewards or losses modulates broad neural networks involved in motivation and task execution. To date, distinctions between the neural representations underlying the motivational effects of potential monetary rewards and losses have yet to be clearly elucidated using conventional univariate analyses of fMRI data. Here, we investigated the ability of multivariate pattern analysis (MVPA) to discriminate between the anticipation (preparation to respond for) and feedback of monetary gains and losses. Data was obtained from twenty-five healthy subjects who performed a monetary incentive delay (MID) task while undergoing fMRI. Whole-brain multivariate analyses were initially performed to establish the predictive capabilities of the multivariate classifier. Multivariate searchlight maps were then computed and compared with a parallel set of GLM-based univariate analyses. Our results reveal that MVPA is capable of reliably decoding between an anticipated monetary gain and loss (accuracy=56.3%, p=3.33x10-4). While there was overlap in significant voxel clusters detected by both univariate and multivariate methods, the MVPA results were much more robust. Notably, MVPA revealed the involvement of medial frontal and occipital regions that were substantially more active under conditions of large potential

rewards than large potential losses. By contrast, ventral striatal areas that are robustly modulated when there are incentives showed little or no discrimination of the valence of monetary incentives. These data indicate that specific cortical areas are differentially recruited in valence-dependent reward processing. Our findings further demonstrate the potential utility of a multivariate approach in affective neuroscience.

B30

PSYCHOLOGICAL AND NEURAL MECHANISMS UNDERLYING COMPASSIONATE THOUGHT AND BEHAVIOR

Yoni Ashar[1], Jessica Andrews-Hanna[1], Jenifer Sills[1], Tal Yarkoni[1], Sona Dimidjian[1], Tor Wager[1]; [1]University of Colorado, Boulder — Recent research has advanced our scientific understanding of compassionate thought and emotion. However, the psychological factors and brain pathways underlying naturalistic compassion-eliciting situations, as well as compassionate action, have not been well characterized. To investigate these phenomena, we conducted two studies, one behavioral and one fMRI. In both studies, participants read or heard biographies depicting the suffering of others, rated the biographies across a number of dimensions, and chose whether to make a charitable donation from their experimental earnings. Study 1 (n=270) validated a theoretical model predicting compassionate action, operationalized as charitable donation. We dissected the predictors of charitable donation into several affective components, including a) 'warm,' empathic care and b) personal distress, and several social cognitive components, including attributions of c) responsibility and d) perceived instrumental value of the donation to the recipient, and e) perceived similarity to the recipient. All of these factors explained unique variance in donation amounts, except for perceived similarity, the effects of which were fully explained by the other factors. In Study 2 (n=33), we mapped these factors onto their neural substrates using fMRI. Consistent with its role in valuation, increased activity in the ventromedial prefrontal cortex (vmPFC) was predictive of both empathic care and personal distress. However, activity in secondary somatosensory area (S2) increased with personal distress, but decreased with empathic care. These results suggest that feelings of empathic care and personal distress at others' suffering are distinct at both the behavioral and neural levels, and both make important contributions to compassionate behavior.

B31

ENDOGENOUS-DRIVEN AFFECTIVE PROCESSING: A META-ANALYSIS

Shir Atzil[1], Ajay Satpute[1], Tor Wager[2], Lisa Feldman Barrett[1]; [1]Northeastern University, [2]University of Colorado at Boulder — Affective experiences are driven by a combination of both exogenous and endogenous inputs. Research in affective neuroscience has focused a great deal on exogenously-driven responses. Much less is known about the neural regions associated with endogenously-driven affective processing. Progress in understanding the neural mechanisms for how endogenously-driven affective processes occur has been stilted in part because a clear theoretical perspective and related pattern of findings has yet to be determined. We took a data-driven approach and asked which regions are frequently associated with endogenously driven affective responses. Specifically, we surveyed the neuroimaging literature for studies that induced affect using imagery or autobiographical memories. We then pooled across 53 contrasts and a performed a meta-analysis using the Multi-Kernel Density Analysis method to examine which regions show consistent activation to endogenously driven affective responses. The results pointed to several cortical regions, including the dorso-medial prefrontal cortex, inferior frontal gyrus, subgenual anterior cingulate cortex, temporal poles, and anterior insula, and to several subcortical regions including the amygdala, thalamus, striatum, and midbrain. While most of these studies have focused their interests on the amygdala and anterior insula, these results reveal that the endogenously-driven affective processes also relies on certain mentalizing regions, more so than endogenously-driven non-affective imagery and memory-recall processes. We interpret these findings from a constructivist perspective, which suggests that these regions are key nodes in a set of intrinsic brain networks that make up the functional architecture of the human brain.

B32

NEURAL CORRELATES OF EMOTION CATEGORIZATION

Erin L. Beatty[1], Oshin Vartanian[1], Alexandra Muller-Gass[1], David R. Mandel[1], Stergios Stergiopoulos[1]; [1]Defence R&D Canada - Toronto — Categorization is fundamental to cognition, and much evidence suggests that categorizing emotional stimuli holds a privileged position in human information processing. Several different theoretical accounts have been proposed for explaining the psychological and neural processes whereby emotional stimuli are categorized. According to one influential theory the subjective emotional feeling elicited by a stimulus plays a causal role in its categorization. In other words, the emotional response evoked by a stimulus in the observer serves as a cue for its emotional categorization. If this were true, then the act of categorization should be accompanied by the activation of neural systems involved in the subjective experience of emotion. Alternatively, the act of categorization should be accompanied exclusively by activation in bilateral prefrontal regions involved in categorizing non-emotional stimuli. We tested these two competing hypotheses by scanning 12 subjects using functional magnetic resonance imaging. The experiment was administered in three runs, involving 270 trials. On each trial a picture from the International Affective Picture System (IAPS) belonging to one of three emotional categories (positive, negative, neutral) was presented, after which a second IAPS picture appeared. Upon presentation of the second picture the participants' task was to categorize the second picture as belonging to the same or a different emotional category than the first picture. The results demonstrated that compared to rest, categorization activated a left-lateralized network including the lateral orbitofrontal cortex and medial temporal lobe. These results suggest that categorizing emotional stimuli activates neural structures known to underlie the subjective experience of emotion.

B33

NEURAL CORRELATES OF ANXIETY VULNERABILITY: CEREBELLAR REACTIVITY TO NOVEL FACES AND SCENES AND AT REST.

Meghan D. Caulfield[1,2], J. Devin McAuley[1,3], David C. Zhu[3,4], Richard J. Servatius[1,2,5]; [1]Stress & Motivated Behavior Institute, [2]Graduate School of Biomedical Sciences, University of Medicine & Dentistry of New Jersey, [3]Department of Psychology, Michigan State University, [4]Department of Radiology, Michigan State University, [5]Department of Veterans Affairs, NJHCS, East Orange, New Jersey — Behavioral inhibition is a risk factor for the development of anxiety disorders typified by extreme withdrawal when facing novel social and nonsocial challenges. Previous research has revealed that individuals scoring high on measures of anxiety vulnerability show faster acquisition of cerebellar-dependent learning tasks, such as eyeblink classical conditioning. Here, we assess individual differences of cerebellar reactivity to the presentation of familiar and novel social and nonsocial stimuli using functional magnetic resonance imaging (fMRI). Twenty-six college students (M = 20.7 years of age, 27% male) were given a battery of surveys that assessed increased risk for anxiety, including the Adult & Retrospective Measures of Behavioral Inhibition, the Concurrent and Retrospective Self Report of Inhibition and the State Trait Anxiety Inventory. Participants were familiarized to 96 faces and scenes on day one and then underwent fMRI on day two while making 'old' vs. 'new' recognition judgments about familiarized and novel faces and scenes. Between-group voxel-based contrasts between high risk and low risk individuals examining differences in BOLD response to novel and familiar faces revealed three significant clusters in the cerebellum: left cerebellar lobule VI/Crus I, left lobule IV/V, and right lobule VIII/IX. Furthermore, significant differences in BOLD response were observed in the novel compared to familiar scenes in the cerebellum right lobule VII/Crus II, indicating a general effect of novelty beyond social stimuli. In order to assess individual differences of cerebellar functional connectivity participants also underwent a 7-minute resting state scan which will be evaluated in future analyses.

B34

AMYGDALA RESPONSES TO IN-GROUP AND OUT-GROUP MASKED FACIAL EXPRESSIONS IN NEWLY ARRIVED US CHINESE POPULATIONS

Pin-Hao Chen[1], James Taylor[1], Todd Heatherton[1], Paul Whalen[1]; [1]Dartmouth College — Previous studies have found an in-group advantage effect for recognition of emotional expressions, and this effect is inversely correlated with the exposure length to the out-group culture (Elf-

enbein & Ambady, 2003). Prior fMRI research also indicates that amygdala activity was greater for in-group than for out-group fear expressions, but only for explicit presentations of fear expressions (Chiao et al., 2008). An open question is whether this same-race advantage will be found using an implicit masking paradigm. The current study used a backward emotional masking paradigm to explore whether amygdala activities were greater for in-group than for our-group fear expressions in new arrivals to the US. Twenty-three newly arrived native Chinese students were recruited, and during three functional runs, were asked to passively view block-presented masked same (Chinese) or different race (Caucasian) faces with one of three emotional expressions (fear, surprised, or happy). Signal beta values of the six conditions were extracted from an anatomical amygdala ROI for further analysis. Results indicated that race main effects were significant in right amygdala, and marginally significant in left amygdala. Post-hoc analysis revealed that bilateral amygdala only showed significantly greater responses for Chinese than for Caucasian masked facial expressions of happiness, but not for the masked fear and surprised facial expressions. One possible explanation for the difference between this study and the Chiao et al.'s study is that the prior study examined explicit emotional recognition whereas this study used implicit measures.

B35

PSYCHOPATHIC TRAITS MODULATE ACTIVITY IN EMOTION-RELATED NEURAL REGIONS DURING AVERSIVE CONDITIONING

Mona Sobhani[1,2], Michael E. Dawson[3], Anne M. Schell[4], Laura Baker[3], Lisa Aziz-Zadeh[2,5]; [1]Neuroscience Graduate Program, University of Southern California, [2]Brain and Creativity Institute, University of Southern California, [3]Department of Psychology, University of Southern California, [4]Occidental College, [5]Department of Occupational Therapy, University of Southern California — Psychopathy is a personality disorder that is comprised of an array of personality traits, such as callousness, lack of remorse, and impulsiveness. Past studies have shown that criminals with psychopathy display reduced fear conditioning to aversive stimuli (Hare, 1970; Hare & Quinn, 1971). Neuroimaging studies of fear conditioning in criminals with psychopathy suggest that the neural circuits involved in aversive conditioning display significantly reduced BOLD response patterns when compared to healthy controls (Birbaumer, 2005). However, whether psychopathic traits are related to the neural correlates of aversive conditioning in a non-incarcerated sample have not yet been examined. Here, we investigated whether psychopathic traits modulate functional activity in the amygdala and VMPFC during an aversive conditioning task in a community sample. Preliminary findings suggest that there is a negative correlation between psychopathic traits and activity in emotion-related neural regions. The results support previous findings of a negative relationship between psychopathic traits and altered BOLD activity in emotion-related regions. This further supports the notion of altered neural functioning in individuals with higher levels of psychopathic traits.

B36

WHAT OTHERS THINK OF ME: SELF-REFERENTIAL PROCESSING IN THE POSTERIOR CINGULATE CORTEX

Jae-Yoon Lee[1], Seok-Hwan Ahn[1], Do-Joon Yi[1]; [1]Yonsei University, Seoul, Republic of Korea — It is well established that self-referential processing employs cortical midline structures (CMS) including medial prefrontal cortex (mPFC) and posterior cingulate cortex (PCC). It remains to be seen what functional roles each region in CMS plays in the representation of the self. Previous research demonstrated that PCC is selectively activated when participants think of their duties and obligations - others' expectations on them (Johnson et al., 2006). Accordingly, we hypothesized that PCC plays a pivotal role in integrating others' viewpoints into one's self-concept. To test this hypothesis, we conducted a functional magnetic resonance imaging (fMRI) experiment with a modified version of self-reference paradigm. In each trial, participants viewed an 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, left temporoparietal junction (TPJ), and dorsomedial prefrontal cortex (dmPFC). Specifically, these regions showed a greater activation when participants thought of themselves from their friends' viewpoint (relative to their own viewpoint) but showed little or no difference between the two viewpoint conditions when participants thought of the president. More interestingly, in bilateral PCC, this pattern was strongly and positively correlated with individuals' collectivism bias. Overall, our findings imply that the PCC combines social perspective with self-concept, reflecting individual sensitivity to others' points of view.

B37

NEURAL OSCILLATIONS ASSOCIATED WITH SELF-FACE PHYSICAL PROPERTY AND SELF-FACE IDENTITY

Yina MA[1,2], Yan Mu[2], Shihui Han[2]; [1]Department of Psychological and Brain Sciences, Dartmouth College, [2]Department of Psychology, Peking University — Self-awareness can be induced by looking at one's own face in a mirror. Functional MRI and event-related potential studies have shown evidence for the involvement of blood oxygen level dependent signals and phase-locked neural activity in self-face recognition. The present study investigated whether non-phase-locked neural oscillations also engage in self-awareness during face recognition. Specifically, we assessed whether neural oscillations of different frequencies are respectively involved in the processing of self-face physical property and self-face identity. Subjects were presented with face stimuli drawn from morph continua between self-face (Morph 100%) and a gender-matched friend's face (Morph 0%) and had to make "self" or "friend" judgment on each stimulus. Wavelet analysis was used to calculate non-phase-locked time-frequency power associated with (1) self-face specific physical property by contrasting Morph 100% and Morph 60% that were different in self-face physical properties but both induced self-identity and (2) self-face identity by contrasting Morphs 50% that were recognized as self vs. friend on different trials. We showed that low-frequency band (14-21 Hz) activity over the right central/parietal electrodes at 700-1000 ms were involved in the processing of self-face physical properties. In contrast, self-face identity was associated with multi-frequency band (14-80 Hz) modulations at 100-300 ms over the frontal/central/parietal areas. Moreover, the early gamma band (30-80 Hz) activity plays a key role in generating self-face identity, since it could predict how often subjects recognized Morph 50% as the self. Our results revealed specific neural oscillations that dissociated self-face specific physical properties and consciously perceived self-identity.

B38

EXAMINING SOCIAL AND PHYSICAL SELF-KNOWLEDGE WITH FMRI IN ANOREXIA NERVOSA AND BULIMIA NERVOSA.

Carrie McAdams[1], Daniel Krawczyk[1,2]; [1]UT Southwestern Medical Center, [2]UT Dallas — Eating disorders include bulimia nervosa (BN), an illness characterized by both binging and purging eating behaviors and normal body weight, and anorexia nervosa (AN), an illness characterized by restrictive eating behaviors and low body weight. For both illnesses, self-evaluation that is unduly dependent upon body shape and weight is part of the diagnostic criteria. Understanding differences in the activation of neural regions associated with self-evaluation could help identify pathophysiological changes related to eating disorders. We examined self-knowledge using two fMRI appraisal tasks in 52 adult women (18 AN, 16 BN, and 18 control (CN)). The Social Appraisal task asked subjects to evaluate the validity of personalized statements with social adjectives (ex. Social-Self statement, "I believe I am kind"). The Physical Appraisal task presented similar statements with physical phrases (ex. Physical-Friend statement, "I believe my friend's hair is frizzy"). Recently, using whole-brain voxel-wide comparisons of the AN and CN groups, we found regions in the precuneus (PreC), dorsal anterior cingulate (dACC), and a ventral portion of the dorsal anterior cingulate (cc-dACC) that differed. Here, we report the neural activations in these regions in the BN subjects. In all regions, the BN percent signal change fell between the activation levels observed in the CN and AN groups. Statistically, the BN responses were not significantly different from the AN responses in any regions but were different from the CN responses in the PreC and dACC. These data suggest that neural activations related to self-evaluation are similar in AN and BN.

B39

NEURAL OSCILLATIONS RELATED TO SELF-FACE PROCESSING: AN EEG STUDY

Yan Mu[1], Shihui Han[1]; [1]Peking University — Self face is vitally important social information for our human being. Self-face recognition reflects higher-order self-awareness. Previous neuroimaging studies using functional magnetic resonance imaging (fMRI) and event-related

potentials (ERP) technology have found the dynamic neural mechanism related to self-face process. However, there has been little research to examine whether non-phase locked neural activities are involved in differentiating self- from other-face processing. To address this issue, we recorded fifteen subjects' 62-channel electroencephalograph (EEG) signal when they were performing implicit and explicit self-face tasks respectively. In the implicit task, subjects needed to judge orientations of self-, friend- or scrambled-face. And in the explicit task, they were asked to judge whether a face stimuli is a self- or friend- face. The results showed that explicit self-face recognition evoked late theta desynchronization in the parieto-occipital region, late gamma desynchronization in the mid-central region. Whereas the implicit self-face task induced low-frequency delta, theta, and alpha bands synchronous activities. Our findings provide evidence for non-phase locked neural activities can differentiate between self- and friend-face in attended and unattended conditions. Consistent low-frequency synchronous activities are involved in automatic self-recognition process, while more late theta and gamma band desynchronous activities for self-face than friend-face might be an index of increased self-awareness during explicit self-face identification.

B40

BEING RIGHT IS REWARDING: RECEIVING CORRECT FEEDBACK ENGAGES THE NUCLEUS ACCUMBENS

Katherine Powers[1], William M Kelley[1], Todd F Heatherton[1]; [1]Dartmouth College — Trivia contests are popular, possibly in part because people enjoy being right. Here, we investigated the intrinsic motivation underlying this desire. During fMRI scanning, participants (N = 33) answered multiple-choice questions relating to local college traditions and student life (e.g., "What is the best part of homecoming weekend?"). Questions were created such that no correct answer actually existed; that is, every answer choice was equally plausible. After each question, participants were presented with feedback indicating whether their responses were correct or incorrect on a trial-by-trial basis. Although participants were told that the feedback reflected their knowledge, feedback was actually pre-programmed prior to the experimental sessions, such that participants received correct feedback on half of the trials, and incorrect feedback on the rest. After scanning, participants were given a surprise memory test examining memory for the different types of feedback. Receiving correct feedback recruited the nucleus accumbens (NAcc), a central component of the brain's reward circuitry. NAcc activity also predicted performance on the post-scan memory test. Taken together, our results demonstrate that humans find being right intrinsically rewarding, and as a result, preferentially encode these events. Moreover, being right in this experimental task implies knowledge of group norms, which may confer social benefits. Thus, our results suggest that being right is rewarding, especially when being right is consistent with being a good group member.

B41

THE NEURAL MECHANISM FOR EMBODIED SELF-REFLECTION

Zhenhao Shi[1], Shihui Han[1]; [1]Peking University — Recent research has shown that self-reflection on visual and auditory stimuli recruited distinct neural activities (Ma & Han, 2011), and making gestures modulated hormone level and altered one's self-evaluation (Carney et al., 2010; Schubert & Koole, 2009). These findings imply the embodied nature of self-reflection. The present study investigated the neural mechanism for embodied self-reflection by examining the effect of sensorimotor experience on the neurocognitive processing of self-reflection. Using functional magnetic resonance imaging (fMRI), we scanned adults while they made judgments on whether trait words described either self or a celebrity (SELF/OTHER). Trait judgments were performed while participants either held tight or relaxed the left hand (FIST/REST). We found that SELF relative to OTHER activated the medial prefrontal cortex (MPFC) in both FIST and REST conditions. However, the supplemental motor area (SMA) and the left dorsolateral prefrontal cortex (lDLPFC) were activated only in the FIST condition. Moreover, SMA and lDLPFC activities were associated with subjective feelings of embodiment. Granger-causal connectivity analysis showed that the MPFC received influence from both SMA and lDLPFC, and these influences were correlated with participants' dispositional bodily consciousness. Our findings suggest that the embodiment of self-reflection engages the SMA and lDLPFC, which may modulate self-reflection processes in the MPFC. Reference: [1] Carney DR, Cuddy AJC, Yap AJ. 2010. Psychol Sci 21:1363–8 [2] Ma Y, Han S. 2011. Brain 134:235–46 [3] Schubert TW, Koole SL. 2009. J Exp Soc Psychol 45:828–34

B42

KEEPING MINE CLOSE: THE EFFECTS OF SPACE ON THE SELF-OWNERSHIP ADVANTAGE

Grace Truong[1], Craig S. Chapman[2], James T. Enns[1], Todd C. Handy[1]; [1]University of British Columbia, [2]University of Alberta — Objects that are arbitrarily identified as belonging to you (self-owned) are preferentially attended and remembered better (Cunningham et al., 2008; Turk et al., 2011). We questioned whether this ownership effect would interact with the spatial position and the movement required to classify an object as "Mine" or "Other", as has been shown for motor responses to other affective stimuli (Eder & Rothermund, 2008). On each trial, participants (n=24) acted directly with pictures of objects on a touch interactive table. The border color cued them whether the object was "Mine" or "Other" and participants had to drag the object either towards themselves (close) or away from themselves (far) into specified areas on the tabletop. We predicted the self-ownership advantage would be largest for objects identified as "Mine" and moved close to the participant. Confirming this prediction, in a subsequent surprise recognition memory task we show a significant space-by-ownership interaction (Cohen's d = .397). Objects in the Mine-close group were recalled with greater accuracy than those in the Mine-far group as well as all objects in the Other category, regardless of space. Importantly, this reveals that this is neither specifically an ownership advantage, nor specifically a space advantage, but rather an advantage for objects that participants identified as theirs and moved close to them. Our novel use of motion-tracked reaching during the ownership sorting and recognition memory tasks also allows us to show kinematic evidence (i.e. reach trajectories and timing) consistent with the critical memory advantage for self-owned objects moved towards participants.

B43

HIGH QUALITY SLEEP IS ASSOCIATED WITH PREPARATION AND TASK-SET ADOPTION IN YOUNG AND OLDER ADULTS

Kristine Wilckens[1], Kirk I. Erickson[1], Mark E. Wheeler[1]; [1]University of Pittsburgh — Sleep affects cognitive function, but whether it does so by influencing preparatory functions remains unknown. Objective sleep efficiency was measured through accelerometery for one week in young and older adults. Using a task-switching paradigm, which manipulated preparation time, we found that, independent of age, higher sleep efficiency was associated with faster response times during a switching block compared to a single task block, suggesting specificity of sleep efficiency to executive control. Also independent of age, higher sleep efficiency was associated with a robust preparation effect on task accuracy such that individuals with higher sleep efficiency were more likely to take advantage of the preparatory interval when switching task sets than their less efficient counterparts. This effect remained significant after controlling for inhibition and working memory abilities. These results suggest that switching and preparation abilities are enhanced in individuals with high sleep quality and that this relationship is independent of age.

B44

NEURAL MECHANISMS OF BRAIN PLASTICITY WITH COMPLEX COGNITIVE TRAINING IN HEALTHY SENIORS

Sandra Chapman[1], Sina Aslan[2], Jeffery Spence[3], John Hart[1], Nyaz Didehbani[1], Molly Keebler[1], Hanzhang Lu[3]; [1]Center for BrainHealth®, The University of Texas at Dallas, Dallas, TX 75235, United States, [2]Advance MRI, LLC, Frisco, TX 75034, United States, [3]University of Texas Southwestern Medical Center, Dallas, TX 75390, United States — Evidence suggests that complex mental activity induces cognitive improvements as well as changes in brain function and structure in animals and young healthy adults. It is not clear to what extent the aging brain is able to exhibit such plasticity. This study builds on previous evidence of generalized cognitive gains after short-term complex mental training in healthy seniors. Using three MRI-based measurements, i.e. arterial spin labeling (ASL) MRI, functional connectivity (fcMRI), and diffusion tensor imaging (DTI), we examined training-induced brain changes at three time points pre-training (T1), mid-training (T2, 6 weeks), and end of training (T3, 12 weeks) in a randomized sample (n=37) who received strategy-based cognitive training versus a control group. We found significant training-re-

lated brain state changes at rest specifically, (1) increases in global CBF with specific group differences in the Default Mode Network (DMN) and the Central Executive Network (CEN), (2) greater connectivity in the these same networks: DMN and CEN, and (3) increased white matter integrity in the left uncinate fasciculus demonstrated by linear increase in fractional anisotropy. We also found improvements in cognition on trained and untrained measures as well as significant neural correlates of the cognitive gains. These convergent results across brain networks provide clear evidence that mechanisms of neural plasticity (i.e., resting blood flow, network connectivity at rest and structural connectivity) can be harnessed with strategy-based cognitive training in cognitively healthy seniors.

B45

INFORMATION PROVIDED BY FOREGONE REWARDS HINDERS DECISION-MAKING ABILITY IN OLDER ADULTS Jessica Cooper[1], Darrell Worthy[2], W. Todd Maddox[1]; [1]The University of Texas at Austin, [2]Texas A&M University — Despite neural declines associated with aging, our lab (Worthy et al., 2011) found an age-related advantage in a decision-making task for which the optimal strategy involves forgoing larger immediate rewards to maximize delayed reward. This advantage was attributed to compensatory scaffolding whereby older adults recruit additional frontal regions to compensate for age-related neural decline (Park & Reuter-Lorentz, 2009). We hypothesized that knowledge of foregone rewards (i.e. information about the non-chosen reward on each trial) would increase attention to immediate outcomes over long-term gains, causing older adults to reach their "crunch" point which will attenuate performance (Reuter-Lorenz & Cappell, 2008). To test this hypothesis older and younger adults performed the Worthy et al. (control) task where only the reward from the chosen option was shown or where rewards were given from the chosen and unchosen (foregone) option on each trial. Supporting our predictions, we replicated the age-related advantage in the control task and found that foregone rewards led to an age-related performance decline. We applied a Softmax reinforcement-learning model, a heuristic-based win-stay lose-shift (WSLS) model that assesses participants' propensity to "stay" or "shift" after experiencing a "win" or "loss" on the current reward relative to the previous trial, and a similar WSLS model that compares the current reward to the foregone reward. Model-based analyses indicate that older and younger adults were less likely to use heuristic-based strategies when foregone rewards were present and that the deficit for OA was due to greater attention to the foregone reward than younger adults.

B46

ERPS REVEAL LIFE-SPAN DIFFERENCES IN REACTIVE COGNITIVE CONTROL AND CONFLICT DETECTION Daniela Czernochowski[1], Julia Saße[1], André Haese[1], Steffen Herff[1]; [1]Heinrich-Heine-University Düsseldorf — Current theories propose that detecting response conflict triggers the up-regulation of cognitive control. Previous research (Czernochowski et al., 2010) has demonstrated that older adults experience increased response conflict, in particular as task difficulty increases, but are able to maintain high accuracy by relying on reactive control. By contrast, children are typically error-prone despite long reaction times, which could be due to a deficit in conflict detection or up-regulation of control or both. Here, children in grade two (7-8 years) and grade five (10-11) as well as young (20-25) and older (65-74) adults were instructed to emphasize either accuracy or speed in separate blocks during a cued task-switch paradigm. Event-related potentials (ERPs) were recorded to determine potential age differences in the neural correlate for reactive control (pre-response negativity, PRN) and post-response conflict detection (medio-frontal negativity, MFN). Behavioral data indicate adjustments in response criteria in terms of speed and accuracy in young adults, and small response speed adjustments for children and older adults. Starting 200 ms pre-response, ERPs revealed a (left-) frontal PRN for adult participants only. In young adults, it was observed selectively under accuracy instructions, but across task-conditions for older adults. While both groups of children appeared unable to up-regulate cognitive control, post-response MFN amplitudes revealed a deficit in detecting conflict for young children only, suggesting that older children are able to detect response conflict, but not to efficiently counteract it by recruiting additional control processes. By contrast, both conflict and reactive control were elevated for older adults

B47

BILINGUALISM EFFECTS ON LEXICAL AMBIGUITY RESOLUTION: BEHAVIOURAL AND N400 RESPONSES IN HEALTHY OLDER ADULTS. Will Deller[1,2], Shanna Kousaie[2], Vanessa Taler[1,2]; [1]University of Ottawa, [2]Bruyère Research Institute — It has been found that inhibitory control declines with age, resulting in language comprehension changes. However, bilingualism has been associated with spared cognitive function, including inhibition, which is important for language comprehension, particularly for lexical ambiguity processing (e.g., homonyms, words with more than one meaning, e.g., pen, meaning "writing implement" or "enclosure"). The present study examines the effects of bilingualism on lexical ambiguity processing in a sample of healthy older monolingual (n=13) and bilingual (n=14) adults. Participants were presented with sentences biasing the meaning of a sentence terminal homonym towards one of its meanings (e.g., She signed the letter in pen.) and were required to judge whether a target word was related to the homonym. Target words could be related to the contextually appropriate (e.g., pencil) or inappropriate (e.g., cage) meaning, or unrelated to either meaning. Both behavioural and electrophysiological (N400) data were collected. It was expected that language group differences in inhibitory control would result in different patterns of meaning activation as measured by reaction times and N400 amplitude in a semantic priming paradigm. Preliminary analysis of the electrophysiological data revealed an Appropriateness x Language Group interaction ($F(2,50)=4.9$, $p=.01$), showing that bilinguals demonstrated selective activation of the appropriate meaning of the homonym, whereas monolinguals did not. These findings suggest language group differences in lexical ambiguity processing in older adults. Future research will examine this question in patients with cognitive impairment.

B48

URIC ACID AND NEUROCOGNITIVE FUNCTION IN SURVIVORS OF CHILDHOOD ACUTE LYMPHOBLASTIC LEUKEMIA Michelle N. Edelmann[1], Tara M. Brinkman[1], Daniel A. Mulrooney[1], Cara I. Kimberg[1], Melissa M. Hudson[1], Kevin R. Krull[1]; [1]St. Jude Children's Research Hospital — Long-term survivors of childhood acute lymphoblastic leukemia (ALL) are at risk for numerous late effects, including cardiac, renal, and neurocognitive morbidity, yet the interaction between these is unclear. The aim of this study was to examine associations between biomarkers of renal and cardiovascular function with neurocognitive performance. Neurocognitive function was evaluated in 84 adolescent survivors of ALL (mean age of diagnosis=6.5 years, age at evaluation=14.3 years) treated with chemotherapy only. Fasting serum measurements of uric acid, creatinine, and glucose, as well as resting blood pressure, and body mass index (BMI) were assessed within 48 hours of neurocognitive testing. For each biomarker, survivors with values within the highest quartile were designated as "at risk" and were compared to survivors in the lower quartiles. Neurocognitive function was examined between groups for each biomarker. Compared to national norms, survivors demonstrated lower performance on measures of visuospatial skills, processing speed, attention, and executive function. Survivors in the highest uric acid quartile performed lower on measures of executive function (Complex Figure, $p=0.03$; Letter Fluency, $p=0.03$) and focused attention (Trail Making, $p=0.05$) compared to those in the lower quartiles. Gender and age did not impact associations between biomarkers and neurocognitive measures. There were no significant associations between neurocognitive performance and creatinine, blood pressure, BMI, or glucose. Uric acid may be useful in identifying survivors of childhood ALL at higher risk for neurocognitive problems. Further examination of interactions between this marker of vascular and renal health and adverse late neurocognitive effects is warranted.

B49

NEURAL CORRELATES OF RESPONSE CONFLICT AND EMOTIONAL REGULATION IN MIDDLE CHILDHOOD Sarah Elke[1], Diya Shi[1], Mahsa Khoei[1], Aamena Kapasi[1], Sandra Wiebe[1]; [1]University of Alberta — Past research suggests emotion regulation and executive function are mediated by overlapping brain networks including prefrontal and anterior cingulate cortices. Childhood is marked by rapid development of emotional, attentional, and behavioural control, but the precise relationship between these distinct, interacting systems remains unclear. The current study investi-

gated the relationship between emotion regulation and executive function in middle childhood using event related potentials (ERPs). The frontocentral N2, a stimulus-locked negative deflection reflecting response conflict, was examined in a modified Flanker task. Seven- and 8-year-olds were asked to "follow the middle fish" by pressing the left or right button. The target fish was flanked by fish swimming in the opposite direction (conflict), the same direction (congruent) or by starfish (neutral). Emotional regulation was manipulated across three blocks: a Baseline block where the task was presented normally; a Frustration block where some trials included a temporal lag; and a Recovery block where the task returned to normal. There was a significant flanker effect on response times (RTs): conflicting stimuli were associated with longer RTs than congruent or neutral trials. ERP effects varied by block: in the Baseline block, N2 amplitude was larger to conflict trials than neutral trials consistent with the N2's suggested role in conflict detection, whereas in the Frustration block, N2 amplitude was larger to congruent trials than neutral trials while the conflict N2 did not differ from either of the other two conditions. These results suggest frustration alters children's ability to process stimulus conflict and this effect persists after induction.

B50

AGE-RELATED CHANGES IN MONITORING AND CONTROL IN DISSOCIABLE LEARNING SYSTEMS

Marissa Gorlick[1], David Schnyer[1], W. Todd Maddox[1]; [1]University of Texas at Austin — Cognitive psychology emphasizes two learning systems; a reflective system that is under conscious control and a reflexive system that functions implicitly. Research from our lab (Glass et al., 2011) found an age-related deficit in reflective learning but an age-related advantage in reflexive learning. During reflective learning, conscious knowledge about the current state of learning is updated (monitoring) and used to guide strategy selection (control). However, reflexive learning is an implicit process and does not rely on these mechanisms. Age-related declines in monitoring and control likely influence differences in reflective learning. Older adults both (a) struggle to monitor their learning and (b) have difficulty applying that knowledge to select the appropriate strategy. The present study provides evidence for an age-based deficit in monitoring reflective learning leading to poor control. Participants learned to classify exemplars modified from one prototype (AN; reflexive learning) or two prototypes (AB; reflective learning) and were then tested on both categories. During test, participants provided a confidence rating as a measure of online monitoring. Replicating Glass et al, older adults were less accurate than younger adults in the reflective task indicating poor control, but older adults outperformed younger adults in the reflexive task. Older adults revealed poorly calibrated monitoring relative to younger adults in the reflective task. Also as predicted, there were no age-related monitoring differences in the reflexive task. Overall, our results suggest that older adults are less successful than younger adults at monitoring reflective learning, potentially contributing to deficits in control that are critical for learning.

B51

GIVING YOUR BRAIN A BOOST: ENGAGING ACTIVITIES ENHANCE NEURAL RECRUITMENT

Sara Haber[1], Ian McDonough[1], Denise Park[1]; [1]University of Texas, Dallas — The Scaffolding Theory of Aging and Cognition (STAC) postulates that with advancing age, people use and develop alternative neural circuits (neural scaffolding) to maintain cognitive functioning in response to brain changes (i.e., cortical thinning, dopamine depletion). Neural scaffolds may develop as a result of differing lifestyle activities and potentially explain individual variations in cognitive function in old age. To evaluate this hypothesis, a lifestyle intervention was implemented in older adults (aged 60-90) using a sub-sample of the Synapse Project (n=39). Participants in the experimental groups engaged in cognitively demanding tasks for 15 hours a week over 14 weeks such as quilting and digital photography (Productive Engagement). Control groups had an equivalent weekly commitment, but did not participate in new learning and involved low-demand cognitive or social stimulation (Receptive Engagement). All participants underwent a battery of cognitive tests and fMRI scanning before and after the intervention. While in the scanner, older adults completed a semantic classification task in which they made living/non-living judgments to easy (cat) or hard (virus) words. Univariate analyses were used to evaluate the extent that the lifestyle intervention altered neural modulation in response to increased task demands. Productive Engagement (when compared to Receptive Engagement) increased neural modulation at post-test in regions not previously recruited at pre-test including occipital, parahippocampal, and fusiform regions. Thus, as predicted by the STAC model, making a lifestyle change that requires learning new, cognitively demanding sets of skills can result in neural scaffolding by the recruitment of alternate brain regions.

B52

PSYCHOPHYSIOLOGICAL CONCOMITANTS OF CRAVING: THE ROLE OF SMOKING CUES IN INFORMATION PROCESSING IN ACTIVE SMOKERS AND NON-SMOKERS

Justinn Cochran[1], Ewald Naumann[2], Rob Kydd[1], John Sollers[1]; [1]University of Auckland, [2]Universität Trier — Substance abuse is prevalent worldwide and represents one of the largest preventable health problems in developed countries. Craving has been identified as an undeniable symptom of substance abuse withdrawal and is also one of the most commonly reported reasons for relapse in those attempting to quit. However, little is actually known about the complex nature of the many components driving the phenomenon. In the present study, the contingent negative variation (CNV) and baseline heart rate variability (HRV) will be assessed in smokers and non-smokers while they viewed smoking, appetitive and neutral images. Participants (Total N= 50, 24 smokers) took part in a standard S1-S2 CNV paradigm which consisted of three blocks (40 trials each) of visual stimuli separated by six seconds. Baseline HRV (5 minutes) was assessed prior to any image presentations. Event-related potential (ERP) data were collected from frontal, central, and parietal sites along the vertex (Fz, Cz, Pz). Results indicate there were differences in the early CNV at more frontal sites by group, such that smokers showed increased negativity to the smoking images while the non-smokers did not. This relationship was only observed at Fz and Cz and disappeared at Pz. Individuals with high baseline HRV appeared to process all images in a situationally appropriate manner, regardless of group. It appear both HRV and CNV provide important data that will elucidate how information processing may be different in substance dependent persons, and lead to better understanding of craving.

B53

INDIVIDUAL DIFFERENCES IN ORIENTING SENSITIVITY MODULATE EVENT RELATED POTENTIALS AND REACTION TIMES IN A MODIFIED ATTENTION NETWORK TASK

Russell Costa[1], Emilee Naylor[1,2], Jaiya Choles[1], Nicholas Halper[1], Stephen Rutishauser[1], Lesa Ellis[1]; [1]Westminster College, [2]University of Oregon — Orienting Sensitivity (OS), considered a broad attentional construct in models of adult temperament, reflects individual differences in the propensity to notice and react to low intensity stimuli. We investigated relationships between self-reported levels of orienting sensitivity and behavioral and electrophysiological measures in 54 individuals completing a modified Attentional Network Task. The task included trials with either congruent or incongruent flankers that were either not cued or preceded by a double asterisk cue, allowing for examination of interference effects (congruent/incongruent trials) and alerting effects (cued/non-cued trials). Individuals also completed a self-report measure of temperament (Adult Temperament Questionnaire) and median scores on the Orienting Sensitivity factor were used to divide participants into low and high OS groups. Response time (RT) data revealed no main effect between OS groups; however, a significant interaction between Cueing, Interference, and OS Group revealed that individuals with low Orienting Sensitivity demonstrated greater RT differences between cued and non-cued congruent trials than did individuals high in Orienting Sensitivity. Moreover, event-related potential (ERP) data showed a significant Cueing by OS Group interaction in centro-parietal and frontal electrode sites for target-locked N1 and P3 components, such that participants low in orienting sensitivity displayed greater amplitude differences for cued versus non-cued trials than did those high in orienting sensitivity, regardless of Congruency condition. These findings suggest that individuals low in Orienting Sensitivity are more likely to show decreased attention specifically in non-cued conditions, and that performance differences may be attributable to attentional mechanisms of orienting during early stages of visual processing.

B54

TO IMITATE OR NOT: PREPARATORY SUPPRESSION AND MIRROR NEURON SYSTEM MODULATION

Katy Cross[1], Rob Eriksen[1], Marco Iacoboni[1]; [1]University of California, Los Angeles — Humans have an automatic tendency to imitate observed actions. This is thought to result from motor activation during action observation, mediated by the human mirror neuron system. To avoid perpetual imitation, an active control mechanism is thought to inhibit this automatic tendency. Recent work has focused on reactive imitation control mechanisms in situations where the need for control is unpredictable. Here, we used fMRI to examine preparatory control mechanisms that can be employed when advance information is available. Participants performed a cued compatibility task requiring either imitation (compatible trials) or counter-imitation (incompatible trials) of finger movements. A parallel spatial compatibility task replacing the fingers with moving dots was included to determine whether control of imitation relies on different mechanisms from non-social stimuli. According to dual route models, the automatic response proceeds on compatible trials but is suppressed (1) during preparation for incompatible trials (automatic response is incorrect) and (2) when the compatibility is not known in advance (automatic response is incorrect on half of trials). A Cue (Fingers/Dots) x Preparation (Compatible/Incompatible/No Information) interaction demonstrated that preparatory suppression involves bilateral middle frontal gyrus, primary motor and inferior parietal cortices during imitative control, but only early visual cortex during spatial control. Preparation for compatible trials also demonstrated striking differences: Faster responses were associated with increased inferior frontal gyrus, pars opercularis activity for imitation trials, compared to superior parietal and dorsal premotor cortex for spatial trials. These results suggest a specialized preparatory imitation control mechanism that involves modulation of the mirror neuron system.

B55

SOCIAL SIMON EFFECT: CO-REPRESENTATION OR SOCIAL FACILITATION?

Karen Davranche[1], Laurence Carbonnell[1], Clément Belletier[1], Thierry Hasbroucq[1], Pascal Huguet[1]; [1]Aix-Marseille Université et CNRS — This study aimed to elucidate the mechanisms underlying the social Simon effect (SSE). Electromyographic (EMG) recordings and distributional analyses have been used to assess whether coaction alters information processing, cognitive control, and the susceptibility of making fast impulsive errors. Additionally, each participant's social comparison orientation (SCO) was measured to address whether the effects of co-action varies according to their inclination to compare with others. In a randomized protocol, forty participants performed a Simon task, an individual Go/Nogo task, and a joint Go/Nogo task (social Simon task). Results showed that coaction shortened reaction time (RT). As predicted from social facilitation theory, the benefit was larger for compatible (CO) than for incompatible (IN) trials. This social facilitation effect explains the larger SSE observed in the joint Go/Nogo task (10ms), compared to that observed in the individual Go/Nogo task (4ms). The propensity of making fast impulsive errors also increased when working co-actively, especially for the high SCO participants. The correction rate and the delta curves yet did not highlight any cognitive control impairment. Based on the occurrence of the EMG activity of the agonist muscle involved in the task, fractionated-RT showed that coaction actually shortened both pre-motor time (14ms) and motor time (4ms). Interestingly, for high SCO participants, the coaction affected each RT-component (pre-motor/motor time) differently as function of the nature of the trials (CO vs. IN). The fact that coaction predominantly affected CO trials suggests that SSE has more to do with a social facilitation effect than with a co-representation phenomenon.

B56

REGULATION OF CRAVING IN COCAINE-DEPENDENCE: AN FMRI STUDY

Cameron M. DeLeone[1], Dan Marino[1], Kathleen M. Carroll[1], Hedy Kober[1]; [1]Yale University School of Medicine — Can cocaine addicts regulate their craving? Craving is a central feature of addiction, which repeatedly predicts drug use and treatment outcomes. Consistently, Cognitive Behavioral Therapy (CBT), the 'gold standard' therapy for addiction, includes key training on regulation of craving, and decreases drug use. In contrast, it is a commonly held view that substance-dependent individuals have a brain-based deficit in inhibitory control and regulation. Furthermore, cocaine use has been related to structural decrements in prefrontal cortex (PFC) control systems. Here, we investigated whether cocaine-dependent individuals (CDs) can recruit PFC and regulate their craving for cocaine using a cognitive strategy. A treatment-seeking sample of CDs completed the Regulation of Craving task during fMRI. Participants viewed pictures of food and cocaine, and were instructed to think about either (a) the immediate experience of consuming the item ("NOW") or (b) the negative consequences of consuming the item ("LATER") – the strategy taught in CBT. Self-reported cravings for cocaine were lower during the LATER condition than the NOW condition, suggesting that CDs can regulate craving. Furthermore, the LATER strategy resulted in relative deactivation of subcortical regions associated with craving (e.g., ventral striatum and amygdala) and increased prefrontal activity in regions associated with cognitive control and emotion regulation (e.g., dorsolateral prefrontal cortex (dlPFC)). However, dlPFC activity was variable and related to individual differences in regulation success. Results further related to clinical variables associated with cocaine use.

B57

PUTTING RANDOMNESS UNDER CONTROL: HOW PERSPECTIVE TAKING AND AGENCY INFLUENCE RANDOM DIGIT GENERATION

Sebastian Dieguez[1], Lucas Spierer[1], Peter Brugger[2], Jean-Marie Annoni[1]; [1]University of Fribourg, [2]University Hospital Zurich — The perception of patterns in random events is increased by (real or illusory) control over the generation of those events. Here we investigated whether subjective control would also affect the voluntary production of random events. We tested participants with the Mental Dice Task (MDT), which requires generating digits 1–6 as randomly as possible at a paced timing. In separate experiments, we manipulated motor agency, perspective taking and felt control. Throwing a blank die while generating random digits significantly reduced stereotyped responses (counting in +1), compared to watching someone else throw the blank die. This effect persisted even after the blank die was no longer rolled (Study 1). The same effect was found when instructions were given in a first-person perspective (compared to a third-person perspective) format (i.e. "imagine [You are vs I am] rolling a die") (Study 2). Additionally, when throwing a blank die with the left hand we found that right-handers also reduced backward counts (counting in -1), suggesting a motor-spatial component (Study 3). Finally, we investigated whether generally lacking control influenced MDT performance. After performing a frustrating task, participants produced less stereotypical responses than after a neutral task (Study 4). Collectively, our findings show that modulating the sense of control alters random digit generation: motor involvement and motor priming of the self, first-person perspective-taking, and the need to restore personal control all improve the production of randomness by suppressing a prepotent counting bias. Somewhat paradoxically, staying in control can thus be said to facilitate random behavior.

B58

GO /NOGO PERFORMANCE UNDER SOCIALLY EVALUATED PHYSIOLOGICAL STRESS: INFLUENCES ON INHIBITORY CONTROL - AN EVENT-RELATED POTENTIAL STUDY

Angelika Dierolf[1], Julia Fechtner[1], Ewald Naumann[1]; [1]Department of Psychology, University of Trier, Germany — There is increasing evidence for impairing effects of stress on cognitive performance, especially memory. However, other cognitive functions, such as flexibility or inhibitory control have been hardly examined, even though there is some evidence that stress increases impulsive and aggressive behavior. The aim of the present study was to investigate the effect of acute stress and the thereby caused cortisol increase on executive function, specifically inhibitory control. 39 healthy male participants were randomly assigned to the socially evaluated cold pressor test or warm pressor test (control condition). Beforehand and afterwards, participants performed a Go/Nogo task with visual letters. Event-related potentials (ERPs), reaction times, and error rates were measured. Additionally, acute levels of salivary cortisol were collected on the basis of which stressed participants were divided into cortisol-responder and –nonresponder. Established Go/Nogo effects within the ERPs could be replicated: the N2 and P3 components were augmented for Nogo relative to Go stimuli at frontal and fronto-central sides. Additionally, Go trials showed a more positive P2 compared to Nogo trials. Acute stress or cortisol increase did not affect error rates and reaction times, but influenced event-related earlier components.

While cortisol-responder showed an enlarged frontal P2 Go>Nogo effect after the stressor, it was diminished in cortisol-nonresponder. Moreover, cortisol-nonresponder and –responder showed a more negative N2 after the stressor. These results indicate that stress affects the underlying neuronal processes of behavioral inhibition as a function of cortisol increase. This study provides further evidence that acute stress changes brain processes during executive functions.

B59

UNCONSCIOUS WORKING MEMORY ENGAGES THE PREFRONTAL CORTEX

Johan Eriksson[1], Fredrik Bergström[1]; [1]Umeå University — Representational durability is commonly considered to differ depending on whether the initial presentation was consciously or unconsciously perceived. Consciously perceived material can be retained for a lifetime, whereas the effects of unconscious perception is believed to last for less than a second. Here we use the attentional blink paradigm to present single letters either consciously or unconsciously. By introducing a delay of 5-15 seconds between letter presentation and a forced-choice task, we demonstrate that task performance was above chance level for unseen letters even for delays of up to 15 s, implying a long representational durability. We then used functional magnetic resonance imaging and multiple regression to separate brain activity related to the different processing stages of perception (encoding), information maintenance, and response (retrieval), similar to a common approach for studying neural correlates of working memory. We demonstrate that the maintenance phase, which for unseen T2:s can be conceptualized as unconscious working memory, engages the prefrontal cortex. Thus, memory for unconscious events can have a duration of several seconds, and prefrontal cortex is involved in maintaining unconscious representations over longer periods.

B60

NEUROIMAGING DURING A WORKING MEMORY TASK IN REMOTE TRAUMATIC BRAIN INJURY: EVIDENCE FROM NHL ALUMNI

Carrie Esopenko[1], Priya Kumar[1], Claude Alain[1,2], Tiffany Chow[1,2], Randy McIntosh[1,2], Stephen Strother[1,2], Brian Levine[1,2]; [1]Rotman Research Institute, [2]University of Toronto — Traumatic brain injury (TBI) is associated with neurocognitive changes that can result in cognitive impairment, and can elevate the risk of developing dementia, including Alzheimer's disease (AD) and chronic traumatic encephalopathy (CTE). Repetitive mild TBIs in sport have been linked to cognitive impairments in aging (such as AD and memory impairments) and to an earlier onset of cognitive impairments compared to individuals who have not experienced a concussion. Given that the National Hockey League alumni (NHLa) comprise a large sample of individuals across a wide age range who were subjected to high speed collisions with concussion during their careers, these athletes provide an excellent model for research examining the interaction between TBI and aging. NHLa and control participants' working memory (WM) and attention abilities were assessed during simultaneous functional magnetic resonance imaging (fMRI) and electroencephalography using a series of n-back tasks. Behaviorally, NHLa showed decreasing accuracy with increasing WM load relative to controls. FMRI data showed greater activation in the middle prefrontal cortex and posterior parietal regions with increasing WM load for NHLa compared to controls. This was accompanied by a greater P300 for the target relative to the standard for NHLa compared to controls, also modulated by differences in WM load. Our results suggest that sports-related TBIs may have long-term implications on neurocognitive functioning.

B61

ENHANCING VERBAL AND SPATIAL WORKING MEMORY WITH NON-INVASIVE, DIRECT CURRENT STIMULATION OF LEFT DORSOLATERAL PREFRONTAL CORTEX

Brian Falcone[1], Ryan McKendrick[1], Raja Parasuraman[1]; [1]George Mason University — Previous research points to a possible dissociation between left and right dorsal lateral prefrontal cortex (DLPFC) in the control of working memory, with left DLPFC associated with verbal working memory and right DLPFC with spatial working memory, although the latter results are less clear than the former. This study further examined the issue of lateralized DLPFC control of verbal and spatial working memory through the application of a non-invasive brain stimulation technique, transcranial direct current stimulation (tDCS). Anodal (2mA) or sham (0.1mA) stimulation was applied to the left or right DLPFC while participants performed spatial and verbal working memory tasks. The results of stimulation were compared to pre-stimulation baseline performance to determine performance gain scores for each group. Anodal stimulation of DLPFC enhanced performance in both working memory tasks. However, no evidence was found for a dissociation between left and right DLPFC stimulation. Participants who received right DLPFC stimulation did not display improved spatial working memory as predicted; however stimulation of the left DLPFC improved performance on both verbal and spatial working memory. The results show that the left DLPFC plays a major role in the control of both verbal and spatial working memory.

B62

TIMING AND FUNCTIONAL CONNECTIVITY OF CORTICAL REGIONS SUBSERVING VERBAL ENCODING AND REHEARSAL

David Fegen[1], Bradley Buchsbaum[2], Mark D'Esposito[1]; [1]University of California, Berkeley, [2]Rotman Research Institute, Toronto — Working memory (WM) refers to the limited-capacity store responsible for maintaining and manipulating task-relevant information over short time-periods. WM tasks generally involve multiple stages: an encoding period during which the incoming task-relevant information is perceived and converted into a construct that can be remembered, and a delay period during which the task-relevant information is maintained by rehearsal processes. For verbal WM many areas are known to be active during encoding including primary auditory cortex in superior temporal gyrus (STG) as well as Sylvian-parietal-temporal junction (area Spt), while during the delay period rehearsal regions are known to be active: inferior frontal gyrus (IFG, BA 44), premotor (PM, BA 6) and area Spt. However, while many studies have consistently identified these cortical areas as being active, there is little evidence directly using the fMRI BOLD signal demonstrating how the different areas relate to each other in a network. Therefore, we examined both the timing and functional connectivity during two important phases of verbal WM: encoding (with a listen word task), and the delay period (with a subvocal rehearsal task) in an fMRI study with 31 subjects. Preliminary results show that during the listen word task STG activates before area Spt and that the two regions are functionally connected. We also demonstrate that during the subvocal rehearsal task activity occurs first in PM, then area Spt, followed by IFG and that these regions form a functional network. These results provide evidence that functional networks among different cortical areas subserve different stages of WM.

B63

CAUSAL EVIDENCE FOR MECHANISMS UNDERLYING MAINTENANCE IN VISUAL WORKING MEMORY: A BEHAVIOURAL TRANSCRANIAL MAGNETIC STIMULATION STUDY.

Eva Feredoes[1,2], Nahid Zokaei[2,3], Masud Husain[2,3]; [1]University of Reading, [2]Institute of Cognitive Neuroscience, University College London, [3]Institute of Neurology, University College London — The number of visual items that can be maintained in working memory is limited, although the underlying mechanisms of maintenance that leads to such capacity limits are unclear. One hypothesis is that, in sensory cortex, only a one item (or a subset) can be represented in a focus of attention (FOA). To test this, we applied the causal brain stimulation approach of transcranial magnetic stimulation (TMS) to motion sensitive MT+, with the aim of disrupting maintenance of motion information in FOA. In Experiment 1, TMS was applied after a cue indicating which of two previously presented motion directions was to be recalled. This manipulation would presumably bring the cued item only into FOA. TMS decreased recall precision of the cued item; recall of the uncued item was unaffected. In Experiment 2, by presenting motion memory targets sequentially, the item in FOA was manipulated intrinsically. This manipulation relied on previous observations in which the last item in a sequence is maintained with higher precision, suggesting it enters FOA in an obligatory fashion. Seemingly paradoxically, TMS improved precision for the first item in the sequence (and marginally disrupted the second item). We suggest that TMS again disrupted the item in FOA (i.e., the second item), resulting in it producing less interference on maintenance of the first item, hence improving its recall precision. Together, these results show that items are maintained in sensory cortex with varying precision, which could, in turn, be explained by some items being represented in a limited capacity FOA.

B64

NEURAL SYSTEMS UNDERLYING DISTRACTOR INHIBITION IN VERBAL WORKING MEMORY AND THEIR CONTRIBUTION TO INDIVIDUAL DIFFERENCES IN WORKING MEMORY CAPACITY

Christian Fiebach[1,2,3], Basten Ulrike[1]; [1]Department of Psychology, 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 — Recent work has shown that ventrolateral prefrontal cortex (VLPFC) is involved in shielding the contents of working memory (WM) against distraction. While it has been suggested that the individual ability to inhibit distractors critically contributes to individual differences in WM capacity, an association between inhibition-related brain activity and WM capacity was observed in dorsolateral prefrontal cortex (DLPFC) but not in VLPFC. These insights rely primarily on studies of visual and visuo-spatial WM. We used functional magnetic resonance imaging to investigate the neural bases underlying distractor inhibition in verbal WM and their contribution to individual differences in WM capacity. In a sample of 52 participants, we observed robust activity in VLPFC and DLPFC, elicited by distractor letters during the delay period of a letter WM task, but suppressed activation in occipital cortex. Functional coupling of VLPFC and DLPFC with visual regions was increased during distractor inhibition, and multiple prefrontal seed regions showed convergent functional coupling with the occipital areas that exhibit distractor-related suppression of BOLD signals. Individual WM capacity was negatively correlated with the strength of functional coupling between right VLPFC and higher visual areas. These results provide evidence for fronto-posterior top-down guided suppression of perceptual processing as a mechanism underlying the shielding of working memory against distraction. Importantly, our data lend strong support to the hypothesis that the capacity of WM is determined – at least partly – by the degree to which VLPFC can implement top-down control over visual areas when task-irrelevant information must be ignored.

B65

BLOBOLOGY : USING MECHANISTIC COMPUTER MODEL OF HUMAN BRAIN CIRCUITS TO UNDERSTAND THE NEUROBIOLOGY OF BOLDFMRI

Hugo Geerts[1], Athan Spiros[1], Patrick Roberts[1]; [1]In Silico Biosciences — Many BOLD-fMRI imaging studies report on changes in neuronal activation during specific tasks, but the real payoff is to understand the neurobiological basis of these changes that might ultimately lead to new drug targets for cognitive enhancement. Quantitative Systems Pharmacology, e.g. computer-based mechanistic simulation of biophysically realistic neuronal circuits, especially when combined with human pathology or genotype imaging, is a new approach to understand the neurobiological basis of BOLD-fMRI changes. We have developed a computer model of a cortical network, containing 18 different neuromodulatory receptors that is calibrated using human clinical data on the N-Back working memory test in various populations. We calculate a measure for a single-voxel BOLD-fMRI signal based upon the implementation of the biophysical processes from neuronal synaptic activity and coupled with energy and glucose metabolism and changes in vascular flow and blood level oxygen. The COMT Val-158Met genotype is implemented using the results of clinical PET imaging radiotracer displacement in healthy volunteers. We illustrate the power of this approach by reproducing the observed effects of the COMT genotype in schizophrenia patients on cognitive performance and on cortical activation. While the COMT Met/Met subjects as a group are better on working memory performance, a subgroup of COMT Val/Val achieve the same performance level, but always at the expense of higher BOLD-fMRI by recruiting additional GABA or D1 mediated processes. With the limitation of studying single-voxel readouts, this approach is a powerful technique for starting to better understand the neurobiology of BOLD-fMRI changes.

B66

THE ROLE OF AGE OF ACQUISITION AND PROFICIENCY ON NON-WORD RHYMING IN 6- TO 8-YEAR-OLD BILINGUAL CHILDREN

Annika Andersson[1], Jessica L Fanning[2], Lisa D Sanders[3]; [1]Lund University, [2]University of Oregon, [3]University of Massachusetts — Speech signals change rapidly and timing differences as small as 50 ms can be critical for distinguishing between minimal pairs (e.g., bat-pat). Thus, fast phonological processing is important for understanding speech. Strong and positive relationships between phonological awareness (PA, e.g., the ability to recognize rhymes) and vocabulary size have been widely reported in both monolingual and bilingual children. Though PA has been explored with behavioral studies in bilingual children, online processing of phonology has not. ERPs were measured in 6- to 8-year-old native Spanish speaking children with English as their second language listening to rhyming and nonrhyming pairs of nonsense words with English phonology. Nonwords were used to help children focus on phonological rather than semantic processing. Though bilingual 6- to 8-year olds were expected to recognize rhymes, neurocognitive measures of rhyme processing failed to establish the anterior effect (an increased negativity for rhyming targets) previously reported in monolingual children. Further, the posterior rhyming effect (a decreased negativity for rhyming targets) was evident only in the group with higher English proficiency, within the normal range for monolingual children. In this group the posterior rhyming effect had a longer latency than what was observed in younger monolingual children. The results suggest that even though bilingual children do well on behavioral tests of PA, processing of sub-syllabic phonology is slowed and more variable in their second language. Proficiency and age of acquisition are more important for mature phonological processing than previous behavioral studies have suggested.

B67

ADULTS WITH DYSLEXIA SHOW INTACT BUT LESS ACCESSIBLE NEURAL REPRESENTATIONS OF SPEECH SOUNDS

Bart Boets[1], Hans Op de Beeck[1], Maaike Vandermosten[1], Sophie Scott[2], Céline Gillebert[3], Dante Mantini[4], Stefan Sunaert[1], Jan Wouters[1], Pol Ghesquière[1]; [1]KU Leuven, Belgium, [2]University College London, UK, [3]University of Oxford, UK, [4]ETH Zurich, Swizerland — It is well-established that individuals with dyslexia perform poorly on various phonological tasks. Currently, there is an ongoing debate whether this phonological deficit should be attributed to less well specified phonetic representations per se or rather to an impaired access to these speech sound representations. Here we combine functional magnetic resonance imaging with multi-voxel pattern analysis to quantify the neural quality of these representations in adult dyslexic and typical readers. Results reveal that the activity profiles elicited by different sublexical speech sounds can be differentiated along various brain areas involved in auditory, speech and phonological processing, with left-hemisphere regions outperforming right-hemisphere regions in classifying stop-consonants. Yet, in spite of their obvious reading and phonological problems, the neural fingerprint of these speech sounds was as robust and distinct in adults with dyslexia as in typically reading controls. However, by assessing intrinsic functional connectivity we revealed that the communication between left inferior frontal areas and left superior temporal areas was significantly hampered in dyslexics. These findings, along with the evidence for a structural impairment in the left superior longitudinal fasciculus white matter tract, suggest that the left inferior frontal areas (which are involved in effortful phonological processing) have less efficient access to the phonetic representations which are mainly hosted in left superior temporal areas. Therefore, these data provide the first neural evidence that individuals with dyslexia show intact but less accessible phonetic representations.

B68

AN ELECTROPHYSIOLOGICAL STUDY OF BILINGUALS' READING STRATEGY TRANSFER: THE CONTRIBUTION OF SPELLING-SOUND CONSISTENCY AND ORTHOGRAPHIC SIMILARITY TO THE ACTIVATION OF PHONOLOGY

Mona Roxana Botezatu[1], Maya Misra[1]; [1]The Pennsylvania State University — We examined whether bilinguals with a logographic first language (L1–Chinese) transferred reading strategies to their orthographically deep second language (L2–English). Highly proficient Chinese-English bilinguals made rhyme judgments of visually presented English words while behavioral and EEG measures were recorded. Results were compared to those from a group of English monolingual controls. The spelling-sound consistency and orthographic similarity of semantically unrelated rhyming and non-rhyming prime-target pairs were varied systematically. To manipulate consistency, graphemically dissimilar primes and targets that either matched or did not match in consistency were compared in both rhyming (consistent/consistent: WHITE-FIGHT; inconsistent/consistent: HEIGHT-FIGHT) and non-rhym-

ing conditions (consistent/inconsistent: SCALE-LEAK; inconsistent/inconsistent: WORK-LEAK). Orthographic similarity was manipulated by comparing pairs that matched in consistency but were either graphemically dissimilar (WHITE-FIGHT; WORK-LEAK) or similar (RIGHT-FIGHT; STEAK-LEAK). Bilinguals were more sensitive than monolinguals to the consistency manipulation for rhyming words, with increased N400 amplitudes to targets following inconsistent versus consistent words. Bilinguals also showed increased latencies and N400 amplitudes to targets primed by consistent non-rhyming words, whereas monolinguals were more sensitive to targets primed by inconsistent non-rhyming words. However, both groups showed equally accurate responses to the consistency manipulation. The effect of orthographic similarity was comparable for the bilingual and monolingual participants, with behavioral and ERP measures from both groups showing facilitation for converging cues from orthography and phonology and inhibition for diverging cues. Results suggest that bilinguals with an L1 logographic writing system may have a bias to consider words in an L2 alphabetic orthography as more consistent than they are.

B69

PREDICTING TONE LANGUAGE APTITUDE WITH THE MISMATCH NEGATIVITY

Anita R. Bowles[1], Valerie Karuzis[1], Valerie Shafer[2], Joseph Dien[1]; [1]University of Maryland, [2]City University of New York — The MMN is an event-related potential (ERP) component that provides an index of early auditory sensory memory (Näätänen, 2001). It is sensitive to native and foreign language (FL) phonological categories (e.g., Chandrasekaran, Krishnan & Gandour, 2007; Kaan et al, 2008; Näätänen et al., 1997) and may differ for successful and unsuccessful FL learners (Diaz et al., 2008; Jakoby, Goldstein, & Faust, 2011). In a study of tone language FL vocabulary learning, English native speakers were passively exposed to two auditory nonce syllables during EEG recording. These syllables carried different pitch contours (rising, falling, or flat) and began at three different frequencies (low, middle, or high). MMN responses were recorded for segmental and tonal contrasts. Following this EEG session and a set of behavioral pre-tests of intelligence, memory, pitch processing ability, and other cognitive abilities, individuals learned to associate Mandarin-like monosyllables and disyllables with a set of 24 pictures, over 6 training sessions, and were tested on their learning accuracy. MMN responses to specific contrasts differed for successful and unsuccessful learners of the new words and correlated with pre-training tests of cognitive and perceptual ability. In addition, previous musical experience, self-rated musical ability, and performance on musical aptitude tests correlated with MMN responses. This study supports the MMN as one measure of an underlying ability that supports FL vocabulary learning in a tone language.

B70

AN ELECTROPHYSIOLOGICAL STUDY OF THE TIME COURSE OF BILINGUAL WORD RECOGNITION

Loretta Yiu[1], Kriya Krisnabai-Gitanjali[1], Michael Pitts[1], Enriqueta Canseco-Gonzalez[1]; [1]Reed College — Current theories of language comprehension in monolinguals suggest that phonological processing occurs before activation of semantic and syntactic information. Bilingual language comprehension likely requires an additional level: knowledge of which language a specific utterance belongs to. The Revised Bilingual Interactive Activation (BIA+) model of word recognition proposes that bilinguals use language 'tags,' that is, information identifying the specific language of a word, to help them monitor the appropriate language at any given time (Dijkstra & van Heuven, 2002). A central question then is when exactly this language 'tag' information becomes available during language comprehension. Using the recording of event-related potentials, we investigated the time course of semantic and language 'tag' encoding during visual word recognition. Spanish-English bilinguals viewed a series of printed words while making dual-choice go/nogo and left/right hand decisions based on semantic (whether the word was an object or an animal) and language 'tag' information (whether the word was in English or Spanish). The onset latency of the N200 (related to response inhibition) indicated that semantic information was available approximately 50 ms before language 'tag' information. This finding is compatible with the BIA+ model and supports the claim that language 'tag' information is accessed relatively late during bilingual word recognition.

B71

HIGH PROFICIENCY IN A SECOND LANGUAGE IS CHARACTERIZED BY GREATER INVOLVEMENT OF THE FIRST LANGUAGE NETWORK: EVIDENCE FROM CHINESE LEARNERS OF ENGLISH

Fan Cao[1], Ran Tao[2], Li Liu[2], Charles Perfetti[3], James Booth[4]; [1]Division of Psychology, School of Humanities and Social Sciences, Nanyang Technological University, Singapore, [2]State Key Lab of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [3]Learning Research and Development Center, University of Pittsburgh, Pittsburgh, PA, USA, [4]4Department of Communication Sciences and Disorders, Northwestern University, Evanston, Il., USA — The assimilation hypothesis argues that second language learning recruits the brain network for processing the native language, whereas the accommodation hypothesis argues that learning a second language recruits brain structures not involved in native language processing. This study tested these hypotheses by examining brain activation of a group of native Chinese speakers, who were late bilinguals with varying levels of proficiency in English, when they performed a rhyming judgment to visually presented English word pairs (CE group) during fMRI. Assimilation was examined by comparing the CE group to native Chinese speakers performing the rhyming task in Chinese (CC group), and accommodation was examined by comparing the CE group to native English speakers performing the rhyming task in English (EE group). The CE group was very similar in activation to the CC group, supporting the assimilation hypothesis. Additional support for the assimilation hypothesis was the finding that higher proficiency in the CE group was related to increased activation in the Chinese network (as defined by the CC > EE) including the left middle frontal gyrus, the right inferior parietal lobule and right precuneus and decreased activation in the English network (as defined by the EE > CC) including the left inferior frontal gyrus and the left inferior temporal gyrus. Although most of the results support assimilation, there was some evidence for accommodation as the CE group showed less activation in the Chinese network including the right middle occipital gyrus, which has been involved in holistic visuo-spatial processing of Chinese characters.

B72

MATURATION OF NEURAL CORRELATES OF DISCRIMINATION OF SPEECH SYLLABLE SEQUENCES IN PRESCHOOL CHILDREN AND ADULTS

Margaret Kamowski-Shakibai[1,2], Valerie L. Shafer[2], Yan H. Yu[2,3], Katherine Hawkland[2]; [1]Marymount Manhattan College, [2]City University of New York, Graduate Center, [3]William Paterson University — Previous studies have shown both positive and negative mismatch responses (MMRs) under the age of five years to segmental changes (Shafer, Yu, Datta, 2010). The goal of the current study is to examine MMRs to syllable sequence changes in preschool children and adults. Three naturally-produced 150-ms syllables [ko], [gu] and [ka] were presented as a standard sequence /koguka/ or deviant sequence /kokagu/ to preschoolers and adults. Preliminary analyses show a variation of responses across age groups. Mature adults showed a mismatch negativity (MMN) at all frontal-central sites to the syllable sequence change. In preschoolers, the MMR appears initially as a positivity at frontal midline and right sites; the negativity first appears at left sites around 20 months of age. Four-year-olds generally showed a negative MMR/MMN over left sites and a positive MMR over right sites. The topography of these MMRs differs from that found to changes in vowel spectral information; the negative MMR/MMN first emerged over right rather than left sites to these spectral changes (Shafer, et al., 2011). These preliminary findings suggest differences in involvement of the hemispheres in spectral versus temporal changes that are highly apparent in cortical maturation.

B73

THE ORTHOGRAPHIC CONSISTENCY EFFECTS IN CHINESE SPOKEN WORD RECOGNITION

Wei-Fan Chen[1], En-Ju Lin[1], Yu-Lin Tzeng[2], Jie-Li Tsai[3], Chia-Ying Lee[1,2,3]; [1]Institute of Linguistics, Academia Sinica, Taiwan, [2]Institute of Neuroscience, National Yang-Ming University, Taiwan, [3]Department of Psychology, National Chengchi University,Taiwan — In alphabetic languages, orthographic consistency or feedback consistency is defined as the degree of mapping consistency from phonology to orthography (whether words had rimes that can be spelled in multiple ways, e.g., /ip/ in heap and deep). Studies have demonstrated the orthographic consistency effect,

in which the feedback inconsistent words took longer and yielded more errors than the consistent words in the auditory lexical decisions task. It suggests that the orthographic knowledge influences the spoken word recognition. In Chinese, the pervasive homophony implies the orthographic form is particularly important for selecting meaning and escaping homophony. A greater impact from orthography during spoken word recognition in Chinese than in other alphabetic writing system is expected. This study examined two types of orthographic consistency effects, namely homophone density and feedback consistency, in the semantic categorical task with event-related potentials (ERPs) measurement. The homophone density is defined as the number of characters sharing exactly the same pronunciation (including tonal variation) and the feedback consistency is defined as whether a set of homophones can be subdivided into several orthographic subgroups based on their phonetic radical. Two types of orthographic consistency effects were found in different ERP components. One is the feedback consistency effect in the N400 time window with frontal central distribution and the other is the homophone density effect in the late positivity component with central parietal distribution. Congruent with the orthographic consistency effect found in English, our data supports the bi-directional interaction between phonology and orthography for Chinese spoken word recognition.

B74

THE NEURAL LOCUS OF THE BILINGUAL ADVANTAGE Emily Coderre[1,2], Jason Smith[2], Walter van Heuven[1], Barry Horwitz[2]; [1]University of Nottingham, [2]NIDCD, National Institutes of Health — In bilingualism, the daily need to control multiple languages is thought to enhance cognitive control abilities, conferring a 'bilingual advantage' such that bilinguals outperform their monolingual counterparts on both linguistic and non-linguistic tasks of executive control. However, despite the well-documented behavioral evidence for a bilingual advantage, there has been no methodological investigation into the neural origin of this advantage. If the bilingual advantage stems from the experience of bilingual language processing, and if the advantage extends to non-linguistic executive function, then a brain area or network that is commonly activated for language processing, linguistic cognitive control, and non-linguistic control should be enhanced in bilinguals compared to monolinguals. The current study investigated this possibility by testing monolinguals and bilinguals on separable conditions of linguistic and non-linguistic cognitive control (via an adapted flanker task) and language processing (via a semantic categorization task). A conjunction analysis in each group identified brain regions that were similarly activated by all three functions. In monolinguals, the conjunction showed no significant areas of overlap between these functions, indicating that monolinguals used largely disparate areas for each function. However, the bilingual conjunction showed a significant area of overlap in the left inferior frontal gyrus (LIFG), indicating that the broad involvement of the LIFG in cognitive control and language processing selectively enhances this structure in bilinguals, reciprocally enhancing domain-general executive processing. This research therefore identified, for the first time, a neural locus of the bilingual advantage, providing valuable insight into the nature of the enhanced cognitive abilities in bilinguals.

B75

CLIMAXING UNEXPECTEDLY: EVENT-RELATED POTENTIALS TO STRUCTURAL AND SEMANTIC VIOLATIONS IN SEQUENTIAL IMAGE PROCESSING Neil Cohn[1], Phillip Holcomb[2], Ray Jackendoff[2], Gina Kuperberg[2]; [1]University of California, San Diego, [2]Tufts University — Recent evidence suggests that sequential image comprehension relies on an interaction between narrative structure and semantic content, analogous to the interaction between syntactic structure and semantics in the comprehension of sentences (1). In this study, we used event-related potentials (ERPs) to determine whether the brain responds differently to violations of narrative structure and violations of general semantic theme as participants viewed 6-panel comic sequences. In Normal sequences, the critical panel was semantically related to its context and depicted the expected narrative climax, as defined by Cohn's theory of visual narrative (2). In Semantic Violation sequences, the critical panel was semantically unexpected (its content was unrelated to its context), but structurally expected (still depicted a narrative climax). In Structural Violation sequences, the critical panel violated structural expectations by introducing a narrative initiation rather than a climax; its content, nonetheless, was semantically related to the context. In Dual Violation sequences, the critical panel was both structurally and semantically unexpected (a narrative initiation that was semantically unrelated to its context). The N400 evoked by critical panels was smaller when the content was semantically expected (Normal, Structural Violations) than unexpected (Semantic and Dual). At the subsequent panel, the P600 was larger following structural violations (Structural and Dual) than following a coherent structure (Normal, Semantic Violations). These findings provide further evidence that sequential image comprehension is guided by an interaction between narrative structure and semantic content. 1. N. Cohn, et al, Cognitive Psychology 65,1 (2012). 2. N. Cohn, Cognitive Science, (In Press).

B76

FACING EMOTIONAL LANGUAGE: IMPAIRED FACIAL FEEDBACK AFFECTS EVENT-RELATED POTENTIALS TO EMOTIONAL LANGUAGE Joshua Davis[1], Piotr Winkielman[1], Seana Coulson[1]; [1]UCSD — This research examined the role of motor processes in understanding emotional language. Specifically, we tested how inhibiting spontaneous smiling influences comprehension of emotional sentences, as measured by the N400 Event-Related Potential (ERP). Ability to smile was inhibited by having participants hold chopsticks between their teeth and closed lips. In the motor control condition, participants held chopsticks lightly using their lips alone. As a manipulation check, we recorded facial muscle activity from the zygomaticus "smiling" muscle using electromyography (EMG). During the experiment, participants read sentences and judged their valence. Each sentence's overall valence was contingent upon its last three words: "After climbing into bed, she heard her new KITTEN (PURRING/CHOKING) close BY." ERPs were time-locked to the control word (kitten), the valence word (purring), and the sentence final word (by). The results showed a significantly larger N400 to the final word of the pleasant sentences in the motor inhibition condition relative to the motor control condition. This was also where the greatest difference in smiling EMG occurred. The obtained results suggest that the semantic integration of motor and language information occurs during sentence wrap up. It is also possible that a threshold of differential motor activity must be overcome to generate an N400 effect. Overall, these data suggest naturally produced facial expressions serve as implicit cues for the comprehension of emotional texts, and that in the absence of these cues, additional cognitive resources are recruited.

B77

ANIMACY, THEMATIC REVERSALS, AND PSYCHOLOGICAL VERBS REVISITED John Drury[1], Nicolas Bourguignon[2,3], Karsten Steinhauer[3]; [1]Stony Brook University, [2]University of Montreal, [3]McGill University — Thematic reversals (TR) have been shown to be highly relevant for understanding the factors responsible for eliciting N400 or P600 effects (or both) in connection with violations turning on animacy (e.g., …the eggs would *eat…). Bourguignon et al. (2012) found that Agent-Subject verbs (e.g., The eggs have *eaten…) elicit only a monophasic late positivity whereas Experiencer-Subject verbs (e.g., The storm has *feared…) elicit a biphasic N400/P600 pattern. They claim that the N400 for the latter case is tied to additional lexical processing since Experiencer is a role that can also be assigned to objects (given the existence of Experiencer-Object verbs like "frighten"; in contrast, note there are no Agent-Object verbs). However, the details of their account suggest that this N400 effect may not be expected if both arguments of Experiencer-verbs are encountered before the verb is. We tested this in an English ERP reading study (N=19) involving psychological-verbs (both subject- and object-experiencers) in object relative clauses (e.g., The storm/girl [that the girl/storm had feared/frightened __] was…). Results showed that TR-violations yielded positive-going deflections ("semantic P600s") for both verb types, with no N400 effects for either (consistent with the idea that an increase in lexical processing for these verbs does not occur when both arguments have been encountered before the verb). Also, an early posterior positivity for object-experiencers only was observed which strongly resembles an effect reported for contrasts involving the same verb-type in German (Bornkessel et al. 2003), which has been interpreted as reflecting early thematic reanalysis.

B78

THE COMPUTATION OF MEANING VIA EVENT KNOWLEDGE AND NUMBER

Veena Dwivedi[1], Kaitlin Curtiss[1]; [1]Brock University — In order to investigate the role that heuristic vs. algorithmic mechanisms play in language comprehension, we conducted a picture verification study with word triplets that described a conceptual script, such as KID CLIMB TREE (cf., Chwilla & Kolk, 2005). These words formed the lexical skeleton from quantifier scope ambiguous sentences such as Every kid climbed a tree. Such sentences are semantically ambiguous; either one or several trees were climbed. This ambiguity is attributed to the algorithmic computation of quantifier scope, where it has been shown that participants prefer the plural interpretation. However, perhaps the interpretation is not derived via computation but instead from heuristic knowledge regarding events and the likely number of participants in events. In the current word triplet study, 45 subjects were instructed to interpret such word chunks as telegrams, and select a picture via button press regarding the number associated with TREE. The hypothesis was that responses to word triplets could serve as a predictor for judgments of full sentences. In a previous norming study, 32 participants judged tree in Every kid climbed a tree as plural 100% of the time but diamond in Every jeweler appraised a diamond was judged as plural at 60%. In the present work, a logistic regression analysis was conducted to test the likelihood of a plural judgment in the norming study using the word triplet responses as a predictor. Results confirmed that the triplet judgments were reliable predictors of the sentence judgments. Implications for the on-line computation of meaning are discussed.

B79

ARE RELIGIOUS IDEAS SPECIAL BECAUSE THEY ARE SEEN AS METAPHORS? : AN EVENT-RELATED BRAIN POTENTIAL STUDY

Sabela Fondevila[1], Sabrina Aristei[3], Werner Sommer[3], Laura Jiménez-Ortega[1,2], Pilar Casado[1,2], Manuel Martín-Loeches[1,2]; [1]Center for Human Evolution and Behaviour, UCM-ISCIII, Madrid, Spain, [2]Complutense University of Madrid, Spain., [3]Humboldt-University at Berlin, Germany. — In this study we aimed at exploring to what extent the figurativeness of religious ideas might be an important factor in explaining the human natural tendency for religious thought. Using the N400 component of the ERPs (Event-related brain potentials) we looked at the semantic processing of two types of counterintuitive ideas, i.e., religious and non-religious, when they are either literally or metaphorically interpreted. Reading mode (literal and metaphorical) was induced by asking questions about the semantic content of the sentences in a block-wise design. Performance results showed longer reaction times (RTs) for the metaphorical relative to the literal mode. Furthermore, whereas both counterintuitive ideas displayed similar RTs when literally interpreted, religious ideas were more quickly interpreted when comprehension was biased to metaphorical interpretation. ERPs revealed no differences in the early N400 (300-380ms) between both counterintuitive sentences. However, the late N400 (380-500ms) was modulated as a function of reading mode and type of counterintuitive material. Namely, the amplitude for the non-religious ideas was larger than to religious ones only when a metaphorical mode of processing was induced. Our results suggest that the semantic integration of counterintuitive religious ideas is favoured by the metaphorical induction while the integration of counterintuitive non-religious ideas exhibit semantic processing difficulties during both the literal and the metaphorical modes. Some religious ideas could, therefore, behave as metaphors for the human cognitive system unlike other types of counterintuitions, and this could arguably be a reason for their evolutionary success and spreading.

B80

INTERACTIONS BETWEEN LEXICAL AND SYNTACTIC KNOWLEDGE DURING INCREMENTAL PROCESSING OF THE CAUSATIVE CONSTRUCTION IN ENGLISH

Gwen Frishkoff[1], Gregory Taylor Brooks[1], Jessica Wise[1]; [1]Georgia State University — We examine event-related potential (ERP) responses during comprehension of the Causative construction. A construction is a mapping between sentential form (syntax) and meaning. The English Causative is syntactically specified as 'NP-V-NP-PP', and means 'Someone-CAUSED-Something-toChangeLocation'. Importantly, only certain verbs are permitted within this construction: e.g., "walk" is allowed ("Jack walked his sister to the party"), but "arrive" is not (*"Jack arrived his sister to the party"). Our goal was to test whether word-to-construction mismatches would elicit semantic or syntactic ERP effects, or both. 17 native English-speaking adult participants viewed sentences, presented one phrase at a time, while we recorded their EEG. The task was to say whether each sentence was acceptable (speeded task). The response probe could come after the verb (intransitive construction), after the object NP (transitive construction), or after the PP (Causative/to-Dative construction). According to syntax-first theories, "arrive" should elicit a P600 syntactic response to the object NP (*"Jack arrives HIS SISTER ..."), but no N400 semantic response. Results supported this prediction. Interestingly, however, the final PP (*"Jack arrives his sister TO THE PARTY"), elicted a pronouned N400 effect. This suggests that subjects continued to process the sentence meaning, even after they recognized the syntactic error earlier in the sentence. These results are inconsistent with syntax-first theories, but are compatible with theories like Construction Grammar, which emphasize ongoing meaning integration at the level of words and higher-level structures, i.e., clause-level meaning.

B81

A HOMOLOGY BETWEEN HUMAN AND MONKEY BRAIN SYSTEMS THAT CONSTRUCT MEANING FROM VOCAL COMMUNICATION

Ricardo Gil-da-Costa[1], Steven Hillyard[2], Marta Kutas[2], Raynard Fung[1], Thomas Albright[1]; [1]Salk Institute for Biological Studies, [2]University of California San Diego — Previous research suggests homologies between the neural networks for conceptual representation and vocal communication in human and non-human primates. We investigated the temporal dynamics of the activation and integration of information from the rhesus macaque vocal repertoire, as compared to human speech. In humans, the "N400" event-related brain potential (ERP) is associated with the processing of meaning across a sequence of items, and characterized by a negative-going voltage deflection between 250-550ms, with a parietal maximal scalp topography. Building from knowledge pertaining to the semantic content of rhesus vocalizations, we investigated electrical brain responses to contextually congruent versus incongruent strings of three vocalizations (words or rhesus calls) across species (humans and rhesus). As expected, humans elicited an increased N400 to the third word when it violated the semantic context of the previous words, and a decrease when it was contextually congruent. Humans showed no congruency modulation for rhesus calls. Remarkably, rhesus macaques showed a homologous pattern: a negative-going ERP with the same functional sensitivity and topography for their own vocalizations, but occurring 400ms later. We label this congruence-related ERP, occurring between 700-900ms, "mN800" (macaque N800). The first evidence of an ERP functionally homologous to the N400 in any other species, it implies that rhesus monkeys not only appreciate the meaning associated with each call, but also the meaningful (or not) relationship between the various calls in a sequence. This finding offers novel insights into the cognitive and neural mechanisms associated with vocal communication, shedding new light onto the evolution of language.

B82

SPEECH ACT COMPREHENSION IN SPOKEN DIALOGUE: AN ERP STUDY

Rosa Gisladottir[1,2], Dorothee Chwilla[3], Stephen Levinson[1]; [1]Max Planck Institute for Psycholinguistics, [2]International Max Planck Research School for Language Sciences, [3]Donders Institute for Brain, Cognition and Behaviour, Radboud University — Speech acts such as asking people out, teasing, and complimenting are the building blocks of conversation. Successful communication requires recognizing these speech acts for planning an appropriate response. However, little is known about how listeners bridge the gap between the literal meaning of utterances and the relevant action content. In an EEG study, we aimed to find the ERP correlates of speech act comprehension. Participants listened to spoken dialogues, without semantic or pragmatic violations, in which target sentences (e.g., "I have a credit card") delivered three speech acts (Answers, Declinations, Pre-offers) depending on the prior turn. The ERP results reveal an early influence of the prior turn on speech act processing, reflected by a right fronto-temporal slow-wave in Declinations and Pre-offers, relative to Answers, starting 100 ms (in Declinations) and 200 ms (in Pre-offers) after first word onset. In Pre-offers a late posterior negativity occurred at the final word. In Declinations a midline and left frontal positivity emerged 400 ms after first word onset. The Empathy Quotient (Baron-Cohen and Wheelwright, 2004) was used to

assess participants' cognitive (theory of mind) and affective empathy. The positivity in Declinations was found to be positively correlated with empathy in an early time window, suggesting that the positivity starts earlier in people with high empathizing skills. The results demonstrate that speech act comprehension in natural dialogue starts immediately, already at the first word, and that the ability to empathize can impact the online processing of speech acts.

B83

GESTURE COMPENSATES FOR IMPAIRED LEXICAL ACCESS FOR SPATIAL LANGUAGE

Tilbe Goksun[1], Matthew Lehet[2], Katsiaryna Malykhina[1], Anjan Chatterjee[1]; [1]The University of Pennsylvania, [2]Carnegie Mellon University

— People gesture when they talk about spatial information. Little is known about the neural correlates of spatial language and their accompanying spontaneous gestures. We ask how focal brain-injured individuals describe spatial motion events, involving dynamic components of manner and path. In a sentence "the boy jumps over a fence," jumping describes the manner and over describes the path of the motion. We tested whether motion event components are independently impaired, and if gestures compensate for impaired verbalization. Patients with left (LHD, n=16) or right hemisphere damage (RHD, n=16), elderly controls (n=14) were asked to describe motion events (e.g., the woman runs across the street), depicted in brief video clips (22 trials). The correct use of manners and paths of motion and spontaneous gestures representing these components (e.g., wiggling the middle and index fingers for running) were coded. Patients with LHD made more errors in producing both manners and paths compared to RHD and controls, $p<.01$. Yet, they were worse in producing paths of motions than manners (Mmanner=76%, Mpath=52%). Using voxel-lesion symptom mapping we found that damage to the left posterior middle frontal gyrus, left inferior frontal gyrus, left superior temporal gyrus (STG) were related specifically to impairments in producing paths of actions. While describing motion events, LHD patients produced more spatial gestures than other participants. Lesions to the left STG were significantly correlated higher use of path gestures. We suggest that manners and paths of actions can be separately impaired and gestures compensate for lexical access produced by STG lesions.

B84

THE EFFECTS OF NEGATIVE EMOTION ON ENCODING-RELATED ELECTROPHYSIOLOGICAL ACTIVITY PREDICTING SUBSEQUENT RECOLLECTION

Luciano G. Buratto[1], Yee Y. Yick[1], Alexandre Schaefer[1]; [1]University of Durham

— The goal of this study was to investigate the emotional modulation of an electrophysiological index of memory encoding (the "Dm" effect) using two retrieval tasks previously linked to recollection processes: source memory and confidence judgment tasks. Event-related potentials (ERPs) were recorded while participants studied two blocks of randomly intermixed negative and neutral images. On the next day, participants performed an Old-New recognition test. In addition, they were also asked (a) to judge the confidence of their recognition responses and, for images judged "old", (b) to decide whether the image was originally presented in the first or in the second study block (source memory task). The Dm effect was obtained by separating ERPs elicited to images at encoding according to whether these images were later accurately recognized or forgotten. ERPs were also separated according to source memory accuracy, confidence levels, valence (negative vs. neutral) and arousal levels (high vs. low). Behavioural results revealed better source memory to negative compared to neutral images. A Dm effect starting at 400 ms with fronto-central maxima was enhanced for negative compared to neutral images, regardless of source accuracy and negative images' arousal levels. By contrast, the enhancement of the Dm effect by emotion was only found for high- but not for low-confidence judgments. These results are consistent with models suggesting that the emotional enhancement of recognition is influenced by effects of emotion at encoding. The results also suggest that the modulation of source memory and memory confidence by emotion might rely on different encoding processes.

B85

RECALL ORDER IS PREDICTED BY CATEGORY-SPECIFIC NEURAL ACTIVITY OF PRECEDING ITEMS AT STUDY

Stephanie C.Y. Chan[1], Marissa C. Applegate[1], Neal W. Morton[2], Sean M. Polyn[2], Kenneth A. Norman[1]; [1]Princeton University, [2]Vanderbilt University

— Context-based models of episodic memory posit that memories of items are linked to a "mental context" representation that drifts over time; at test, we can retrieve recently-studied items by cuing with the current state of mental context. These models have successfully explained a wide range of memory effects (e.g., temporal clustering in free recall), but there is still considerable debate over the factors that shape mental context. Early context models (e.g., Estes, 1955) posited that mental context drifted randomly over time, whereas modern implementations (e.g., Howard & Kahana, 2002) posit that mental context reflects a running average of recently-experienced thoughts. A key prediction arising from the latter set of models is that, if two items are preceded by similar thoughts, they will be linked to similar mental contexts, which (in turn) will bias participants to recall the items sequentially at test. To test this prediction, we scanned participants using fMRI while they studied, one item at a time, lists of the form AACBBCAACBBCAACBBC; A, B, and C denote different categories. For each list, participants were asked to recall as many C-items as possible, in any order. We used an fMRI pattern classifier to track category-specific neural activity, and examined pairs of C-items that were preceded by the same category during study (e.g. A). For a given pair, if the classifier showed an elevated level of the preceding category when the two C-items were studied, then participants showed an elevated probability of recalling the two items sequentially, as predicted.

B86

MEMORY ENCODING AND RETRIEVAL OSCILLATIONS ARE RELATED

Yvonne Y Chen[1], Jeremy B Caplan[1]; [1]University of Alberta

— Memory-related EEG oscillations at study show analogous effects on memory. At study, the subsequent memory effect (SME; activity during hits minus activity during misses), points to alpha (8-12 Hz) desynchronization and concurrent theta (4-8 Hz) synchronization associated with better subsequent memory (Klimesch, 1997, 1999). At test, the retrieval success effect (RSE) also reveals reduced alpha and increased theta power associated with better memory (Burgess and Gruzelier 1997, Düzel et al, 2003, 2005; Klimesch, 1997). We hypothesized that this reflects visual attention (reduced alpha) combined with activation of item-context representations at both study and test. We tested the prediction that memory-related oscillations at study would correlate with the same memory-related oscillations at test, across participants. Participants were given 9 25-word lists for study, each followed by old/new recognition. After replicating the alpha/theta pattern for both the SME and RSE using a duration-of-oscillation measure that has high sensitivity to rhythmic activity relative to non-repeating signal that has energy at a particular frequency (Caplan et al., 2001), we found support for our prediction: the SME and RSE correlated positively in the alpha band at Oz ($r(29)=0.94$, $p<0.01$) and the theta band at Fpz ($r(29)=0.66$, $p<0.01$); thus, the study and test oscillatory pattern explained common subject variability, and suggest that alpha and theta oscillations have a similar influence on recognition memory at study and test.

B87

MOVE FASTER TO LEARN BETTER: EXPLORATION SPEED IMPACTS LEARNING ABOUT OBJECTS AND THEIR LOCATIONS

Nathan Clement[1], R. Alison Adcock[1]; [1]Duke University

— The identification and induction of neural and behavioral states that are conducive to learning would benefit education, psychotherapy, and workplace training, as well as numerous other potential applications. Previous work in humans has shown that activation of midbrain regions containing dopamine neurons and implicated in motivated behavior prior to learning predict enhanced memory (Adcock et al., 2006). Because dopamine also regulates goal-directed movement, including exploration (e.g., Fink and Smith, 1980), there is reason to predict a relationship between exploration and learning. To date, however, the relationship between exploratory movement and learning has received little focus. In the present studies, we manipulated the speed with which participants could explore a spatial array of objects. We made the counterintuitive prediction that increased speed of exploration during learning would positively correlate with subsequent memory for objects as well as for their locations. Participants used keypresses to explore

spatial arrays under variable speed conditions: Slow or Fast. Total viewing time for each stimulus was capped to control for maximum duration of stimulus exposure. Participants showed considerable variability in both their exploratory behavior and their subsequent memory. Across individuals, greater exploration in the Fast vs. Slow condition predicted a selective enhancement of memory for objects encountered during the Fast condition as well as for their spatial locations. We posit that increasing exploratory activity may enhance the relationship between midbrain neuromodulatory systems and the hippocampus to induce a state conducive to new learning.

B88

MEMORY SELECTIVITY IS ASSOCIATED WITH GREATER ENGAGEMENT OF AREAS INVOLVED IN DEEP SEMANTIC ENCODING FOR HIGH-VALUE ITEMS

Michael S. Cohen[1], Jesse Rissman[1], Alan D. Castel[1], Barbara J. Knowlton[1]; [1]University of California, Los Angeles — Previous work examining the neural basis of how value affects memory (e.g., Adcock et al., 2006) has focused on the role of the midbrain dopaminergic reward system in potentiating memory for valuable items via functional connections with the hippocampus. However, people may also strategically control encoding strategies to enhance memory selectivity for more valuable items. We used fMRI to examine how differences in neural activity at encoding as a function of value relate to subsequent free recall for words. Each word was preceded by an arbitrarily assigned point value, and participants went through multiple study-test cycles with feedback on their point total at the end of each list, allowing for further sculpting of strategy use. We examined the correlation between value-related modulation of neural activity and participants' selectivity index, a measure of how close a participant was to their optimal point total given the number of items recalled. Greater selectivity scores were associated with greater enhancement of neural activity in semantic processing regions, including left anterior ventrolateral prefrontal cortex, during encoding of high-value words relative to low-value words. This suggests that strategic engagement of deep semantic processing may be critical for enhancing memory for valuable items. While the present study tested only young adults, it is notable that older adults are particularly proficient at utilizing value in this type of paradigm (Castel et al., 2002). Thus, engagement of this semantic processing network may be a means whereby older adults can efficiently mobilize limited resources to prioritize encoding of important information.

B89

IDENTIFYING ASSOCIATIVE MEMORY DEFICITS AND NEUROBIOLOGICAL CORRELATES OF ENCODING AND PERFORMANCE IN A NATIONAL SAMPLE OF VETERANS WITH GULF WAR ILLNESS USING FMRI

Crystal Cooper[1], Timothy Odegard[2], Richard Briggs[1], James Bartlett[2], Farris Emily[3], Haley Robert[1]; [1]University of Texas Southwestern Medical Center at Dallas, [2]University of Texas Dallas, [3]University of California San Francisco — Roughly 26-32% of U.S. veterans who served in the 1991 Persian Gulf War report suffering from chronic health problems (Golomb, 2008). Memory complaints are regularly reported by ill Gulf War veterans (GWV), but there is scarce data to verify their complaints. Using an associative memory paradigm of faces and names, the present study was conducted to 1) investigate the memory deficits reported by ill-GWV in a nationally representative sample comprised of both ill- and well-GWV and 2) investigate whether or not there are functional brain differences between the groups when encoding face-name pairs. During administration of the memory task, functional magnetic resonance imaging (fMRI) was used to acquire the Blood Oxygenation Level Dependent (BOLD) contrast to serve as a proxy of brain activation evoked by the memory task. It was hypothesized that ill-GWV would demonstrate decreased memory performance relative to well-GWV on the associative memory test, providing evidence of memory deficits using an objective measure of memory. This was confirmed. Additionally, it was hypothesized that these memory differences would be related to differences in brain function during the encoding of novel associative memories. We predicted that differences would be observed between ill- and well-GWV in the amount of brain activation measured during associative memory encoding using BOLD fMRI. Such differences were observed in several brain regions, which included the frontal and temporal lobes, parahippocampus, and posterior cingulate. However, hippocampal differences did not follow predictions. Of the regions found to differ between the groups, several may be implicated in compensatory processing.

B90

SYSTEMATIC ERROR IN THE DUAL PROCESS SIGNAL DETECTION MODEL OF RECOGNITION MEMORY

Adam Dede[1,6], John Wixted[1], Ramona Hopkins[4,5], Larry Squire[6,1,2,3]; [1]University of California San Diego department of psychology, [2]University of California San Diego department of psychiatry, [3]University of California San Diego department of neurosciences, [4]Bringham Young University department of psychology, [5]Intermountain Medical Center department of medicine, [6]Veterans Affairs San Diego Healthcare System — In recent years, neuroscientists have used the Dual Process Signal Detection (DPSD) model to measure two processes thought to subserve declarative memory (familiarity and recollection), and to relate these processes to neuroanatomy. Familiarity refers to a simple feeling that an item has been encountered before, and recollection refers in addition to memory for the context in which learning occurred. The DPSD model relies on strong assumptions about the nature of familiarity and recollection. An alternative model, the Unequal Variance Signal Detection (UVSD) model, makes no assumptions about familiarity and recollection, and does not measure these two processes directly. We compared these models using a novel technique. The two models can be represented by memory strength distributions associated with studied and unstudied items. The differences in these distributions are such that if the UVSD model is correct, then the DPSD model should consistently underestimate low-confidence responses to targets. If the DPSD model is correct, then the UVSD model should consistently overestimate low-confidence responses to targets. Recognition memory was tested in patients with circumscribed hippocampal lesions and in healthy controls. The UVSD model did not yield systematic errors (and also fit the data better overall). By contrast, the DPSD model systematically underestimated low-confidence responses to targets in both the patients and controls (as it should if the UVSD model is correct). These findings raise questions about the legitimacy of using the DPSD model to investigate which brain structures support familiarity and recollection. Other methods for measuring these constructs will be discussed.

B91

THE IMPACT OF PARTIAL AND FULL DETAIL RECOMBINATION ON THE ACCEPTANCE OF AUTOBIOGRAPHICAL MEMORY CONJUNCTION ERRORS

Aleea Devitt[1], Edwin Monk-Fromont[1], Daniel L. Schacter[2], Donna Rose Addis[1,3]; [1]The University of Auckland, [2]Harvard University, [3]ARC Centre of Excellence in Cognition and its Disorders — Memory conjunction errors may be the most common type of false autobiographical memory, yet current theories provide conflicting views on whether partial or full recombinations of details are more likely to result in false memories. Combining memory conjunction error and autobiographical recombination paradigms, the current study examines the relative contribution of partial versus full recombination to the acceptance of autobiographical memory conjunction errors. In session one, participants retrieved 150 autobiographical memories, specifying a person, place and object for each. These details were randomly recombined to form 108 fictitious sets, each containing a person, place and object, where either one detail was substituted or all three details came from separate memories. Using these sets, participants imagined novel past events in session two, rating each for plausibility and vividness. In session three, source judgements were made for 216 sets from real and imagined events, and previously unseen recombinations. False memories occurred when imagined and unseen sets were incorrectly judged as depicting real memories. Partially recombined sets were accepted twice as often as full recombinations, regardless of whether the set had been previously seen. Imagined events with higher plausibility ratings had subsequently greater false acceptance rates, and partial recombinations were more likely to result in plausible imagined events. These results suggest that plausibility may be utilised more as a cue for veridicality than recollection rejection, familiarity, or vividness when making rapid source judgements about autobiographical memory conjunctions, resulting in greater acceptance of partial recombinations.

B92

TIME-DEPENDENT CHANGES IN CONTEXTUAL FACILITATION OF MEMORY RETRIEVAL Manoj K. Doss[1], Maureen Ritchey[1], Charan Ranganath[1]; [1]University of California, Davis — Several studies have demonstrated that immediate recall of a studied item can be facilitated if the study context is reinstated, but it is not clear whether context-dependence of episodic retrieval changes over time. One possibility is that, through systems consolidation processes, memories might become less tied to their specific context. We ran a series of experiments that tested the context-dependency of memories over time. On two consecutive days, participants encoded separate sets of objects overlaid onto scenes that served as contexts. Immediately after the second encoding session, memory was tested for these objects in two possible conditions: the same condition in which objects were overlaid onto their respective scenes from encoding and the different condition in which objects were overlaid onto different scenes. We found that for items studied on the same day (i.e. short retention interval), context reinstatement affected recollection-based recognition such that recollection was worst in the different condition. Furthermore, under some circumstances, this effect tends to diminish for items studied on the previous day. Future variants will incorporate a cued recall test, which may be more sensitive to recollection-based memory effects. This study provides evidence that with increasing retention intervals, memories may be less dependent on reinstatement of the exact encoding context, possibly due to the effects of memory consolidation.

B93

FMRI ENCODING PATTERNS PREDICT TEMPORAL ORDER MEMORY ACROSS BOUNDARIES Sarah DuBrow[1], Lila Davachi[1]; [1]New York University — One theory of episodic memory organization proposes that changes in context create representational distance between events (Howard & Kahana, 2002; Polyn, Norman & Kahana, 2009). This model of temporal context has been largely supported by patterns of free recall, but has rarely tested with explicit temporal order memory. In rodents, it has been shown that a gradual change in hippocampal activity is related to successful order memory (Manns, Howard & Eichenbaum, 2007). Thus, we predicted that externally driven changes in context might also enhance relative order memory. In the present fMRI experiment (N=18), we introduced shifts in context across sequences of images that would be tested in recency discrimination and serial recall. We hypothesized that contextual boundaries would enhance relative order memory by increasing the representational distance between across-context items in accord with temporal context models. Surprisingly, we found that recency discrimination for across-context items was significantly worse than within-context items matched for temporal lag. To investigate whether the neural representation of items was modulated by context shifts, we performed RSA analyses on BOLD activity. In the hippocampus, we found no main effect of context switch on similarity scores of the to-be-discriminated items. However, increased similarity predicted subsequent temporal order memory for across but not within-context items. This result suggests that the maintenance of the hippocampal representation may be important for encoding temporal order across boundaries, perhaps acting to bridge across events. Further analyses will investigate the role of MTL and prefrontal cortex in subsequent order and serial recall memory.

B94

HIPPOCAMPAL AMNESIA DISRUPTS EPISODIC MEMORY AND NARRATIVE CONSTRUCTION Melissa Duff[1,2,3], Jake Kurczek[3]; [1]Department of Communication Sciences and Disorders, University of Iowa, [2]Department of Neurology, Division of Behavioral and Cognitive Science, University of Iowa, [3]Neuroscience Training Program, University of Iowa — The critical role of the hippocampus and related medial temporal lobe structures in the formation and subsequent retrieval of new enduring memories (i.e. long-term memory) is well established. The hippocampus has also been linked to episodic future thinking. Much of the work investigating episodic memory and future thinking has relied heavily on the analysis of the verbal productions of patients with amnesia. Given that there is also growing evidence of disruptions in language use and processing in patients with hippocampal damage, it has been challenging to disentangle the impairments in memory from those in language. We have argued that the hallmark processing features afforded by the hippocampus (e.g., relational binding, representational flexibility) are critical for both memory and language performance. To test this proposal, we collected narrative samples using gold standard procedures in the memory (e.g. Autobiographical Memory Interview) and language (e.g., picture description) literatures from six participants with bilateral hippocampal damage and severe declarative memory impairment and 6 healthy comparison participants. We analyzed all samples on memory (e.g., episodic detail) and language (e.g. cohesive adequacy, local coherence, reported speech) measures. Across all narrative types and all memory and language measures, amnesic patients were impaired relative to the healthy comparison participants. These findings suggest that the hippocampus contributes to the use of both episodic memory and language. In patients with amnesia, when the demands on hippocampal processing are sufficiently high, both memory and language performance is affected.

B95

ABNORMAL SEMANTIC MEMORY STRUCTURE IN A CASE OF DEVELOPMENTAL AMNESIA Devin Duke[1,2], Ben Bowles[3], Asaf Gilboa[4], Shayna R. Rosenbaum[5], Ken McRae[1,2], Stefan Köhler[1,2,4]; [1]Department of Psychology, University of Western Ontario, London, Ontario, [2]The Brain and Mind Institute, University of Western Ontario, London, Ontario, [3]Department of Psychology, Stanford University, Palo Alto, California, [4]Rotman Research Institute, Baycrest, Toronto, Canada, [5]Department of Psychology, York University, Toronto, Canada — Developmental Amnesia (DA) is considered one of the strongest sources of evidence for the notion that episodic and semantic memory are dissociable systems that develop independently, with hippocampal integrity necessary for episodic memories only (Vargha-Khadem et al., 1997). While it has been demonstrated that core semantics can be learned even without an intact hippocampus, there is no research directly addressing the structural relationships among semantic representations acquired in DA. Inasmuch as there are suggestions that re-organization processes known to support episodic memory may also play a role in general knowledge integration, it seems likely that semantic representations differ in their structure when acquired against the background of episodic memory impairment. To examine this possibility, we tested a well-characterized developmental amnesic (HC) using semantic memory tasks based on an established normative database of concrete concepts. Importantly, unlike typical neuropsychological tests that primarily tap into discrete aspects of semantic memory, our tasks required comparisons among similar concepts in terms of their typicality for semantic categories, and also their familiarity. Furthermore, we probed relationships between concepts and their features, and between related concepts, in two generation tasks. Preliminary analyses suggest that HC's category structure (typicality rating) differs from that of age- and education-matched controls. In DA, abnormalities in these structural relationships may be present even when concepts have apparently been acquired successfully. These findings suggest that the hippocampus, a brain structure thought to be dedicated to episodic memory, may also play a pivotal role in the development of fine-grained structural semantic relationships.

B96

VALUE-BASED DECISIONS ARE MODULATED BY EXPOSURE TO FAMILIAR VS. NOVEL CUES Katherine Duncan[1], Daphna Shohamy[1]; [1]Columbia University — There is growing behavioral and neural evidence that mnemonic processes unfold over a broad period of time, and that this ongoing processing has consequences for memory performance. Of note, a new series of behavioral studies demonstrated that recent exposure to novel images benefitted processes that support episodic encoding compared to recent exposure to familiar images which benefitted processes that support retrieval (Duncan, et al., 2012). The breadth of situations that mnemonic biases may influence, however, has yet to be investigated. Here, we developed a novel decision-making task that relies on memories for single experiences. Participants were asked to decide between an option of unknown value and one that has been associated with a monetary value on a previous trial. Critically, each of these decisions was made following the presentation of an unrelated scene, which was either familiar or novel. We found that participants' value-based choices were influenced by of the prior scene: Stronger value-associations were formed after viewing unrelated novel images, but value information was more readily recalled after unrelated familiar images. Together, this research provides a novel approach to

systematically assessing the influence of single trial experiences on monetary decisions and demonstrates that manipulations that elicit biases within the episodic memory system influence these decisions.

B97

MAGNETOENCEPHALOGRAPHIC EVIDENCE THAT FAMILIARITY IS GRADED AND INDEPENDENT OF RECOLLECTION Lisa Evans[1], Edward Wilding[1]; [1]Cardiff University Brain Imaging Centre, School of Psychology, Cardiff University, UK — Event-related fields (ERFs) were employed to test a neural prediction that will hold if recollection and familiarity are independent memory processes. Evans and Wilding (2012) observed that an ERF index of familiarity was larger when accompanying a 'Know' rather than a 'Remember' response during a memory retrieval task. This outcome is predicted if the two processes are independent because the level of familiarity associated with all Know responses will be above a criterion, whereas there is no lower bound for the level of familiarity associated with Remember responses – as long as it is assumed that familiarity supports Know responses and recollection supports Remember responses. In this study a further prediction was tested: if the familiarity strength of items increases then the neural index of familiarity will converge for Remember and Know responses. To test this, a modified Remember/Know task was used in which 20 participants endorsed items as remembered if any details from the study episode could be retrieved and, if not, old/new status was judged on a 4-point confidence scale, assumed to index familiarity strength. Familiarity estimates were higher in this experiment than in our previous one, and the ERF index of familiarity was equivalent when accompanying Remember and Know responses. Importantly, these results are not due to a lack of sensitivity to familiarity, because the effect varied with confidence, which is assumed to index familiarity strength. These findings provide further support for the view that recollection and familiarity are independent processes.

B98

INVOLVEMENT AND INTERACTION OF MEDIAL TEMPORAL LOBE- AND PREFRONTAL STRUCTURES DURING CONTEXTUAL FEAR CONDITIONING IN A NOVEL CUE-ARRAY PARADIGM Christian Bäuchl[1,2], Patric Meyer[1,2], Michael Hoppstädter[1,2], Carsten Diener[1,2], Herta Flor[1,2]; [1]Central Institute of Mental Health, Medical Faculty Mannheim, Heidelberg University, Germany, [2]Bernstein Center for Computational Neuroscience Heidelberg/Mannheim, Germany — Contextual fear conditioning is hypothesized to be dependent on the hippocampus. Nevertheless, studies using rodents with hippocampal lesions have shown that contextual fear can still be acquired if damage occurs prior to conditioning. In case of hippocampal impairment neo-cortical areas are believed to facilitate the association of contextual cues with an aversive event. However, theoretical considerations suggest that this 'elemental strategy' fails if there is overlap between the context stimuli, in which case the hippocampus is needed to form hierarchical context representations. To elucidate the neural correlates of this pure hierarchical account we created a cue-array context paradigm that comprises two contexts with identical component features, only differing in their relational arrangement. This new paradigm was tested in humans during functional magnetic resonance imaging (fMRI). T-contrasts revealed sustained activity for the electrical-shock-associated context (CS+), relative to the non-shocked context (CS-), in right rostrolateral prefrontal cortex and bilateral insula. Transient activity for the same contrast was found in right hippocampus and parahippocampal cortex. An analysis of functional connectivity showed that the posterior hippocampus was significantly stronger connected to the right superior orbital gyrus during unpaired CS+ contexts relative to CS- contexts. An additional analysis of effective connectivity revealed that activity of the right anterior hippocampus influences activity in the amygdala and the primary somatosensory cortex. These results depict the activation and interaction of brain regions that are crucial for the acquisition of a differential fear response as a function of learning the distinction between similar contexts.

B99

DELAYED ALTERNATION IN WILD CALIFORNIA SEA LIONS WITH NATURALLY OCCURRING HIPPOCAMPAL DAMAGE Peter Cook[1], Colleen Reichmuth[1], Sophie Dennison[2], Frances Gulland[3]; [1]University of California Santa Cruz, [2]Animal Scan, [3]The Marine Mammal Center — Each year, many hundreds of sea lions are exposed in the wild to domoic acid, an algal neurotoxin with high affinity for AMPA and kainate receptors. Exposure can lead to mossy fiber sprouting in the dentate gyrus, medial temporal lobe epilepsy, and serious hippocampal damage. Because many of these animals come to shore in distress and are sourced to rehabilitation facilities for treatment, they are available short-term for study, thus representing a unique natural model for low-impact behavioral neuroscience. Between 2009 and 2011, 30 wild sea lions were brought from The Marine Mammal Center in Sausalito to University of California's Long Marine Lab, where they completed training and testing in a delayed alternation task. After completion of behavioral testing, each animal's brain was imaged in vivo via MRI. All animals were then returned to The Marine Mammal Center for further treatment or release, as warranted. Brain images were acquired in an oblique plain perpendicular to the long axis of the hippocampus. Hippocampal volumes were calculated by manual tracing, and normalized against total brain volume to provide a measure of possible atrophy for each animal. Some subjects showed bilateral atrophy, but unilateral atrophy, divided across subjects between the right and left hippocampal formations, was more common. Relative hippocampal volume was correlated with a performance deficit in the delayed alternation task, and this effect was driven predominately by damage to the right hippocampus.

B100

TRANSCRANIAL DIRECT CURRENT STIMULATION FACILITATES EPISODIC MEMORY ENCODING. Kevin Jones[1], Filiz Gözenman[2], Marian Berryhill[3]; [1]University of Nevada, Reno, [2]University of Nevada, Reno, [3]University of Nevada, Reno — Posterior parietal cortex (PPC) involvement in episodic memory remains poorly understood. Parietal activations during episodic memory performance may reflect attention to the task or functional involvement in mnemonic function. Here, we used the neurostimulation technique of transcranial direct current stimulation (tDCS) to investigate parietal involvement in episodic memory. TDCS is a safe and noninvasive neurostimulation technique that permits the study of structure-function relationships by subtly altering the resting potential of underlying neural populations. We investigated the role of the left PPC in episodic memory by applying anodal (+, depolarizing) or sham tDCS during encoding (Experiment 1) or maintenance (Experiment 2) periods. Participants performed two versions of the California Verbal Learning Task (CVLT) in which a 16-item word list is repeated and immediately recalled five times with further retrieval testing after short and long delay periods. We hypothesized that tDCS to the left PPC would facilitate encoding because P3 has been shown to be important in both working memory and in long-term memory formation/retrieval (reviewed in: Berryhill 2012). In Experiment 1, the data confirmed that participants learned the word list more quickly after anodal tDCS than after sham. Experiment 2 showed that left PPC stimulation during the delay period did not improve episodic memory. Thus, tDCS to the left PPC selectively improved episodic encoding but not maintenance. These data confirm that there is PPC involvement in episodic memory and that tDCS is an emerging technique that may be used to elucidate PPC function in memory.

B101

RETRIEVAL PRACTICE IS CHARACTERIZED BY REDUCED FRONTO-STRIATAL ACTIVITY Linnea Karlsson[1], Carola Wiklund-Hörnqvist[1], Johan Eriksson[1], Bert Jonsson[1], Lars Nyberg[1]; [1]Umeå University, Sweden — Retrieval practice is known to have stronger effects on long-term retention of material than mere re-reading of the same material, an effect known as the "testing effect". The neurocognitive mechanisms behind such retrieval-enhanced learning are not well understood. The current study examined changes in functional brain networks as a function of retrieval practice. Participants (n=20) first studied 60 Swahili-Swedish word-pairs. Subsequently, they underwent functional magnetic resonance imaging while being tested on each item three times. A factorial design compared activity changes of items successfully repeatedly retrieved with items that were not successfully repeatedly retrieved, a design capturing variance unique to retrieval practice. Successful repeated retrieval was characterized by decreased activity in prefrontal and premotor regions and in the right caudate, compared to items not successfully retrieved at consecutive tests. Successful repeated retrieval was also characterized by increased activity in right middle temporal cortex. The results imply that the benefits of retrieval-enhanced learning might be due to reduced retrieval and executive demands

in frontal cortex and striatum along with strengthening of memory representations in temporal cortex. The current results not only point at possible neurocognitive mechanisms governing the effectiveness of testing as a learning method but also demonstrate how cognitive neuroscience and educational research might learn from each other.

B102

HIPPOCAMPAL DAMAGE DISRUPTS REFERENTIAL PROCESSING

Jake Kurczek[1], Sarah Brown-Schmidt[2], Melissa Duff[1,3]; [1]Neuroscience Training Program, University of Iowa, [2]Department of Psychology & Beckman Institute, University of Illinois, [3]Department of Communication Sciences and Disorders, University of Iowa — A growing body of work suggests the hippocampus contributes to a variety of cognitive domains beyond its traditional role in declarative memory. We propose that the hippocampus, in its capacity for relational binding, representational flexibility, on-line maintenance and integration of rich, multimodal relational representations, is a key contributor to language processing and use. Here we test the hypothesis that referential processing, which requires both maintaining and integrating representations of potential referents with the unfolding discourse, is hippocampus-dependent. We combined eye-tracking with neuropsychological methods, where participants (patients with bilateral hippocampal damage and severe declarative memory impairment and healthy comparison participants) viewed a scene while listening to short dialogs introducing two characters (manipulating gender– same/different) and then referred to one using a pronoun (manipulating order of mention– first/second in preceding sentence); e.g., Minnie is playing violin for Daisy/Donald as the sun is shining overhead. She is wearing a blue/purple dress). Consistent with previous work, healthy comparison participants show preferential viewing of the first-mentioned character particularly when there is ambiguity (same gender). In contrast, this effect was attenuated, and in some cases reversed in hippocampal patients (preferentially viewing the most recently mentioned character). This finding suggests that hippocampus plays a role in maintaining and integrating information even over a very short discourse history and when all the key information is immediately available in the scene. These observed disruptions in referential processing demonstrate how promiscuously the hallmark processing features of the hippocampus are used in service of a variety of cognitive domains including language.

B103

SEX AND SEX HORMONE INFLUENCES ON RETENTION OF EMOTIONAL GIST AND DETAIL

Shawn Nielsen[1], Larry Cahill[1]; [1]Department of Neurobiology and Behavior, University of California, Irvine — Sex influences on emotional memory have received increasing interest over the past decade. However, only a subset of studies explored the influence of sex on emotional memory for central information (gist) and peripheral detail. Here we examined the influence of sex and sex hormones on memory for either an emotional or neutral story, specifically with respect to the retention of gist and detail. Naturally cycling women and men viewed a brief, narrated, three-phase story containing neutral or emotionally arousing elements. One week later, participants received a surprise free recall test for story elements. The results indicate that naturally cycling women in the luteal (high hormone) phase of the menstrual cycle show enhanced memory for peripheral details, but not gist, when in the emotional compared with neutral stories ($p<.05$). In contrast, naturally cycling women in the follicular (low hormone) phase show enhanced memory for gist, but not peripheral details, in the emotional compared with neutral stories ($p<.05$). Men also show enhanced memory for gist, but not peripheral details, in the emotional versus neutral stories ($p<.05$). In addition, these sex influences on memory cannot be attributed to differences in attention or arousal; luteal women, follicular women, and men performed similarly on measures of attention (fixation time percentage) and arousal (pupil diameter changes). These findings suggest that sex and sex hormones influence memory for different types of emotional information. We relate these findings to an established sex difference in the relationship between amygdala activity during emotional events and subsequent memory for those events.

B104

VOLUMETRIC ANALYSIS OF MTL SUBREGIONS IN DEVELOPMENTAL AMNESIA USING HIGH-RESOLUTION MRI

Rosanna Olsen[1], Daniela Palombo[1,2], Brian Levine[1,2,3], Jennifer Ryan[1,2,4], R. Shayna Rosenbaum[1,5]; [1]Rotman Research Institute at Baycrest, [2]Department of Psychology, University of Toronto, [3]Department of Medicine (Neurology), University of Toronto, [4]Department of Psychiatry, University of Toronto, [5]Department of Psychology, York University — There is great interest in the cognitive consequences of early hippocampal volume loss in developmental amnesia (DA). However, surprisingly little is known about the locus, extent, and distribution of hippocampal damage in individuals with DA, in which neural insult occurs well before development is complete. Here we used high-resolution MRI (T2-weighted, voxel size = 0.4x0.4x3.0mm) to manually segment the medial temporal lobe (MTL) subregions in patient H.C., a young adult with DA, and a group of sex- and age-matched control participants (n=10). First, the hippocampus as a whole was defined and divided into anterior and poster segments. Next, the subfields of the hippocampus (CA1, dentate gyrus/CA2/3, and subiculum) were defined within the body of the hippocampus. Finally, the entorhinal (ERC), perirhinal (PRC), and parahippocampal (PHC) cortices were defined. Volumetric estimates were corrected for head size (Arndt et al., 1991) and statistical significance was set to $p<0.05$ (Crawford et. al., 2010). In the right hippocampus, both anterior and posterior segments were significantly smaller in patient H.C.; in the left hemisphere, only anterior hippocampus was significantly reduced. In the body of the hippocampus, all three subfields were significantly reduced in the left hemisphere; CA1 and subiculum were reduced in the right hemisphere. In the MTL cortex, no differences were observed between groups in the PRC and ERC, while bilateral PHC volume was significantly increased in patient H.C. compared to controls. These results can be used to inform patterns of spared and impaired cognitive abilities in DA and perhaps in amnesia more generally.

B105

LONG-TERM MEMORY EFFECTS IN THE N400 DURING SENTENCE PROCESSING: EVIDENCE FROM A NOVEL RECOGNITION MEMORY - SENTENCE COMPREHENSION PARADIGM

Maria Lago[1], Chow Wing yee[1], Barrios Shannon[1], Parker Dan[1], Morini Giovanna[1], Lau Ellen[1]; [1]University of Maryland — Does memory of individual words interact with the expectations built during sentence comprehension? The amplitude of the N400 component is known to be modulated by item repetition in word lists (Rugg, 1985) and by the predictability of a word in sentences (Kutas, 1993). Previous work has examined the relationship between repetition and congruity using whole-sentence repetition (Besson et al. 1992). This work has found an effect of repetition, but only when the target word is incongruous given the context, which suggests that having studied a word might only play a role when something has gone awry in the computation of the meaning of the sentence. Here we asked: (1) whether memory of words affects their processing during sentence comprehension and (2) whether the effect of repetition interacts with the effect of predictability in the sentence. We embedded a sentence comprehension task within a recognition memory task. Participants (n=24) were asked to study a list of words and perform a recognition task after reading sentences. We manipulated the cloze probability of a semantically congruous target word (expected vs. unexpected) and whether the target word was studied earlier (old vs. new). We found a significant main effect of both factors in the N400 amplitude and no interaction between them. That is, repetition of a word leads to a smaller N400 effect during sentence comprehension regardless of its predictability in the sentence. These results suggest that memory of individual words facilitates access to expected and unexpected words equally during sentence comprehension.

B106

REWARD BINDS STIMULUS-ACTION TO STIMULUS-CLASSIFICATION ASSOCIATIONS

Karolina Moutsopoulou[1,2], Qing Yang[1,2], Yi-Fang Hsu[1,2], Anne-Marike Schiffer[3], Nick Yeung[3], Florian Waszak[1,2]; [1]Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [2]CNRS (Laboratoire Psychologie de la Perception, UMR 8158), Paris, France, [3]Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford OX1 3UD, UK — Many studies have shown that in associative learning, a stimulus is associated

with the particular action used to respond to it (S-A), as well as to the specific classification task that is performed on it (S-C). Recently, studies using various methodologies have shown that S-C and S-A associations are independently processed. Here, using an item-specific across-task priming paradigm and measuring reaction times we investigated whether the processing of these associations is influenced by monetary reward which is known to increase dopamine. Reward was investigated using a dynamic model of expected value estimation where participants' expectation of the reward value was defined by whether an upcoming reward was higher, approximately equal, or lower than what they expected (based on the rewards they already had in the previous trials). The results show that giving rewards during the initial learning phase (priming phase) which are higher than the expected, creates an interaction between S-C and S-A while when the reward is lower than expected S-C and S-A associations are processed independently. The type of interaction observed indicates that under conditions of increased dopamine, S-A processing pathways interact with S-C processing, an association not previously observed in the literature. These findings suggest that dopamine-dependent reward learning can strengthen connections between S-C and S-A processing.

B107

NEURAL BASIS OF SUBLIMINAL INHIBITORY PRIMING IN VISUAL WORD RECOGNITION Maciej Pas[1], Kimihiro Nakamura[1], Nobukatsu Sawamoto[1], Hidenao Fukuyama[1]; [1]Kyoto University — Some recent behavioral studies of masked priming report that the subjects' reaction time (RT) for word recognition is increased, as opposed to the typical RT reduction in most priming experiments. This inhibitory priming is observed when prime and target words share a syllable at their initial segment (e.g. 'koin' - 'koruku'). In this study we employed functional magnetic resonance imaging to explore the brain regions linked to inhibitory priming. The behavioral paradigm had a 2x2 factorial design, with prime-target syllabic overlap (shared or different), and prime presentation field (left or right hemifield) as within-subject factors, thereby allowing us to measure the neural priming of each hemisphere separately. Twelve right-handed volunteers judged whether target words represented natural or artificial objects. Consistent with previous behavioral studies, our results showed significant delay in RT in shared syllable trials relative to different syllable trials. At the neural level, imaging results revealed increased activation of the left prefrontal cortex in shared syllable trials, relative to different syllable trials, suggesting that behavioral inhibitory priming is mediated through repetition enhancement rather than repetition suppression previously known for facilitatory behavioral priming. This neural priming was produced by masked primes flashed to the left hemisphere but not by those presented to the right hemisphere. These results provide novel imaging data for the fast word processing mechanism mediated by the left inferior prefrontal cortex, which is distinct from the classical visual word form system in the left occipitotemporal cortex.

B108

LEFT PARIETAL TRANSCRANIAL MAGNETIC STIMULATION DISTURBS PRIMING BETWEEN SYMBOLIC AND NON-SYMBOLIC NUMBER REPRESENTATIONS Delphine Sasanguie[1], Silke M. Göbel[2], Bert Reynvoet[1]; [1]KU Leuven, Belgium, [2]University of York, UK — An amodal number representation activated by all types of numerical input, irrespective of the input notation, has often been proposed to be located in the left or right IntraParietal Sulcus (IPS). Two cross-notational priming experiments were carried out to test the existence of a notation-independent magnitude representation in the left or right parietal lobes. In Experiment 1, stimuli were Arabic digits and number words. Results revealed no significant effect of stimulation with Transcranial Magnetic Stimulation (TMS) over left or right IPS during prime presentation. In contrast, in Experiment 2, digits and dot patterns were intermixed and here the priming distance effect (PDE) was reduced in the right TMS condition and absent for stimulation over left IPS. These findings suggest: 1) that TMS over left but not right IPS disrupt processes that are crucial for priming when symbolic and non-symbolic stimuli are intermixed, and 2) that disruption of the left IPS on its own is not sufficient to disrupt cross-notational priming when purely symbolic number notations are used. Our results point towards a crucial role of the left hemisphere for the mapping between small symbolic and non-symbolic numerosities.

B109

TRACKING SOURCES OF IMPLICIT RECOGNITION IN VISUAL CORTEX USING PARAFOVEAL KALEIDOSCOPE IMAGES Iliana M. Vargas[1], Joel L. Voss[1], Alejandra N. Garcia[2], Jonathan H. Hofman[3], Ken A. Paller[1]; [1]Northwestern University, [2]California State University San Marcos, [3]Columbia University — Stimulus repetition can facilitate perceptual processing and behavioral responses in implicit memory tests. In some circumstances, repetition-induced facilitation of perceptual processing can also support highly accurate recognition responses in the absence of awareness of memory retrieval. Our previous studies examined this phenomenon of "implicit recognition" using two-alternative forced-choice recognition testing with kaleidoscope images and perceptually similar foils. Recently we found that implicit recognition was dependent on stimulus location, in that guesses were 71% accurate for stimuli presented on the same side of fixation and in the same location during study and test, but only 50% accurate (chance) for stimuli presented on different sides. We thus hypothesized that implicit recognition arises from memory storage in retinotopic visual cortex. In order to further test this hypothesis, we adapted recognition testing procedures for recording event-related brain potentials. At encoding, stimuli appeared briefly either left or right of fixation. At test, stimuli appeared on both sides simultaneously (either the same repeat kaleidoscope on both sides or the same highly similar foil on both sides). Guess responses were more prevalent than remember and know responses, and guessing accuracy was greater than chance, as in our previous studies. Analyses of corresponding lateralization of implicit recognition brain potentials was motivated by our previous findings regarding neural correlates of implicit recognition. Overall, results confirmed that remarkably accurate guessing can arise during recognition testing when behavioral responses are influenced by a repetition-induced facilitation of perceptual processing.

B110

DISTINCT NEURAL SYSTEMS FOR THE PRODUCTION OF SPEECH AND EMOTIONAL VOCALIZATIONS Zarinah Agnew[1], Lilya Ward[1], Carolyn McGettigan[1,2], Oliver Josephs[1], Sophie Scott[1]; [1]UCL ICN, Alexandra House, 17 Queen Square, London, WC1N 3AR, UK, [2]Royal Holloway, University of London, UK — The neural control of production of emotional vocalizations may be fundamentally different to that of speech sounds. Emotional vocalizations may be more akin to vocalizations made by non-human primates in that many are universal, i.e. recognizable across distinct cultures. Conversely, speech sounds are highly over-learnt articulations that are not consistent across cultures. Given these differences, it has been suggested that emotional vocalisations may rely on evolutionarily older, or different neural systems. This is the first time functional neuroimaging has been used to investigate two evolutionarily distinct subsystems for articulation by comparing the production of speech sounds and emotional vocalizations. Subjects were cued to either produce an emotional vocalization or a speech sound related to a written cue. The emotional conditions were disgust, sadness, amusement and relief. Functional data were acquired using a clustered sparse acquisition to deal with head motion. Breathing was monitored throughout in order to investigate neural activity associated with changes in breathing across conditions. Finally a motor localizer was performed in order to identify cortical maps for movement of different aspects of the articulators. Early analyses indicate that production of emotional vocalizations compared to speech was associated with activity in right putamen, right anterior inferior frontal gyrus/insula, anterior cingulate and bilateral inferior parietal cortex. These data suggest that there may be different neural pathways for the control of these two types of movement, lending support to the suggestion that speech and emotional vocalizations rely on different neural pathways.

B111

LATERALIZED READINESS POTENTIAL AMPLITUDE IS ASSOCIATED WITH RELATIVE MOVEMENT EFFICIENCY AND CHOICE: SIMULTANEOUS PREPARATION OF LEFT AND RIGHT HAND ACTIONS DURING A POINTING TASK. Donald Atkin[1], Peter Dixon[1], Anthony Singhal[1]; [1]University of Alberta — Evidence from human and non-human primates indicates that two or more potential actions can be represented simultaneously. In humans, conflict between prepared actions can

be detected using electroencephalography (EEG) via the lateralized readiness potential (LRP), which appears smaller in amplitude as the number and distance between potential targets is increased. However, this line of research has thus far only investigated conflicts between potential actions involving a single effector, such as a hand, rather than conflicts between effectors. In two experiments, we sought to extend the investigation of action competition by offering participants a choice of effector when performing pointing towards a left- or right-lateralized, circular target. While Experiment 1 was free-viewing in design, Experiment 2 introduced a fixation cross as a control for target visual field. EEG was recorded during each experiment, which permitted detection and analysis of the LRP. Experiment 1 demonstrated a reduction in LRP amplitude when participants performed contralateral movements as well as when they performed movements to centrally-located targets regardless of effector, while Experiment 2 replicated the reduction in LRP amplitude during contralateral movements. Together, these findings constitute the first evidence of competition between effectors in humans. Competition appears to occur when no effector possesses an efficiency advantage in terms of the physical distance it must transverse to the target, or when people choose to perform movements which are inefficient. As relative movement efficiency is likely established through movement simulation and prediction, this finding suggests that the LRP could be used to measure imagined movements.

B112

USING EEG AND MACHINE LEARNING TO PREDICT ACTION GOALS FROM DATA IN THE HUMAN MIRROR SYSTEM

Lawrence P Behmer Jr.[1], Jason Fairey[1], Lawrence B Holder[1], Lisa R Fournier[1]; [1]Washington State Univeristy — The frontal-parietal mirror circuit (FPMC) is active when individuals observe or perform a goal-directed behavior. Evidence in macaques and humans suggest that the FPMC is extremely robust at the point when individuals code the goal of the motor act, enabling an observer to understand an agent's intentions. Recent theoretical hypotheses in the fields of computer science and machine learning suggest that data from the FPMC may have applications in robotics and artificial intelligence. Recently, EEG data has been used to control brain-machine interfaces, move a cursor on a computer screen, access a smart phone app, and to predict whether an individual won or lost in a blackjack game. Here, we used human FPMC data from the EEG (electroencephalography) to design a machine learning algorithm to predict the action outcome of an event that a participant was observing. Adapting a paradigm used by Iacoboni and colleagues, we measured mu-ERD (event-related desynchronization) while individuals observed videos of an actor engaging in goal-directed actions where the outcomes were either ambiguous or unambiguous. We observed that mu-ERD was significantly strongest during the action and goal conditions compared to the non-movement setting conditions. Additionally, mu-ERD was strongest when the action outcome was ambiguous. Mu-ERD data was used to evaluate machine learning algorithms that can predict an individual's intention. We discuss the use of this data towards the development of hands-free, non-invasive neural devices that can assist senior citizens with mobility impairments in a Smart Home environment.

B113

PLASTICITY IN ADULT SOMATOSENSORY CORTEX: COMPARISON BEFORE AND AFTER BRAIN SURGERY

Hana Burianova[1], Anina Rich[1], Mark Williams[1], Lars Marstaller[1], Michael Morgan[2], Greg Savage[3]; [1]Centre in Cognition and its Disorders, Macquarie University, Sydney, Australia, [2]Australian School of Advanced Medicine, Macquarie University, Sydney, Australia, [3]Department of Psychology, Macquarie University, Sydney, Australia — We investigated brain reorganization in a patient who underwent a surgery to remove a brain arteriovenous malformation located in left somatosensory cortex and who, consequently, lost proprioception in the fingers of her right hand. The objectives of our study were to investigate long-term changes in neural activation and functional connectivity associated with the loss of finger proprioception and its gradual recovery. The patient participated in a longitudinal functional magnetic resonance imaging study in which she was required to engage in a simple motoric (finger tapping) task several times in the span of fourteen months. The results show that after surgery the patient's right finger tapping was significantly slower than left finger tapping. These behavioural changes were associated with pronounced decreases in left-hemispheric somatosensory activity and increases in right-hemispheric motor activity. Additionally, we observed significant changes in functional connectivity of the somatosensory network over time. The results of this study provide further support for neural plasticity in adulthood, evidenced not only by changes in regional activations but also by changes in functional connectivity.

B114

LOOKING AT UNDERSTANDING THE INFLUENCE OF PERSPECTIVE ON HANDEDNESS IN ACTION RECOGNITION IN RIGHT HANDED SUBJECTS

Rachel Kelly[1], Chris Mizelle[1,2], Lewis Wheaton[1]; [1]Georgia Institute of Technology, [2]Atlanta VA Medical Center — Comprehension of skilled action is a typical aspect of daily behavior. The ability to understand action may require us to simulate that action in ourselves. The purpose of this neurobehavioral study is to evaluate the interaction of handedness and perspective plays in our ability to recognize the goals of motor acts. In a two- part study, right- handed subjects were first trained directly with different tools. Then they were presented with randomly organized static visual images of novel and familiar tools from egocentric or allocentric perspectives performed by either a left or right hand. For the first part, behavioral results showed there was a significant effect of accuracy with respect to perspective, with highest accuracy in the egocentric perspective. As this may relate to encoding of action from an internal perspective as opposed to a social perspective, the second neural study was performed. The neural study showed parietal and occipital activation for the allocentric perspective when compared to egocentric perspectives. Egocentric perspective showed a greater activation in the premotor regions that which is involved in motor planning. Further analysis revealed an effect of handedness of the actor, which showed activations consistent with limb-specific motor simulation. This suggests activation of motor representations of the observer's left hand when watching a left-handed person for comprehending actions, regardless of the perspective of the action seen. Consequently, the current research will help us better understand how we encode action and recall motor simulations and may ultimately contribute to understanding of some tool-use related deficits.

B115

TIME-FREQUENCY ANALYSIS OF CORTICAL RESPONSES TO VOICE PITCH FEEDBACK PERTURBATION REVEALS BILATERAL NETWORK OF DETECTION AND COMPENSATION.

Naomi S Kort[1], John F Houde[1], Srikantan S Nagarajan; [1]University of California, San Francisco — Speech requires the coordination of motor commands to produce sounds that convey an intended message. While auditory feedback, when available, is used to monitor speech and correct errors, the role of feedback in speech remains poorly understood. Thus, experimental manipulation of auditory feedback during speaking offers a unique window to understand the neural substrates of speech motor control. This study used real-time pitch-altered auditory feedback with magnetoencephalography to explore the neural correlates of feedback processing. In the Speaking Condition, subjects produced a sustained utterance of the vowel /a/. During the phonation the subjects heard one 100-cent pitch perturbation lasting 400ms. Equal numbers of trials raising and lowering the perceived pitch were pseudorandomly distributed. In the Listening Condition, subjects passively listened to the recording of their perturbed voice feedback. The neural analysis consisted of time-frequency beamforming using the NUTMEG software package. Only subjects who systematically changed their pitch to oppose the direction of the applied perturbation were used in this analysis. The compensation began on average 206ms after the perturbation onset with an average compensation of 19% and the range from 9% to 41%. The cortical response to the applied pitch perturbation revealed a distinct bilateral pattern of enhanced activity in the speaking condition as compared to the listening condition. Furthermore, a temporally dynamic network including temporal and motor areas shows significant regression with individual subjects' compensation. With this time-frequency analysis we observe the bilateral network involved in recognizing and responding to the pitch perturbation.

B116

ERROR ARGUMENTATION ENHANCE ADAPTABILITY IN ADULTS WITH LOW MOTOR ABILITY Chi-Mei Lee[1], Jin Bo[1]; [1]Eastern Michigan University, Michigan, USA — Developmental Coordination Disorder (DCD) is characterized as having motor deficits that interfere with individuals' daily activities. It is a pervasive and enduring disorder, which persists into adulthood. Children with DCD have shown learning deficits in visuomotor adaptation tasks, and failure to detect the errors seem to be the key that impede their motor learning (e.g., Kagerer et al., 2006). Studies showed that larger feedback could improve the rate and extent of motor learning in young adults (e.g., Patton et al., 2006). The current study recruited adults, who self-reported as having motor coordination problems and as healthy controls (aged from 18 to 34), to examine their adaptability in a center-out adaptation task when error feedbacks were either regular (30° rotation) or enlarged (30° + double error). We predicted that adults with low motor ability would show less difficulty in the enlarged feedback condition compared to the regular feedback condition. Results revealed that participants with lower motor ability (assessed by the Adult DCD/Dyspraxia Checklist, Kirby et al., 2010) showed less adaptability (i.e. significant group x block interaction on spatial variability and no aftereffects on motor planning measures) than those with higher motor ability in the regular feedback condition. However, they were able to reach a similar level of adaptability compared to the controls in the enlarged feedback condition (i.e. no group differences on aftereffects for all the measures). We argue that adults with motor difficulties can compensate their "noisy" internal visuomotor mapping by relying more on their feedback processes.

B117

EXPERIENCE AND EXPERTISE MODULATE REWARD PROCESSING WITHIN MEDIAL-FRONTAL CORTEX Stephane MacLean[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. In the present study we had participants do a postural control task while electroencephalographic (EEG) data was recorded. Specifically, we had participants complete a task that required them to learn to improve their control of their center of balance. An analysis of our behavioral data revealed that participants did improve their postural control over the course of the experiment. An analysis of the EEG data revealed that a feedback error-related negativity (fERN) was elicited by movement errors, a finding in line with previous work (i.e., Krigolson et al., 2008). Further, we found that the amplitude of the fERN could be used to distinguish between differing levels of behavioral performance – people who exhibited better behavioral performance had larger fERN amplitudes overall. Finally, participants who demonstrated better behavioral performance at the postural control task also self-reported histories of greater athletic experience. Interestingly, these results suggest a relationship between reward processing by the medial-frontal system, behavioral performance, and expertise. In sum, these findings are in line with the aforementioned research (i.e., Krigolson & Holroyd) and further extend it to provide an insight into the mechanisms that potentially underlie the development of expertise.

B118

AGING, AEROBIC ACTIVITY AND INTERHEMISPHERIC COMMUNICATION Keith McGregor[1,2], Kenneth Heilman[3,4], Joe Nocera[1,2], Carolynn Patten[3,4], Todd Manini[5], Bruce Crosson[1,2], Andrew Butler[1,6]; [1]Atlanta VA RR&D Center for Neurocognitive and Visual Research, [2]Emory University, Department of Neurology, [3]Malcom Randall VA Medical Center, [4]University of Florida, Department of Physical Therapy, [5]University of Florida, Institute on Aging, [6]Georgia State University, Department of Physical Therapy — Recent studies have shown that during unimanual motor tasks older adults show bilateral recruitment of primary motor cortex (M1), while younger adults show a suppression of the ipsilateral motor cortex. Additional work has indicated that increased bilateral M1 recruitment in older adults may be deleterious when performing some motor tasks. However, higher levels of physical fitness are associated with improved dexterity and fitness may mitigate the loss of both inhibitory and excitatory communication in aging adults. The goal of this study was to assess dexterity and interhemispheric motor communication in physically fit and sedentary middle-age (40-60 years) right handed participants using tests of hand deftness and transcranial magnetic stimulation (TMS). To behaviorally assess the influence of interhemispheric communication on motor performance, participants also perform the coin rotation deftness task while maintaining pinch force with the opposite hand (bimanual condition). We correlated these behavioral measures with the ipsilateral silent period using TMS to assess interhemispheric inhibition. Our results show that the middle-aged adults who were physically fit had better dexterity of their right hand (finger tapping and peg-board). When performing the coin rotation task the fit group had no between hand differences, but the sedentary group's left hand performance was inferior to the their right hand. Whereas we found that better dexterity correlated with ipsilateral silent period duration (greater inhibition) thereby supporting the postulate that fitness improves interhemispheric motor communication, for unknown reasons the two groups' performance during the bimanual task condition was similar.

B119

INTERACTION OF THE TWO VISUAL SYSTEMS IN A GRASPING TASK Kelly Mills[1], Claudia Gonzalez[1]; [1]University of Lethbridge — The dual-stream theory of visual processing posits that visual information is processed by two functionally distinct neural pathways. The ventral stream mediates the conscious perception of visual features that remain relatively stable over time, while the dorsal stream mediates visually-guided actions and updates spatial information on a moment to moment basis. For example, the location of your coffee cup earlier this morning is irrelevant to dorsal stream processing; only the information of where the cup is as you reach to pick it up is of importance. Here, we demonstrate that stable information stored in the ventral stream can in fact influence online actions under the control of the dorsal stream. Two groups of participants constructed replicas of a presented Lego model, from an array of Lego pieces, over 11 trials. Participants first used memorized visual information to search and build (Ventral trials), and in later trials they used online visual feedback to complete the models (Dorsal trials). In the Ventral trials, participants that were presented with Lego pieces in consistent locations on the table top (Experimental group) showed a decrease in search time over trials; participants that were presented with identical pieces but in randomized locations (Control group) did not show any savings. In the Dorsal trials, when both groups completed the task using online information, the results showed that the dorsal visual stream can capitalize on information acquired and stored by the ventral visual stream. This finding highlights the interaction between the two visual streams in a behavioural task.

B120

SEEING WHAT YOU WANT TO SEE: A BAYESIAN ACCOUNT Noham Wolpe[1,2], Daniel M Wolpert[1], James B Rowe[1,2]; [1]University of Cambridge, [2]Medical Research Council Cognition and Brain Sciences Unit — People tend to perceive their own abilities as superior to others. These illusions of superiority are not common in many aspects of life, but are also linked to good mental health. Misperceptions that arise in visual illusions have been successfully explained by Bayesian models. According to these models, the brain generates a percept by combining imperfect sensory information about the external world with expectations of possible sensory events, called priors. Here we ask whether self performing a task affects the priors people use when perceiving the outcome, and thus whether overestimation of performance might have a Bayesian account. We developed a visuomotor task to examine how participants integrate priors with sensory information, either when performing goal-directed actions themselves or when observing these actions. By fitting Bayesian models, we inferred the distribution of these priors, and compared them to the actual performance distribution. We found that priors for self-generated actions were consistently narrower (smaller standard deviations) relative to both the actual performance distribution and the priors for observed actions. In contrast, priors for observed actions were similar to performance distribution. This indicates that when performing goal-directed actions, the brain uses priors that represent exaggerated expectations of goal success, compared to when simply observing these actions. Consequently, people underestimate their own errors while more accurately perceiving the errors of observed actions. Such a Bayesian

account suggests that goal priors for our own actions underlie the common illusions of superiority, so that when acting we tend to see what we want to see.

B121

N170 VISUAL WORD SPECIALIZATION ON IMPLICIT AND EXPLICIT READING TASKS IN SPANISH-SPEAKING ADULT NEOLITERATES

Trey Avery[1], Laura Sanchez[1], Karen Froud[1]; [1]Teachers College, Columbia University — Adult literacy training is known to be difficult in terms of teaching and maintenance (Abadzi, 2003), perhaps because neoliterate adults have not acquired reading automaticity. This study examines fast word recognition processes in neoliterate adults, to evaluate whether they show evidence of perceptual (automatic) distinctions between linguistic and visual (symbolic) stimuli. Such a mechanism is thought to be the basis for effortless reading, associated with Visual Word Form Area activation that becomes "tuned" to script as literacy skills are acquired (McCandliss, Cohen, & Dehaene, 2003). High density EEG was recorded from a group of neoliterate adults who participated in two reading tasks: (1) a one-back task requiring implicit reading (available only to those who have attained automaticity), and (2) an explicit reading task, in which participants detected mismatches between pairs of visual and auditory words. Results were compared to recordings from a comparison group of adults who learned to read in childhood. The left-lateralized N170 ERP was targeted as an index of automaticity in reading. Participants from the comparison group showed left-lateralized N170 to word stimuli in both the implicit and reading tasks. Conversely, the N170 elicited from the experimental group showed a left-lateralized topography only in the explicit reading task, and a right lateralization in the one-back task. This suggests that automaticity in reading can be indexed in neoliterate adults using the N170, and that automaticity had not been acquired by the experimental group investigated here. Study implications with respect to literacy education and attainment are discussed.

B122

INTEGRATING REAL AND IMAGINED STIMULI ACROSS SENSORY MODALITIES

Christopher C. Berger[1], H. Henrik Ehrsson[1]; [1]Karolinska Institutet — Research on imagery has found a great deal of behavioral and neuroanatomical overlap between the things we conjure up in our minds, and the things we perceive as coming from the external world (c.f., Kosslyn, Ganis, & Thompson, 2001). Independently, an abundance of research on the interaction and integration of the senses has demonstrated the importance of combining stimuli from different sensory modalities on our perception of the external world (cf., Stein & Stanford, 2008). Historically, however, research on imagery has focused on similarities between imagery and perception within a single modality (Kosslyn et al., 2001). Here, in a novel approach to investigating the nature of imagery, we utilized classic multisensory illusions and functional magnetic resonance imaging (fMRI), to systematically examine whether imagery can interact with veridical stimuli of a differing sensory modality in the same way veridical stimuli from different sensory modalities interact with one another. We found that supplanting a veridical stimulus with an imagined stimulus in the presence of a simultaneously presented veridical stimulus from a different sensory modality lead to the same multisensory effects found for veridical versions of the cross-bounce illusion (Sekuler, Sekuler, & Lau, 1997), ventriloquist illusion (Howard & Templeton, 1966), and McGurk illusion (McGurk & MacDonald, 1976). Together, these findings demonstrate for the first time that imagery is capable of leading to multisensory integration, and are consistent with previous findings of overlapping representations of imagery and perception.

B123

NEURAL MECHANISMS MEDIATING TOLERANCE FOR AUDIO-VISUAL STIMULUS ONSET ASYNCHRONY

Jyoti Bhat[1], Lee M. Miller[2], Antoine J. Shahin[1]; [1]The Ohio State University,Columbus, OH, [2]University of California, Davis, CA — Audiovisual (AV) integration is integral to maintaining speech intelligibility in adverse acoustical environments. However, AV integration can be compromised by auditory and visual stimulus onset asynchrony (SOA) e.g. long AV delays often experienced while using electronic media communications, such as video conferencing. However, the brain is able to tolerate long SOA durations up to a point, termed the point of perceptual fusion (PPF). Here, PPF indicates the time point that lies between the first instance in which the forward-shifted acoustic signal is perceived out of sync and the last instance in which it was perceived in sync with respect to mouth movements. We investigated the neural mechanisms that facilitate the tolerance of long duration SOA for monosyllabic spoken words, in which SOA duration was adaptively roved around the PPF for each subject. The subjects judged each AV pair as either synchronous or asynchronous. The comparison of the underlying EEG activity for these conditions, revealed a significant difference in right lateralized centro-parietal beta band (14-30 Hz) activity following the PPF (0 – 500 ms) that was greater for the synchronous percept. Beta activity has been implicated in cortical-to-cortical long distance communication associated with perceptual object binding in the visual and auditory domains. Also, it has been implicated in AV integration mediating the McGurk effect, via the superior temporal gyrus (STG). Our findings suggest that the brain creates a temporal window of tolerance for SOA by coupling neural activity of auditory and visual centers via a central integrator, i.e., STG.

B124

ANATOMICAL AND FUNCTIONAL NETWORKS UNDERLYING AUDIO-VISUAL INTEGRATION

David Brang[1], Jacob Zweig[1], Jyoti Mishra[2], Satoru Suzuki[1], Steven A Hillyard[3], Vilayanur S Ramachandran[3], Marcia Grabowecky[1]; [1]Northwestern University, [2]UCSF, [3]UCSD — Our senses interact in daily life through multisensory integration, facilitating perceptual processes and behavioral responses. Anatomical and functional connectivity have been suggested as mechanisms underlying the ability to integrate information across the senses. Here we examined the role of both forms of connectivity in the modulation of visual processes by auditory cues. Multisensory interaction was quantified using the "sound-induced illusory flash" paradigm, in which a single visual flash paired with two auditory beeps frequently generates the novel percept of an illusory second flash. The role of anatomical connectivity was assessed by examining the relationship between the perception of an illusory second flash and individual differences in white matter connectivity (as assessed by diffusion tensor imaging) on 22 participants. Results revealed a significant positive correlation between the experience of an illusory second flash and enhanced anatomical connectivity (fractional anisotropy) between auditory and visual cortices, suggesting that increased connectivity increases auditory-visual interactions. Functional connectivity was assessed from EEG coherence data on a separate group of 40 subjects. Physically identical trials were divided for each participant according to whether or not an illusory second flash was reported. Interestingly, the experience of an illusory second flash was significantly associated with decreased phase coherence between auditory and visual cortices, suggesting increased functional connectivity reduces auditory-visual interactions. Thus, stronger anatomical connectivity increased but stronger functional connectivity decreased auditory-visual interactions. This dissociation suggests a complex and novel interaction between anatomical and functional connectivity in multisensory processes, suggesting both facilitatory and inhibitory processes between vision and audition.

B125

HEIGHTENED MOTOR REFERRAL AND SENSORY REFERRAL INDUCED BY NERVE BLOCK OR TOPICAL ANESTHETIC

Laura Case[1], Radhika Gosavi[1], Vilayanur Ramachandran[1]; [1]Center for Brain and Cognition, University of California, San Diego — Mirror neurons allow us to covertly simulate the sensation and movement of others. Yet if motor and sensory neurons fire during observation of movement or touch, why don't we actually feel that movement or touch? Might synesthetes lack inhibitory mechanisms that normally inhibit mirror representations from reaching conscious experience? Indeed, we have previously reported heightened sensory referral in amputees with phantom limbs and in patients with temporarily anesthetized arms. These observations suggest that sensory referral is heightened when sensory feedback is reduced or eliminated. In the current study we replicate the enhancement of sensory referral under nerve block, and also extend it to motor referral, in dental clinic patients undergoing minor procedures on one side of the mouth. In addition, we obtain causal, quantitative evidence of heightened sensory referral under temporary deafferentation in healthy participants who had anesthetic cream (versus control creams; double-blind) applied using a mirror-touch confusion task that elicits "false alarms" when the apparent visual feedback of touch leads the

participant to feel touch. We suggest that sensory and motor feedback participate in dynamic equilibrium with mirror representations of observed sensation and motor activity; when sensory or motor feedback is reduced, the brain relies more on visual information. The fact that participants actually feel touch in these cases, as opposed to merely guessing it occurred, suggests that this integration occurs in the mirror system. The sensory and mirror systems may implement Bayesian processes through mutual inhibition and disinhibition, relying more on visual feedback when sensorimotor feedback becomes noisy.

B126

THETA MODULATION IN THE FRONTAL CORTEX: A NEURAL CORRELATE OF CYBERSICKNESS

EunHee Chang[1], InJae Hwang[1], Hyeonjin Jeon[1], YeSeul Chun[1], Changhoon Park[2], Hyun Taek Kim[1]; [1]Korea University, [2]Hoseo University — Cybersickness occurs when participant experience virtual environments. Most studies of cybersickness have focused on subjective indices using questionnaires. However, physiological measures can provide more objective indices of cybersickness, and these measures can characterize depending on the levels of cybersickness. To determine whether the level of cybersickness affects brain activity, participants (n=4) passively navigated a 3D virtual environment for 10 min while undergoing EEG recording. They were instructed to report cybersickness by pressing a button whenever they felt symptoms of cybersickness while navigating the environment. Low-level cybersickness refers to the 60 s duration for which cybersickness was least reported among participants, and high-level cybersickness refers to the duration for which cybersickness was most often reported. Spectrograms were used to identify different brain activity patterns between low-level and high-level cybersickness. A repeated measures ANOVA was conducted on each frequency band (delta: 0.1–4 Hz, theta: 4–8 Hz, alpha: 8–13 Hz), with the level of cybersickness and periods of each level (the first 30 s and the last 30 s) as within-subject factors. We found that the power of the theta band was higher for the high-level cybersickness than for the low-level cybersickness at the F4 site ($F(1,3)=11.795$, $p<.05$). This result indicates that higher levels of cybersickness can be associated with increased brain activity related to spatial encoding, which is known to be a correlate of theta oscillations. This may reflect compensatory brain processing to reduce spatial disorientation caused by cybersickness.

B127

PERCEPTUAL CONFLICT OVER TIME AND BETWEEN MODALITIES: COMPARING BISTABLE PERCEPTS AND INTERSENSORY ILLUSIONS.

Pin-wei Chen[1], Allison K. Allen[1], Carlos Montemayor[1], Ezequiel Morsella[1,2]; [1]San Francisco State University, [2]University of California, San Francisco — Although neuroimaging research has illuminated the neural correlates of intersensory processing (e.g., ventriloquism) and of bistable percepts (e.g., Necker cube), little research has revealed how these conflicts influence action and the experience of the 'psychological self' (i.e., the sense of an observing self). Hence, building on previous research, we investigated these under-explored phenomena using two novel behavioral paradigms amenable to neuroimaging technologies. To assess the effects of intersensory conflict on action, in Study 1 (n = 16) we employed the McGurk illusion, where observers are unaware of intersensory interactions involving discrepant visual and auditory speech cues (McGurk & MacDonald, 1976). We observed that, under some circumstances, responses to the consciously-experienced illusion were influenced by the nature of trained responses to the unconscious speech-related cues underlying the illusion, $F(1,15) = 13.34$, $p = 0.002$. We discuss the inherent confounds of this paradigm. To investigate the effects of bistable stimuli on the stable, psychological self, in Study 2 (n = 26) participants observed bistable and unambiguous objects (e.g., 12 dots) while introspecting about the stability of the self. As predicted, participants reported that the self was more unchanging than the experience of either bistable or, interestingly, even unambiguous objects, $F(16) = 17.92$, $p = .0006$. Together, these projects introduce paradigms that are amenable to neuroimaging technologies and can reveal much about the neural bases of perception, unconscious conflicts, and the sense of self.

B128

AN EMPIRICAL EXAMINATION OF CREATIVE THINKING IN SYNESTHETES

Charlotte Chun[1,2], Jean-Michel Hupe[2]; [1]University of North Carolina at Greensboro, [2]Centre de Recherche Cerveau et Cognition, Université de Toulouse & Centre National de la Recherche Scientifique — Synesthesia is a subjective phenomenon in which individuals experience an automatic connection between two or more senses; for example, grapheme-color synesthesia, in which letters or numbers evoke a color association. Synesthesia is purportedly associated with enhanced creativity, though this claim lacks empirical support. The goal of this study was to examine creativity in groups of synesthetes and non-synesthetes, along with cognitive and personality factors. Participants were recruited from universities and public museums (n=3743) to complete an online screening survey, thus avoiding the usual requirement bias of synesthetes who spontaneously contact researchers. From the initial pool of respondents (n=1092), we selected a group of verified synesthetes (n=29) and non-synesthetes (n=36) to complete tests of creativity (verbal, visual, convergent, and divergent) and global cognition, as well as questionnaires of personality and mental imagery. The two groups did not differ on overall cognitive ability. However, synesthetes showed enhanced visual convergent and verbal divergent thinking relative to non-synesthetes. They also exhibited elevated self-reports of openness to experience and absorption in imaginative activities on personality questionnaires, as well as higher usage (but not vividness) of mental imagery. These differences were, however, rather weak (effect sizes between 0.1 and 0.2, as measured by partial Eta squared), meaning that, on the individual level, synesthetes might not be necessarily different from non-synesthetes. But on the group level, synesthesia is associated with some enhanced creative thinking skills and specific personality traits. This work is supported by Agence Nationale de Recherche ANR-11-BSH2-010

B129

REINFORCEMENT LEARNING AND COGNITIVE MAPS: THE ROLE OF MEDIAL-FRONTAL CORTEX

Shannon Doherty[1], Laura Bow[2], Cameron Hassall[1], Olave Krigolson[1]; [1]Dalhousie University, [2]University of British Columbia — A series of recent studies has demonstrated that a reinforcement learning system within medial-frontal cortex plays a role in the acquisition of perceptual expertise (Krigolson et al., 2009), motor skill acquisition (Krigolson & Holroyd, 2007), language development (Gossett et al., 2010) and other types of cognitive learning. In addition to the aforementioned research, a recent study demonstrated that the medial-frontal reinforcement learning system seemed to play a role in a navigational maze-learning task (Baker & Holroyd, 2009). Here, we used event-related brain potentials (ERPs) to extend Baker and Holroyd's work and demonstrate that the medial-frontal reinforcement learning system plays a role in the development of spatially based cognitive maps (i.e., Tolman, 1948). Participants completed a spatial navigation task where they sought to find rewards and avoid punishments while navigating a virtual room. Interestingly, reward feedback elicited the feedback error-related negativity (fERN: Miltner et al., 1997). However, the ERP waveform was not as clear as in previous work – our data demonstrated that the spatial context evoked an electroencephalographic response in the same time range as the fERN in addition to the reward related activity. To confirm our findings, we ran two control experiments which: 1) highlighted the influence of spatial context on the ERP waveforms, and 2) affirmed that a fERN was indeed elicited by reward feedback within the context of our task. In sum, our results indicate that the medial-frontal reinforcement learning system does play a role in the development of the cognitive maps that underlie spatial navigation.

B130

DIFFERENCES IN LEARNING FROM 'YUMMY' AND 'YUCKY' FEEDBACK: EVIDENCE FOR MULTIPLE SIGNALS GUIDING FOOD-RELATED LEARNING IN HUMANS

Matthias Doucerain[1,2], Lesley K. Fellows[2]; [1]Harvard University, [2]McGill University — Food is a primary reinforcer, and learning from feedback is likely to play a key role in human eating behavior. It has been proposed that dopamine provides a general reward signal underlying such learning. However, food does not only vary between so-so and delicious: it can also be disgusting. There is debate about whether dopamine alone is sufficient to signal negative outcomes, with other brain systems, such as amygdala and insula, implicated in aversive learning. The

present study explored choice behavior of healthy human participants in a variant of a probabilistic selection task (Frank, 2004). In this task, participants learned through trial and error that abstract representations of novel food packages predicted visual feedback in the form of a humanoid exclaiming either 'yummy', 'okay', or 'yucky', with varying probabilities. As expected, the probability of correct choices increased across trials ($p<0.0001$) and did so more quickly for easy than for difficult stimulus pairs ($p<0.001$). Interestingly, the probability of correct choices given 'yummy/okay' feedback was significantly larger ($p<0.05$) than that for 'okay/yucky' feedback, even after controlling for the other influences. This effect was also evident in the test phase (which examines how learning generalizes across novel combinations of stimuli in the absence of feedback). This result suggests distinct disgust-driven and reward-driven learning mechanisms, engaged here by entirely abstract feedback in a hypothetical 'food choice' learning task. A fuller understanding of the neural basis of these mechanisms will be important if feedback-learning models are to be applied to food choice in humans.

B131

DISSOCIATING THE NEURAL REPRESENTATION OF RISK CONSTRUCTS IN A NOVEL GAMBLING TASK

Rena Fukunaga[1], Joshua W. Brown; [1]Indiana University — Risk is a concept with multiple meanings that are often disputed when used to inform cognitive neuroscience studies of decision making. This study was designed to test competing hypotheses of how risk is represented in the brain based on different measures of risk. We aimed to dissociate between three types of risk constructs, specifically variance (Preuschoff et al., 2008), loss probability (Brown & Braver, 2005), and the magnitude of a loss (Brown & Braver, 2007). Participants chose between a series of hypothetical gambles that measured their preferences regarding decisions about money. For each given trial, a sure payoff option was presented against a gamble option. Five gamble options were created in order to independently manipulate the risk constructs while keeping the expected value constant across the conditions. Gambles were created to consist of three pairwise comparisons that partially controlled for each of the three risk constructs thus ensuring that any effects from a given pairwise comparison was not due to the controlled factor. Preliminary findings showed a greater bilateral anterior cingulate, right inferior frontal gyrus, and left insula activity at the time of decision with increasing variance of the chosen gamble. In contrast, we found no significant activation for either the loss probability or the magnitude of loss in brain regions known to be involved in representing risk. Our results suggest that the neural representation of risk reflects the variance of the possible outcomes, thus highlighting the importance of distinguishing between the different measures of risk in decision-making paradigms.

B132

FRAMING EFFECTS IN DECISION-MAKING: ORBITOFRONTAL DAMAGE DISRUPTS THE DECISION, BUT NOT THE FRAMING EFFECT

Anna Garr[1], Lesley Fellows[1]; [1]Montreal Neurological Institute, McGill University — People often make markedly different choices depending on the context in which options are presented, even when the objective values of the options are identical, an irrational choice phenomenon termed the framing effect. For example, people tend to take more risks when the potential for a loss is emphasized, but choose the certain outcome more often when the same decision is framed in terms of potential gains. A recent fMRI study proposed that the framing effect is mediated by the amygdala, with the orbitofrontal cortex (OFC) playing a regulatory role and so promoting more rational choice. Here we asked whether OFC damage alters the framing effect, measured using several widely used tasks including the classic "Asian-Disease Problem", a multi-trial risky decision paradigm with monetary losses and gains, and scenarios where attributes of decision options were framed in positive or negative terms. Thirteen patients with chronic focal damage affecting OFC were compared to 13 patients with frontal damage sparing OFC and 28 demographically-matched healthy participants. OFC damage did not systematically alter the magnitude of the framing effect in any of these tasks although patients with OFC damage were somewhat more likely to make aberrant choices in trials that required right and wrong answers. This argues that the framing effect is the result of simplifying heuristics--decision 'short cuts'--that do not require OFC and highlights the likely existence of multiple decision mechanisms within the human brain.

B133

NEUROFUNCTIONAL DIFFERENCES RELATED TO THE IOWA GAMBLING TASK IN HEALTHY OLDER ADULTS

Kameko Halfmann[1], Julie Gudenkauf[1], William Hedgcock[1], Antoine Bechara[2], Natalie L. Denburg[1]; [1]University of Iowa, [2]University of Southern California — The Iowa Gambling Task (IGT) is thought to model real-life decisions by factoring in reward, punishment, and uncertainty. Impairment on this task has been associated with circumscribed damage to the ventromedial prefrontal cortex (VMPC). Further, we have demonstrated that two groups of functionally and cognitively intact older adults show divergent behavioral performance (impaired versus unimpaired) on this task – a difference we hypothesize is attributable to disproportionate decline in the prefrontal cortex. To specifically test this hypothesis, sixteen IGT-impaired and sixteen IGT-unimpaired older adults performed an alternate version (K') of the IGT while in a functional magnetic resonance imaging scanner. We predicted that IGT-impaired older adults would have neurofunctional deficits in the prefrontal cortex relative to IGT-unimpaired older adults. In early blocks of the IGT, we observed greater activation among IGT-impaired older adults relative to IGT-unimpaired older adults in ventromedial prefrontal regions. In later blocks of the IGT, we observed greater activation among IGT-unimpaired older adults relative to IGT-impaired older adults in ventral prefrontal regions. These results are consistent with our original hypothesis that there may be disproportionate decline in the IGT-impaired older adults. On a broader scale, these results are consistent with the interpretation of a neural dissociation between decision-making under ambiguity (in the earlier blocks) and decision-making under risk (in the later blocks).

B134

TEMPORAL DYNAMICS OF NEURAL COMPUTATIONS FOR STIMULUS VALUE AND EFFORT COST

Alison Harris[1], Seung-Lark Lim[2], Antonio Rangel[3]; [1]Claremont McKenna College, [2]University of Missouri-Kansas City, [3]California Institute of Technology — We often make decisions not only based on an item's value, but also the effort required to obtain it: e.g., using a vending machine versus walking to a café. Whereas good-based value is represented in ventromedial prefrontal cortex (vmPFC), recent data has implicated dorsomedial frontal cortex (dmFC) in integrating stimulus value with effort cost to derive net (combined) value. However, the temporal dynamics of net value computation remain unclear. Here we examined this question using event-related potentials (ERP) while hungry subjects decided whether to work at different levels of physical effort cost (low, medium, or high grip strength) for the opportunity to obtain food. Subjects' decisions generally incorporated both stimulus value and effort cost, as indicated by significant logistic fits to their choice curves. Parametric ERP responses associated with net value were visible from 100-300 ms after stimulus onset, negatively correlated with effort cost, and from ~450-650 ms, positively correlated with stimulus value. Distributed reconstruction of stimulus-locked responses revealed significant sources in the vmPFC, but not dmFC. In contrast, response-locked signals were chiefly localized to dmFC and superior parietal sources rather than vmPFC, and largely reflected effort cost computations preceding response. Together, these data suggest that localization of net value integration to vmPFC and dmFC sources depends on whether the data is time-locked to the onset of stimulus or response. In line with a transition from good-based to action-based valuation, computations of effort cost may play an increasing role in dmFC activity in the time directly leading up to choice.

B135

SEROTONIN TRANSPORTER GENOTYPE MODULATES IMPULSIVE CHOICE IN HUMANS

Catherine Hartley[1], Jonathan Kanen[2], Morgan McKenna[1], B.J. Casey[1], Joseph Kable[3], Elizabeth Phelps[2], Charles Glatt[1]; [1]Weill Cornell Medical College, [2]New York University, [3]University of Pennsylvania — Many important real-world decisions involve weighing actions that yield immediate gratification against those that only pay off over time. The influence of time on the subjective value of a reward varies widely between individuals, yet the origins of such differences are not well understood. A recent theory that serotonin fosters patience during intertemporal choice suggests that genetically mediated differences in serotonergic function may modulate temporal discounting. Here, we test whether a functional serotonin transporter polyadenylation polymorphism (STPP/rs3813034)

is associated with temporal discounting of monetary rewards. Participants provided saliva samples for genotyping and completed a decision-making task consisting of a series of choices between smaller immediate or larger delayed rewards, from which we estimated each individual's discount parameter. Based on existing theoretical models and experimental data, we hypothesized that a genetic propensity toward lower serotonin transporter expression (and thus, higher extracellular serotonin) would foster patience, increasing preference for larger delayed rewards. Consistent with this hypothesis, we found that individuals carrying a greater number of the lower serotonin-transporter-expressing STPP G allele exhibited lower discount rates. These results suggest that variation in serotonergic function due to STPP genotype modulates preferences for immediate versus delayed rewards, highlighting a genetic contribution to individual differences in impulsive decision-making in humans.

B136

CONNECT FIVE: CORPUS CALLOSUM CONTRIBUTIONS TO CREATIVITY

Jessica Carrasco[1], Eileen Luders[2], Joseph Frantz[1], Sephira Ryman[1], Rex Jung[1]; [1]University of New Mexico, [2]UCLA — The Corpus Callosum (CC) is the primary fiber bundle connecting the two cerebral hemispheres, integrating motor, sensory, and cognitive functioning. Creativity—the ability to generate novel and useful ideas—appears to be influenced by cognitive domains spanning multiple brain networks. We hypothesized that callosal thickness would predict creative cognition measured by the Composite Creativity Index – a composite of several measures of both verbal and non-verbal aspects of divergent thinking (Jung et al., 2010). 120 neurologically and psychiatrically healthy subjects (55 females) between the ages of 18-29 (mean age=22 ± 3) were scanned in a 3 Tesla Siemens MRI. To obtain callosal thickness measures, we traced the CC using MultiTracer and surface-based mesh modeling methods. Correlations between creativity and CC thickness were then computed. We found negative correlations between the Genu and Anterior Midbody thickness and CCI, and positive correlations in the Posterior Midbody and Isthmus. Both negative and positive correlations between CC thickness and CCI were found in the Splenium. Significant results ($p < 0.05$, uncorrected for multiple comparisons) were obtained between the transition of positive and negative correlations, on the border of the Anterior and Posterior Midbody of the CC. These results support the transient hypofrontality hypothesis wherein lower frontal connectivity is seen to facilitate higher idea generation, indicated by negative correlations within the Genu and Anterior Midbody of the CC. In contrast, posterior aspects of the CC demonstrated positive correlations, suggesting that better access to knowledge stores within temporal, occipital, and parietal (TOP) lobes facilitate such ideational generativity.

B137

INDIVIDUAL DIFFERENCES IN APPROXIMATE NUMBER ACUITY CORRELATE WITH CALCULATION AND MATHEMATICAL REASONING ABILITIES

Selim Chang[1], Soohyun Cho[1]; [1]Chung Ang University — Approximate number acuity (or number sense) refers to the intuitive ability to perceive and recognize numerosity. It has been hypothesized that number sense is a basic intuition which provides a basis for not only approximate, nonverbal numerical processing but also for formal mathematical education. Recently, several studies reported evidence that individual differences in number acuity are correlated with mathematical achievement measured longitudinally from kindergarten to 5th grade. However, in these studies, mathematical achievement has been taken from tests of numerical concept and basic calculation, without including higher level mathematical problem solving skills. For a thorough test of the hypothesis that number acuity correlates with mathematical achievement, we considered both arithmetic and mathematical reasoning components of mathematical achievement and examined their correlations with number sense. Participants were 29 adults who were assessed on their number acuity, mathematical reasoning, calculation abilities and fluid intelligence. The results demonstrated that individuals who had better number acuity scored higher on both the mathematical reasoning and calculation tests. When the individual's major was taken into consideration in addition to number sense in a stepwise regression analysis predicting mathematical achievement, both major and number sense were good predictors of mathematical reasoning, while number sense was the only significant predictor for calculation ability. Our results not only provide support for the hypothesis that number sense contributes to the acquisition of arithmetic skills but also demonstrates the possibility that number sense may serve as a foundation for higher achievement in mathematical reasoning and problem solving that goes beyond calculation.

B138

STIMULATING GAME AND STIMULATING BRAIN: IMPROVING BRAIN FUNCTIONS USING BRAIN STIMULATION WHILE PLAYING A COMPUTER-BASED MATH GAME

Chung Yen Looi[1], Mihaela Duta[1], Stefan Huber[2], Hans-Christoph Nuerk[2], Roi Cohen Kadosh[1]; [1]University of Oxford, [2]Eberhard Karls University — Effective processing of spatial representation of number magnitude is crucial for the development of mathematical skills. Recent research has shown that: 1) bodily spatial experiences of number magnitude resulted in pronounced improvement in numerical development (Moeller et al, 2012), and 2) competence with fractions predicts gains in mathematical achievement (Bailey et al, 2012). We combined an adaptive computer-based mathematical game using a motion-sensing input device (KINECT™) with wireless transcranial direct current stimulation (TDCS, NeuroElectrics), and delivered anodal-TDCS to the right dorsolateral prefrontal cortex to modulate neuronal excitability and neuroplasticity during the game. Participants completed two 20-minute training sessions on two separate days. They indicated the location of fractions on a visually presented number line by physically moving side-to-side. Trial difficulty increased as a function of performance. Compared to sham stimulation, TDCS led to more accurate performance and faster reaction times at higher levels of difficulty on the second day of training. At the end of the training, TDCS led to a transfer effect in which participants who received TDCS showed a significant increase in verbal digit-span working memory performance alongside a decrease in visuospatial working memory performance compared to the sham group. These results suggest that the combination of TDCS with computer-based training can lead to an enhancement effect, including positive and negative effects to non-trained mental faculties. Future studies should aim to optimize stimulation parameters to avoid cognitive side effects, in order to facilitate gains in mathematical achievement and provide a potential intervention for those with mathematical learning difficulties.

B139

ACUITY FOR CONTINUOUS MAGNITUDE IS ASSOCIATED WITH MATHEMATICAL ACHIEVEMENT IN EARLY ELEMENTARY SCHOOL CHILDREN

Yunji Park[1], Selim Chang[1], Soohyun Cho[1]; [1]ChungAng University — Approximate number acuity (also known as number sense) refers to the intuitive ability to determine numerosity (the number of elements of a set) in an instant. According to previous research, individuals who have accurate number sense have higher mathematical achievement. In addition, children with dyscalculia tend to have lower number acuity compared to typically developing children of the same age. In the present study, we investigated the correlation between the sensitivity for continuous magnitude and numerosity and whether these measures are correlated with mathematical achievement in children vs. adults. We examined the weber fraction for length and numerosity discrimination as measures of the acuity for continuous magnitude and numerosity, respectively. In addition, each subject was assessed on his or her intelligence quotient and mathematical achievement. The mean weber fraction for length discrimination was .09 in adults and .22 in children. The mean weber fraction for numerosity discrimination was .30 in adults and .48 in children. The weber fraction for numerosity, but not length discrimination, was significantly smaller in adults compared to children. The acuity for continuous magnitude (but not numerosity) was correlated with both intelligence and mathematical achievement in children. On the other hand, the acuity for numerosity (but not continuous magnitude) was correlated with both intelligence and mathematical achievement in adults. Our results indicate that the development of acuity for continuous magnitude precedes that of the acuity for numerosity and children's mathematical achievement is better predicted by the acuity for continuous magnitude rather than for numerosity.

B140

NEUROIMAGING PREDICTORS OF COGNITIVE PERFORMANCE ACROSS A STANDARDIZED NEUROCOGNITIVE BATTERY

David Roalf[1], Kosha Ruparel[1], Raquel Gur[1], Warren Bilker[1], R. Sean Gallagher[1], Mark Elliott[1], Laura Almasy[2], Michael Pogue-Geile[3], Konasale Prasad[3], Joel Wood[3],

Vishwajit Nimgaonkar[3], Ruben Gur[1]; [1]University of Pennsylvania Perelman School of Medicine, [2]Texas Biomedical Research Institute, San Antonio, TX, [3]University of Pittsburgh, Pittsburgh, PA — The advent of fMRI enables the identification of brain regions recruited for specific behavioral tasks. Most fMRI studies focus on single tasks, which limit applicability where assessment of multiple brain systems is needed. We demonstrate the feasibility of using an fMRI activation patterns during a computerized neurocognitive battery (CNB) at two sites to predict performance in 212 healthy individuals. Brain activation reflected task-responsive and domain-specific regions reported in previous single-task studies. Using a cross-validation LASSO approach, brain activation and extent of activation was used to determine the brain regions that best predicted neurocognitive performance on each of six neurocognitive tasks. Prediction of performance was reasonable for abstraction/mental flexibility, visuo-spatial memory and attention. Prediction was less accurate for verbal memory, face memory and emotion processing. In addition, association models within our sample using the cross-validated regions-of-interest indicated improved performance prediction, as expected. Here, we establish a benchmark index of performance associated brain activation that can be applied across an entire CNB. These data may facilitate identification of neural dysfunction associated with poor neuropsychological performance, allow for identification of individuals at-risk for brain disorders, and may ve helpful for early intervention and rehabilitation of neurocognitive deficits.

B141

CREATIVE ACHIEVEMENT AND RESTING STATE NETWORKS

Sephira Ryman[1], Andrei Vakhtin[1], Joseph Frantz[2], Jessica Carrasco[1], Ranee Flores[2], Rex Jung[2]; [1]University of New Mexico, [2]University of New Mexico Health Sciences Center, Department of Neurosurgery — Creativity has historically been a difficult construct to map on the brain using neuroimaging techniques, likely due to the diverse interaction of multiple brain regions involved. The effect of creativity on resting brain function was investigated using independent component analysis (ICA) of functional magnetic resonance imaging (fMRI), which has been shown to be more sensitive than conventional analysis techniques. 131 participants were given the creative achievement questionnaire (CAQ) and had resting state fMRI scans collected over a period of 10 minutes. Group ICA of FMRI Toolbox (GIFT) was used to split the intensity normalized z-scaled data into 100 independent components (ICs). Twenty-eight resting state networks (RSNs) were selected from the GIFT output according to previous publications: 6 visual, 6 sensorimotor, 6 attentional, 4 frontal, 4 default-mode (DMN), auditory, and basal ganglia. Effect of CAQ on the RSNs was examined in three fMRI domains: spatial maps, time course spectra, and functional network connectivity (FNC). Results of the spatial map analysis revealed a positive effect of CAQ on the right superior frontal gyrus. Time course spectra results indicated positive effects of CAQ scores on ~ 0.15 Hz power in 3 RSNs: 2 visual and a DMN. No effects of CAQ on FNC were detected. The increased right frontal superior gyrus activity is consistent with the problem solving and creativity literature. While the lack of effects on FNC was surprising, it may be that increases on FNC would only be apparent while performing a creative task rather than at rest.

B142

DEFAULT NETWORK AND EXECUTIVE CONTROL CORRELATES OF AUTOBIOGRAPHICAL PLANS AND THEIR QUALITATIVE FEATURES REVEALED BY PARAMETRIC MODULATION ANALYSES

R. Nathan Spreng[1], Kathy Gerlach[2], Daniel Schacter[2]; [1]Cornell University, [2]Harvard University — In order to engage in purposeful behavior, it is important to make plans, which then organize subsequent actions. Most studies of planning involve "look-ahead" puzzle tasks that are unrelated to personal or autobiographical plans. We recently developed a novel task to assess autobiographical planning involving the formulation of personal plans in response to real-world goals. Autobiographical planning was found to engage the default network, including medial temporal lobe and midline structures, as well as executive control regions in lateral prefrontal and parietal cortex (Spreng et al., 2010). To examine how specific qualitative features of autobiographical plans modulate neural activity, we collapsed across three fMRI studies of 63 healthy young adults and performed parametric modulation analyses. Ratings of plan detail, novelty, temporal distance, ease of plan formulation, difficulty in goal completion, and confidence in goal accomplishment, were used as covariates in six hierarchical linear regression models. This modeling procedure removed shared variance among the ratings, allowing us to determine the independent relationship between ratings of interest and BOLD signal during autobiographical planning. Differential activity in hippocampus, retrosplenial cortex, and medial prefrontal cortex was modulated by plan detail, novelty, temporal distance, and confidence. More detailed and higher novelty plans were also associated with increasing caudate, lateral prefrontal and lateral parietal activity. Foreseeable difficulty in goal completion increased with amygdala and orbitofrontal cortex activity. Results suggest that specific qualities of autobiographical plans are important predictors of default network and executive control engagement during plan formation and reflect the multifaceted process of autobiographical planning.

Poster Session C

C1

GRAPH PROPERTIES OF LARGE-SCALE FUNCTIONAL BRAIN NETWORKS DURING SENSORY MAINTENANCE IN TOP-DOWN SELECTIVE ATTENTION TO AUDIOVISUAL INPUTS Xiangfei Hong[1,2], Junfeng Sun[1], Shanbao Tong[1]; [1]Med-X Research Institute and School of Biomedical Engineering, Shanghai Jiao Tong University, Shanghai, China, [2]Center for Mind and Brain, University of California, Davis — Previous studies reported that sensory maintenance in top-down selective attention to audiovisual inputs involved distributed cortical activations, while the connectivity between these large-scale cortical regions has been poorly understood. Graph theory has demonstrated to be a useful tool in the analysis of brain networks. In this study, we investigated graph properties of the large-scale functional brain networks during sensory maintenance in top-down selective attention to audiovisual inputs. EEGs were recorded from 30 channels in 13 young healthy subjects (age: 21:2±2:3 yrs; male/female=9/4) during a passive viewing task, and a top-down intersensory selective attention task in the auditory and visual modalities. Phase synchronization indices between EEG channel pairs were estimated to create an association matrix, which were further converted into weighted graphs with different edge numbers. We found invariant small-world properties of the brain networks during both the passive viewing state and the top-down intersensory selective attentional state in alpha (8~13 Hz), beta (13~30 Hz) and gamma (30~50 Hz) EEG bands. The significantly increased clustering coefficient (C) and decreased characteristic path length (L) of the functional brain networks during the attentional state compared with the passive viewing state were observed in beta band and gamma band, but not in alpha band. Our results provided direct evidence for the important role of large-scale brain networks within higher frequency bands (beta band and gamma band) during sensory maintenance in top-down selective attention to audiovisual inputs.

C2

MULTIMODAL MULTITASKING MEASUREMENT AND EYE-MOVEMENTS Li Hsieh[1], Sean Seaman[1], Richard Young[2]; [1]Department of Communication Sciences and Disorders, Wayne State University, [2]Department of Psychiatry and Behavioral Neurosciences, School of Medicine, Wayne State University — We investigated the role of task modality and demands on multitasking using a series of event detection tasks designed to assess levels of distraction and cognitive workload during multitasking scenarios. By measuring event detection to fixed-location visual events (remote detection), head-locked visual events (head-mounted detection) and vibratory stimuli (tactile detection), levels of distraction incurred by different cognitive tests were determined. These tests included the Surrogate Reference Task (SuRT), a motor-visual visual search task, and the N-Back task, and auditory-memory-vocal task, and a driving-related lane-tracking task. In triple task conditions, participants completed a detection response task (remote, head-mounted, or tactile detection), lane-tracking and either an easy or difficult SuRT or N-Back task. Eye glance patterns, reaction times at detecting events and accuracy were used as principle measures of distraction. Our results showed that both N-Back and SuRT tasks increased reaction times and miss rates to all the event detection tasks. However, while increasing difficulty in the N-Back task caused longer RT and more misses for most tasks; increasing difficulty in the SuRT task did not increase RT for all tasks. These findings indicate that increased visual demand did not necessarily cause more distraction during event-detection. Results of eye glance analyses also showed that increased visual task load in the SuRT condition did not result in task "shedding," or a loss of attention to the task. This study suggests that subjects were able to engage with a more difficult visual motor task while multitasking without increasingly distracted by it.

C3

ATTENTION'S GRASP: EARLY AND LATE HAND PROXIMITY EFFECTS ON VISUAL EVOKED POTENTIALS David Leland[1], Benjamin Brekke[2], Alan Hartley[3], Catherine Reed[4]; [1]University of Wisconsin - Eau Claire, [2]Pitzer College, [3]Scripps College, [4]Claremont McKenna College — Behavioral studies suggest that the region of space near the hand ("graspable space") commands a disproportionate share of attentional resources, but it is unclear at what stage of processing this hand-related bias arises. Also, prior work has focused on overtly visuo-tactile integration (involving physical touch) and visual stimuli on the hands themselves, rather than visuo-proprioceptive integration, where the role of the hand is more implied. To address these questions, we examined event-related potentials (ERPs) using a visual detection task in which the palm of the hand was placed near or kept away from target and non-target stimuli, which were matched/counterbalanced for frequency and visual features. Focusing on attention-sensitive ERP components, we found first that P1 (100-140 ms) amplitude was increased for both targets and non-targets in grasping space, suggesting an early, precategorical increase in sensory gain. P3 (350-450 ms) amplitude was increased in grasping space for targets only, demonstrating a late post-categorical effect consistent with the P3's cross-modal and task-relevance influences. In between these components, an N1 variant (central Nd1, 120-190 ms) also showed a target-specific effect of grasping space, which agrees with the N1's association with stimulus discrimination and cross-modal influence. Collectively, these findings provide insight into the time-course of visuo-proprioceptive interaction. Grasping space appears to bias attention early and over a long period, starting with a facilitation of processing for perhaps any visual stimuli near the hand, and continuing with enhancements that are selective to those stimuli categorized as task-relevant.

C4

BORED OR DISTRACTED? FACTORS INFLUENCING ATTENTION ACROSS MODALITY AND AGE Xu Li[1], Ziyong Lin[1], Anne S. Berry[1], Cindy Lustig[1]; [1]University of Michigan — Attentional performance can be affected both by ability and by motivation. To test the contributions of these factors, we used visual and auditory versions of the Continuous Temporal Expectancy Task (CTET; O'Connell et al., 2009), with and without distraction implemented by an adjacent computer playing video clips. The CTET requires participants to monitor the duration of briefly-presented stimuli to detect targets (1070 ms) of longer duration than the standard (800 ms). The visual version has been linked to behavioral and electrophysiological measures of attention lapses. The timing literature suggests that compared to visual stimuli, auditory stimuli capture and hold attention more automatically (Block &Zakay, 1997; Meck, 1991; Penney, 2003), leading to the prediction that performance in an auditory version of the CTET should be better and less influenced by attention lapses. Consistent with this prediction, young adults tested in the auditory condition detected more targets, although both visual and auditory conditions showed declines related to time-on-task and the video distractor. Individual differences in performance differed between the two modalities, with poor performance in the auditory condition primarily related to boredom and poor performance in visual condition primarily related to distractibility. Additional data from older adults suggest that they outperform young adults, and this age difference was mediated by boredom scores. These results support the idea that auditory stimuli capture but do not necessarily hold attention more automatically than visual stimuli. The contributions of ability versus motivation also differ across modalities and influence individual and group differences in attentional performance.

C5

THE COST OF LIMITING POTENTIAL DISTRACTION Francesco Marini[1,2], Leonardo Chelazzi[3,4], Angelo Maravita[1]; [1]University of Milan-Bicocca, Milan, Italy, [2]Duke University, Durham, US, [3]University of Verona, Verona, Italy, [4]Italian Institute of Neuroscience, Verona, Italy — The role of attention in the selection of relevant stimuli is particularly critical when distracting events are likely to occur. In these situations, the exclusion of potential distracters is an essential process for guiding behavior towards the achievement of current goals. Recent work shows that the brain can anticipate the presence of a distracting event and prepare to deal with it. Although beneficial for limiting potential distraction, engagement of this mechanism can be costly for the individual, as it might drag away some cognitive resources that are needed to perform a given task. So far, however, this prediction has

never been tested. In a series of experiments, we aim to investigate whether foreseeing potential distraction produces a cost in performance even when distraction is only expected, yet absent. We clearly show that, in potentially distracting contexts, the engagement of a mechanism for dealing with potential distraction causes a dramatic behavioral cost in no-distracter trials. Crucially, across participants, the observed strategic cost is inversely related to the interference exerted by a distracter on distracter-present trials. We replicated this pattern of results with different combinations of target and distracter sensory modalities, such as vision, audition and touch. Although the activation of the mechanism for dealing with distracters is modulated by probabilistic and cross-trial contingencies, its engagement is consistent across different manipulations of task and context, being likely a general feature of attentional control. Our data thus attest to a supramodal mechanism for monitoring and limiting potential distraction in the human brain.

C6

AUDITORY INDUCED MODULATION OF VISUAL OSCILLATORY ACTIVITY DEPENDS ON THE SOUND SOURCE POSITION Wiktor Mlynarski[1], Claudia Freigang[2], Marc Stöhr[2], Jan Bennemann[2], Rudolf Rübsamen[2]; [1]Max Planck Institute for Mathematics in the Sciences, [2]University of Leipzig — According to the existing evidence, most of the neocortex is multisensory. A unimodal stimulus can modulate activity of multiple cortical areas already on the early stage of sensory processing. It is still unclear, which stimulus features exhibit crossmodal influence of this sort. Here, we investigated the dependence of crossmodal auditory-visual interactions on a spatial location of a sound source. We performed an experiment to verify, whether oscillatory activity of the visual cortex depends on a position of an auditory object. In an acoustic free-field setup, we presented white noise bursts either at the center of the visual focus or at lateral positions on the edge of the binocular visual field (-/+ 64 deg) and recorded high-density electroencephalogram (EEG). Using Independent Component Analysis, clustering algorithms and single trial population analysis, we identified three cortical sources in the visual areas showing systematic, stimulus-specific oscillatory responses. During lateral stimulation, amplitude of alpha (8-12 Hz) and beta (13-20 Hz) band activity slightly decreased over contralateral visual area, which was preceded by pronounced phase resetting of theta (4-7 Hz) oscillations. Those effects were inverse in the ipsilateral visual area: alpha/beta amplitude was strongly increased, while theta phase resetting was weaker. When the stimulus originated at the center of the gaze, alpha/beta power was highly reduced in all three visual sources. In summary, we show, that visual cortex is early modulated by auditory stimulus alone and it is informed about the sound source position, which may result in shifting visuospatial attention towards unattended locations.

C7

WHERE WOMEN SEE CONTRAST, MEN SEE LUMINANCE Julia Mossbridge[1], Marcia Grabowecky[1], Satoru Suzuki[1]; [1]Northwestern University — The ability to ignore visual context in order to perform an unrelated task, sometimes called "field independence," is generally more common among men than women. A large literature has shown that reduced prioritization of context is related to adaptive traits, such as better performance on working memory tasks, as well as maladaptive conditions, such as autism spectrum disorders. However, the source of the gender difference in context prioritization has not been clear. Here we test the hypothesis that women prioritize context even at the most fundamental level of visual processing, center-surround contrast (e.g., a center dot is darker relative to a lighter surround). We used an implicit behavioral task that exploited the well-known auditory-visual association based on intensity (sounds that are louder and higher-pitched are associated with higher visual intensity). The task was visual flicker detection of a centrally presented gray dot on a white background, and either the high-luminance or high-contrast phase of the flicker was synchronized with the high-intensity/high-pitch phase of the accompanying sound. Women's (N=16) flicker-detection performance improved when the high-CONTRAST phase of the flicker was synchronized with the high-intensity/pitch phase of the sound; men's (N=16) flicker-detection performance improved when the high-LUMINANCE phase of the flicker was synchronized with the high-intensity/pitch phase of the sound ($F[2,60]=12.581$, $p<0.00003$ for the gender by crossmodal-phase interaction). It appears that women prioritize center-surround contrast whereas men prioritize center luminance. Thus, gender differences in context prioritization in perception and cognition may arise from fundamental differences in the processing of basic visual features.

C8

BOTH PERCEPTUAL AND CENTRAL INTERFERENCE CONTRIBUTE TO DUAL-TASK COSTS Omar AlHashimi[1], Joaquin Anguera[2], Adam Gazzaley[2]; [1]UCSF/UCB, [2]UCSF — Performance deficits characterized by response delays and errors often arise when dual-tasking. Psychological refractory period (PRP) experiments have largely pointed to central processes as the serial bottleneck responsible for these costs. Based on accumulating neural evidence, we hypothesized that dual-tasking costs involve a limitation of attention resources during perceptual processing. To investigate, we combined a continuous visuomotor tracking task (task 1;T1) that included jittered events (tracking changes) with a perceptual discrimination task (task 2;T2) while recording electroencephalography to resolve processing limitations with high temporal resolution. Decreasing time between events of the two tasks (stimulus onset asynchrony (SOA)) led to increased RT in T2, as well as reduced amplitude of an early measure of visual processing of T2 (P100). Importantly the degree of modulation of the P100 correlated with the RT effect. To further understand what aspect of T1 is causing T2 perceptual interference effects, we used another condition where the tracking task was entirely passive. Interestingly, a similar P100 and RT effect was observed revealing T1's influence on T2 was not due to central or motoric effects but rather perceptual processing of T1. We also found discrimination errors in T2 increased during dual-tasking, but this was unrelated to SOA and correlated with the timing of a midline frontal theta power drop when dual-tasking. These findings demonstrate neural evidence that two events interact in a phasic manner to impact early visuocortical processing that result in performance delays, while frontal resources are depleted in a tonic fashion and result in performance errors.

C9

SELECTIVE VULNERABILITY TO DISTRACTION ASSOCIATED WITH CHOLINE TRANSPORTER GENE Anne Berry[1], Yona Isaacs[1], Elise Demeter[1], Randy D Blakely[2], Martin Sarter[1], Cindy Lustig[1]; [1]University of Michigan, [2]Vanderbilt University — The neurotransmitter acetylcholine (ACh) plays a critical role in the top-down control of attention. Its availability is mediated by the choline high-affinity transporter gene (CHT1), which regulates the uptake of choline into neurons that produce ACh. Approximately 8% of the population carries a polymorphism (coding variant Ile89Val of SLC5A7) that reduces transporter capacity and thus ACh availability. The Ile89Val polymorphism has been associated with attention deficit disorder and increased severity of depression (English et al., 2009; Hahn et al., 2007). The present study examines its effects on attention function in a community sample. Across our entire sample (n = 617), Ile89Val carriers self-reported greater distractibility on the Short Imaginal Processing Inventory (SIPI; Huba et al., 1982), and most strongly endorsed items such as "I find it difficult to concentrate when the TV or radio is on." We next tested groups matched for age, gender, and depression scores on a sustained attention task linked to behavioral and electrophysiological measures of mind-wandering and attention lapses, the Continuous Temporal Expectancy Task (CTET; O'Connell et al., 2009), with and without distraction implemented by an adjacent computer playing video clips. Carriers of the Ile89Val variant were significantly more impaired by the distracting videos than controls, but did not show sustained attention differences without distraction. In a post-test questionnaire, carriers also had higher subjective scores for distraction but not boredom or mind-wandering. These results suggest low-capacity cholinergic transport is selectively associated with reduced top-down control of attention during distraction.

C10

AUTOMATIC FORMATION OF TEMPORAL EXPECTATIONS BY TEMPORALLY REGULAR INPUT INDEPENDENTLY OF HIGH-LEVEL TEMPORAL EXPECTATION Assaf Breska[1], Leon Y. Deouell[1,2,3]; [1]Psychology Department, The Hebrew University, Jerusalem, [2]Edmond and Lily Safra Center for Brain Sciences, The Hebrew University, Jerusalem, [3]Interdisciplinary Center for Neural Computation, The Hebrew University, Jerusalem — The processing of an event is facilitated if it appears in-phase with a preceding isochronous input, putatively reflecting entrainment of internal oscillators to the

input frequency and phase. However, whether these behavioral and neuronal effects are based on controlled or automatic processes is unknown. We isolated the automatic component of this effect from controlled components, in two experiments with a total of 31 participants. Visual targets were presented either in-phase or out-of-phase with regularly flickering colored stimuli. The facilitative effect of the rhythm on responses to in-phase targets was measured in three conditions differing in the source of expectation: 1. Non-predictive, task-unrelated rhythm; 2. Non-predictive task-unrelated rhythm, concurrently with predictive, task-related color cues 3. Predictive, task-related rhythm. While the rhythm affected performance most strongly when it was predictive (and task-related), significant facilitation was seen even when it was not predictive, independent of the information provided by the color. Congruently, regardless of whether the rhythm was predictive, a) the contingent negative variation (CNV), an EEG component related to temporal expectations, reflected the interval of the rhythm, and b) EEG alpha desynchronization was enhanced around the timing that was in-phase with the rhythm. The facilitating effect of the non-predictive rhythm as well as the EEG results were replicated in a control experiment in which there was no predictive rhythm condition, thus eliminating the possibility that the effect of task-irrelevant non-predictive rhythm resulted from task confusion. In conclusion, regular rhythms bias temporal expectations automatically even in the presence of different high-level expectations.

C11

REPRESENTING THE STATISTICAL RELATIONSHIPS OF CONTINUOUS VISUAL INPUTS USING OSCILLATORY NEURAL ACTIVITY

Nathan Cashdollar[1], Uri Hasson[1]; [1]University of Trento — The human brain is particularly sensitive to the ongoing complexity of sensory information from the external environment and the ability to represent the statistical relationships of this information can help facilitate behavior. One method that the complexity of continuous information has been mathematically conceptualized is by measures of Markov entropy that characterize the mean level of transition constraints within a sequential input. By using this approach, we manipulated the level of Markov entropy of continuous sequences consisting of visual stimuli from four distinct categories (Animals, Houses, Faces, Tools). In a behavioral version of this study, we presented high and low entropy sequences and asked participants to indicate if each picture was a 'Living' (Animals, Faces) or 'Non-living' (Houses, Tools) item. For low entropy picture sequences (increased statistical regularity) participants demonstrated a beneficial increase in response times, while participants had slower reaction times in the high entropy sequences (increased randomness). Using magnetoencephalography we demonstrate that in a similar paradigm, high frequency bursts of gamma-band (30+ Hz) activity, thought to reflect the neural coding of individual 'bits' of visual information, are present in both high and low entropy sequences. However in the low entropy sequences, these gamma bursts were functionally embedded or 'nested' on slower wave oscillations within the alpha and theta-band frequency (4-12 Hz). Together these results suggest that this high/low frequency nesting temporally binds incoming sensory information allowing for the maintenance of ongoing statistical relationships from continuous visual inputs and thereby allowing the ability to behaviorally anticipate future sensory inputs.

C12

FUNCTIONAL FRACTIONATION OF THE STIMULUS-DRIVEN ATTENTION NETWORK

Suk Won Han[1,2,3], René Marois[1,2,3]; [1]Department of Psychology, Vanderbilt University, [2]Vanderbilt Vision Research Center, Vanderbilt University, [3]Center for Integrative and Cognitive Neurosciences, Vanderbilt University — The presentation of a salient, novel (oddball) event recruits a network of brain areas comprised of anterior insula (AI), inferior frontal junction (IFJ), and temporo-parietal junction (TPJ) (Corbetta et al., 2008). However, it remains unknown how each nodes of this stimulus-driven attention network contribute to the processes evoked by oddballs; namely detection of and switching attention to the oddball event (attentional orienting), followed by evaluation and identification of the event (Kahneman, 1973), and finally by re-orienting of attention towards the goal-oriented task. Because previous studies used brief oddball presentations, they did not have the temporal resolution to dissociate these processes. To address this issue, the first fMRI experiment (N = 14) presented temporally extended oddballs (10-sec long movies) while participants were engaged in a goal-directed attention task. The results showed that the AI was transiently activated by the onset and offset of the oddballs, thereby implicating this region in attentional orienting/reorienting. In stark contrast, a neural signature of stimulus evaluation – sustained monophasic activation during the oddball presentation – was found in the IFJ and TPJ. In a follow-up experiment (N =6) in which the same oddball was repeatedly presented to alleviate the need for its continuous evaluation, the IFJ now showed transient, biphasic activity at oddball onsets/offsets while the TPJ still showed a (weak) monophasic response. These results show a functional dissociation within the stimulus-driven attention network; the AI and TPJ are involved in orienting to and evaluating novel events, respectively, while the IFJ is implicated in both processes.

C13

THE NEURAL GENERATORS OF VISUAL MISMATCH: A SHARED FRONTAL GENERATOR ACROSS MODALITIES

Craig Hedge[1], George Stothart[1], Jenna E. E. Todd Jones[1], Priscila Rojas Frias[1], Kristopher Magee[1], Ute Leonards[1], Elanor C. Hinton[1,2], Jamila Andoh[1,2], Jonathan Brooks[1,2]; [1]University of Bristol, [2]Bristol Clinical Research and Imaging Centre — The automatic detection of change in low-level stimulus characteristics is a core component of our attentional mechanisms. An electrophysiological marker of this mechanism, the mismatch negativity (MMN; Näätänen, Gaillard & Mäntysalo, 1978), has been studied prominently in the auditory domain, with cortical generators identified in temporal and frontal regions (Deouell, 2007; Garrido, Kilner, Stephan & Friston, 2009). In contrast, the cortical generators of its counterpart in the visual modality, the visual mismatch negativity (vMMN), have yet to be established. Here, we use functional magnetic resonance imaging (fMRI) to assess whether the frontal regions associated with MMN in the auditory domain also play a role in the vMMN. Twenty healthy young adults completed a vMMN task in separate EEG and block-design fMRI sessions. The task consisted of a centrally presented target, flanked vertically by rapidly presented single or double white bars, with stimulus type counter-balanced within participants. Participants were instructed to attend to the central target and respond if it changed colour. In 'standard' blocks, the flankers did not change, whereas 'deviant' blocks contained 6.25% of the alternate stimulus type. Separate region of interest analyses were conducted on left and right middle frontal (MFG) and inferior frontal (IFG) gyri (the frontal areas identified as potential auditory MMN generators) using a non-parametric cluster based permutation test technique. Significant increases in activation were observed in the left MFG and IFG in response to blocks containing deviant stimuli. These findings provide support for a common frontal generator for MMN across modalities.

C14

MINDFULNESS DISPOSITION AND RESTING-STATE AMYGDALA CONNECTIVITY IN OLDER ADULTS

Angeline De Leon[1], Lana Wiens[1], Maryanna Klatt[1], William Malarkey[1], Ruchika Prakash[1]; [1]The Ohio State University — An ancient, Eastern-based practice involving interoceptive awareness and emotion regulation, mindfulness has been associated with lower stress, increased positive affect, and enhanced emotional well-being. Research suggests that mindfulness disposition is associated with increased recruitment of frontal top-down control regions and reduced activation of subcortical structures involved in emotional processing. Given the age-related differences in emotion regulation, the current study chose to investigate this top-down modulatory emotion regulation process associated with mindfulness in a developmental context. We examined the resting-state functional connectivity of the amygdala as a function of trait mindfulness in 25 older and 19 young adults. Participants performed a resting-state scan and filled out a measure of mindfulness disposition. A mixed-effects regression revealed that young adults exhibited greater amygdala connectivity to frontal cognitive-control-related regions, such as the orbital frontal cortex (OFC), anterior cingulate cortex, and temporal pole, whereas older adults showed greater amygdala connectivity with posterior brain regions, such as the posterior cingulate gyrus, and precuneus. Across both cohorts, mindfulness was associated with increased amygdala connectivity to similar frontotemporal regions, including the OFC, inferior frontal gyrus, and superior temporal gyrus. Findings imply an age-related reduction in the amygdala's functional coupling with cognitive control regions in older adults at rest. Evidence also indicates the prophylactic potential of mind-

fulness to functionally strengthen the emotion regulation system across both older and young adults. Our findings contribute to an understanding of the relationship between mindfulness, neurocognitive functioning, and emotional processing, especially in respect to the aging emotional brain.

C15

WHAT'S SO IMPORTANT ABOUT PEOPLE, ANYWAY? AN ERP STUDY OF SOCIAL INFORMATION PROCESSING IN ADOLESCENTS.

Danielle diFilipo[1,2], Alison Higgins[2], Renee Migliaccio[2], Jill Grose-Fifer[1,2]; [1]The Graduate Center - CUNY, [2]John Jay College of Criminal Justice - CUNY — Increasing social awareness is a hallmark of adolescence. In this study, we used ERP recording to determine whether there are differences in the ways adolescents and adults process pictures containing social information. We recorded the EEG using 64 scalp electrodes from 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). For adolescents, we found stimulus-related amplitude differences in the early posterior negativity (EPN), which suggested that adolescents showed greater early attention to the non-social stimuli. In contrast, adults had comparable EPN amplitudes for both social and non-social stimuli. Additionally, the late positive complex (LPC) was more positive-going for adolescents for non-social versus social stimuli, but in adults, LPC 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. These data suggest that although the ERP data implies that adolescents found the non-social stimuli more motivationally salient than adults, this did not result in better encoding of the non-social material. Our data infer that there may be age-related differences in social stimulus processing, and supports the idea that social information processing is still developing during adolescence.

C16

DEVELOPMENT OF HUMAN AMYGDALA-CORTICAL FUNCTIONAL CONNECTIVITY AT REST

Laurel Gabard-Durnam[1], Jessica Flannery[1], Bonnie Goff[1], Dylan Gee[1], Kate Humphreys[1], Eva Telzer[2], Nim Tottenham[1]; [1]University of California, Los Angeles, [2]University of Illinois — Connectivity between the amygdala and the pre-frontal cortex (PFC) comprises the neural substrates moderating emotional regulation processes (e.g. Banks et al., 2007; Phelps, 2006). Despite its central role in emotion regulation behavior in both typical individuals as well as in mental illness, the normative developmental progression of neuronal functional connectivity between these two regions is still undefined (Tottenham et al., 2010). Resting-state functional magnetic resonance imaging (rsfMRI) methodology provides a robust approach for characterizing such network organization during development as it has been shown to index the functional integrity of network connections (Pizoli et al., 2011). This study employed MRI-compatible amygdala nuclei maps and rsfMRI methodology to characterize the typical development of the functional connections between amygdala nuclei and the PFC in participants from age four to 23. Positive resting-state functional connectivity between the amygdala and medial PFC and between the amygdala and the anterior cingulate cortex emerged across development ($p < 0.01$). Specifically, children below the age of 12.5 showed no connectivity between the amygdala and the PFC regions, while participants older than 12.5 possessed positive connectivity between these regions that became increasingly positive with age. Therefore, the resting-state functional network between the amygdala and PFC first appears in late childhood but continues to develop over an extensive period through adulthood. These results inform our understanding of the typical development of emotion regulation neural substrates and may have important implications for clinical interventions targeting emotion dysregulation throughout development.

C17

SUSTAINED EFFECTS OF COGNITIVE LOAD ON AMYGDALA REACTIVITY AMONG CHILDREN AND ADOLESCENTS

Dylan Gee[1], Bonnie Goff[1], Laurel Gabard-Durnam[1], Jessica Flannery[1], Nim Tottenham[1]; [1]University of California, Los Angeles — Experimental enhancement of prefrontal cortex (PFC) function has been shown to dampen amygdala reactivity during adulthood (e.g., Pessoa et al., 2005; Blair et al., 2007). More recently, it has been shown that these effects of cognitive load can have sustained and lasting effects on amygdala reactivity (Wagner & Heatherton, 2012). The current study aimed to examine the sustained effects of cognitive load on amygdala reactivity during development. Given changes in this circuitry with development, it remains unclear how manipulations of cognitive load might affect emotional reactivity in childhood and adolescence. Using a novel functional magnetic resonance imaging (fMRI) task that manipulates cognitive load on subsequent brain activation to emotional stimuli, we examined how increased recruitment of PFC may affect amygdala reactivity during development. Typically developing children and adolescents exhibited reduced amygdala reactivity to fearful faces following a period of high cognitive load, relative to low cognitive load ($p<.05$). This finding suggests that PFC regulation over the amygdala is functional during childhood and adolescence. Moreover, results showed sustained effects of cognitive load on reducing amygdala reactivity even after the period of increased cognitive demand. In a second group of children with a history of early life stress, amygdala hyperactivity was unaffected by the cognitive load manipulation, suggesting differential effects of cognitive load on amygdala reactivity following early life stress. Taken together, the present study characterizes the effects of cognitive load on amygdala reactivity in children and adolescents and may have important implications for clinical populations and interventions targeting emotion dysregulation.

C18

REDUCED NUCLEUS ACCUMBENS REACTIVITY AND ADOLESCENT DEPRESSION FOLLOWING EARLY-LIFE STRESS

Bonnie Goff[1], Dylan G. Gee[2], Eva H. Telzer[3], Kathryn L. Humphreys[4], Laurel Gabard-Durnam[5], Jessica Flannery[6], Nim Tottenham[7]; [1]University of California, Los Angeles — Depression is a common outcome following early life stress (ELS). Depressive symptoms typically increase during adolescence and appear to endure into adulthood, suggesting alterations in the development of brain systems involved in depression. Developmentally, the nucleus accumbens (NAcc), a limbic structure associated with reward learning and motivation, typically undergoes dramatic functional change during adolescence. Therefore, age-related changes in NAcc function may underlie the emergence of depression observed in adolescents following ELS. The current functional magnetic resonance (fMRI) study examined the effects of ELS in 38 children and adolescents in comparison to a group of 31 youth without a history of ELS. Consistent with previous research, depression was higher in adolescents with a history of ELS than in children. Additionally, fMRI results showed atypical NAcc development, where the ELS group did not show a typical age-related increase in NAcc reactivity during adolescence. Consequently, the ELS group showed NAcc hypoactivation during adolescence, and lower NAcc reactivity was correlated with higher depression scores. The results have important implications for understanding how ELS may influence increases in depression via neural development during adolescence and highlight the importance of identifying at-risk individuals in childhood, a potential critical period for depression-targeted intervention.

C19

ASSOCIATION BETWEEN LATE POSITIVE POTENTIAL DURING EMOTIONAL PICTURE PROCESSING AND EMOTION REGULATION COMPETENCE IN PRESCHOOLERS

Mizhi Hua[1], Siyi Chen[1], Meng Yang[1], Renlai Zhou[1]; [1]Beijing Normal University — Late positive potential (LPP) is increased for emotional compared to neutral pictures, and is sensitive to emotion regulation strategies in adults. This study examined the LPP elicited by passively viewing IAPS pictures in 20 preschoolers aged from 4- to 5-year-old, and explored its association with emotion regulation competence. Results suggested that in the posterior region, significant main effects were found for picture type ($F(2,38) = 22.76$, $p < .01$, $\eta p2 = .55$), LPP amplitudes elicited by unpleasant and pleasant pictures were both larger compared to neutral pictures during the early (300–700 ms), middle (700–1500 ms), and late (1500–3000 ms) time windows. In the central region, a significant interaction was found between time window and picture type ($F(4,76) = 53.39$, $p = .01$, $\eta p2 = .20$), besides the similar emotional effects in the late window, LPP amplitudes elicited by pleasant pictures were larger compared to neutral pictures in the middle window. In the anterior regions, a significant interaction was found between time window and picture type ($F(4,76) = 6.51$, $p < .01$, $\eta p2 = .26$), LPP amplitudes elicited by unpleasant and pleasant pictures were larger compared to neutral pictures only in the late window. Additionally, the LPP amplitudes elicited by unpleasant pic-

tures in the posterior region in the early and middle windows were negatively correlated with preschoolers' emotion regulation competence rated by their teachers (all ps < .05). The potential of identifying LPP as a neurophysiological marker for emotion regulation competence in preschoolers is discussed.

C20

MULTI-VOXEL PATTERN ANALYSES REVEAL AGE-DIFFERENCES IN SPECIFICITY OF EMOTION REGULATION STRATEGIES

Bruna Martins[1], Ricardo Velasco[1], Allison Ponzio[1], Jonas Kaplan[1], Mara Mather[1]; [1]University of Southern California — Recent research reveals neural dedifferentiation in older adults in basic perceptual processes (Park & Reuter-Lorenz, 2009). In the current study, we examine whether older adults also show fewer differences in brain activity when engaging distinct emotion regulation strategies. Cognitive reappraisal and distraction are two of the most commonly used and effective emotion regulation strategies (Augustine & Hemenover, 2009). Traditional fMRI analyses reveal that reappraisal and distraction activate a shared set of frontal and parietal brain regions involved in cognitive control processing (McRae et al., 2010). In this study, younger (18-30 yrs) and older adults (60+ yrs) subjects viewed a slideshow of negative scenes, and were cued to either "distract" or "reappraise" during each trial in an fMRI scan. Consistent with previous findings, participants later were better able to recall pictures from reappraisal trials than from distraction trials. This memorial difference was as large for older adults than for younger adults. However, multi-voxel pattern analysis (MVPA) searchlight methods showed greater discrimination between strategies in areas of the prefrontal and parietal cortex for younger than for older adults ($p < 0.01$). In contrast with the fMRI results, gaze location alone did not significantly predict emotion regulation strategy use. These findings support an age-consistent network of regions involved in emotional regulation processes, but a more diffuse neural representation of specific strategies in older adults.

C21

HOW REAL-LIFE PRIOR EXPERIENCE INFLUENCES TRUST DECISIONS AND REWARD LEARNING MECHANISMS

Dominic S. Fareri[1], Luke J. Chang[2,3], Mauricio R. Delgado[1]; [1]Rutgers University-Newark, [2]University of Colorado-Boulder, [3]University of Arizona — Social relationships are predicated on trust– the notion that generosity will be reciprocated. Learning whether someone is trustworthy often occurs through repeated interactions, relying on neural circuitry typically implicated in reward learning such as the striatum (e.g., King-Casas et al., 2005). Importantly, prior descriptive knowledge (Delgado et al., 2005) or social experience (Fareri et al., 2012a) can form impressions of others that bias decisions to trust and the ability to learn in subsequent social interactions. As many daily interactions occur with members of our social networks already deemed as trustworthy, however, it remains unclear how prior real-life experience with members of one's own social network may influence subsequent trust decisions and social learning mechanisms. We investigated whether participants would differentially trust three different partners in a repeated trust game––a close friend (in-network), a confederate (out-of-network), and a computer. Participants played as investors and believed interactions would occur in real-time; however, all partners reciprocated participants' investments 50% of the time. We expected highest rates of investment and enhanced reward-related neural responses when interacting with in-network partners. Accordingly, participants (n=18) rated in-network partners as most trustworthy and invested most often with them. This network effect was observed in a ventral striatum ROI when processing trust game outcomes. Further, medial prefrontal cortex demonstrated enhanced neural responses when processing outcomes of trials with social compared to non-social partners. These results suggest that real-life prior experience can bias not only behavior but also value related neural signals during social interactions.

C22

FUNCTIONAL CONNECTIVITY IN EUTHYMIC BIPOLAR PATIENTS. AN FMRI RESTING STATE STUDY.

Pauline Favre[1,2], Mircea Polosan[1,3,4,5], Cédric Pichat[2], Thierry Bougerol[1,3,4,5], Monica Baciu[1,2]; [1]Structure Fédérative de Recherche Santé et Société, Université Pierre Mendès France, [2]Laboratoire de Psychologie et de NeuroCognition, UMR CNRS 5105, Université Pierre Mendès France, [3]Pôle Psychiatrie et Neurologie, Centre Hospitalier Universitaire de Grenoble, [4]Centre expert en troubles bipolaires, Fondation FondaMental, Centre Hospitalier Universitaire de Grenoble, [5]Institut des Neurosciences de Grenoble, Université Joseph Fourier, INSERM — Objectives: The current study aims to assess default mode network (DMN) functional connectivity in euthymic bipolar patients (EBP) in order to identify potential trait abnormalities (not dependent of the mood state) responsible for cognitive and affective processing disturbances in these patients. Methods: Twenty EBP and 24 matched healthy controls (HC) underwent fMRI examination during 6 min resting state condition. Seed-analysis has been used to process data. Posterior cingulate cortex (PCC) was used as a seed region. Functional connectivity maps from PCC were computed for each participant and were compared statistically across groups (EBP, HC). Moreover, we investigated the relationship between patients' clinical variables and functional connectivity in regions showing significant group differences. Results: Different patterns of functional connectivity in EBP and HC were observed between PCC and right amygdala, right putamen, right orbito-frontal cortex (OFC), gyrus rectus (GR) and bilateral angular gyri (AG). Specifically, EBP exhibited significant positive correlation between PCC and right amygdala, medial OFC and bilateral AG, whereas HC exhibited anticorrelation between PCC, right amygdala, OFC and putamen. Significant negative correlation was found between functional connectivity of right AG and scores of social functioning; positive correlation was found between functional connectivity of right OFC and anxiety and mania scores. Conclusions: Our results revealed abnormal increased functional connectivity of DMN within frontal and parietal regions in EBP suggesting abnormal internally-focused activity in these patients. Furthermore, the abnormal recruitment of right amygdala may reflect emotional instability and hyperreactivity of EBP and may constitute a potential trait abnormality of BD.

C23

EMOTIONAL INTERFERENCE IN A WORKING MEMORY TASK IS INFLUENCED BY INDIVIDUAL AUTONOMIC REACTIVITY

Alessandra Galli[1], Jan Derrfuss[1], 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 — Studies investigating the effects of emotional distraction on working memory performance have been inconclusive. While some studies found impairments after emotional distraction, others reported improvements. We suggest that in order to explain these inconsistencies, it is critical to understand how individual psychological and psychophysiological differences modulate emotion-cognition interactions. Here we used a delayed-match-to-sample task where the participants (n = 45) had to encode into working memory an abstract shape, followed during the maintenance period by a distracting positive, negative, or neutral vocalization. Prior to the task, participants were asked to fill in psychological scales followed by a baseline Galvanic skin conductance response recording. The effects of emotional distraction on performance were analyzed in terms of diffusion model parameters. The results showed that overall skin conductance level (SCL) and the reward responsiveness of the BIS/BAS scales were the best predictors of general performance. When SCL was considered as a covariate, emotional distractors (in particular positive vocalizations) lead to a decrement in drift rate and boundary separation. This indicates that the speed of evidence accumulation and the response caution are reduced after emotional distraction. Importantly, the underlying processing changes were only uncovered by the diffusion model analysis while no significant effects on reaction times or error rate were found. In summary, these results highlight the influence of psychological and psychophysiological variables on emotion-cognition interactions and the importance of employing models that decompose reaction times into separate processing components.

C24

MINDFULNESS DISPOSITION AS A MODERATOR IN THE RELATIONSHIP BETWEEN DISEASE SEVERITY AND DEPRESSION IN MULTIPLE SCLEROSIS

Brittney Gidwitz[1], Alisha Janssen[1], Beth Patterson[1], Aaron Boster[1], Ruchika S Prakash[1]; [1]The Ohio State University — Multiple Sclerosis is an autoimmune disease that affects the central nervous system, resulting in physical, affective, and cognitive deficits. This population shows a high prevalence of depression, with research evincing support

for a positive association between disease severity and depression. Mindfulness disposition has been found to support better psychological and physical functioning in individuals with a wide range of disorders. In this study, we examined dispositional mindfulness as a moderator in the relationship between disease severity and depression in MS. Forty-four individuals with a clinical diagnosis of relapsing-remitting MS were recruited for this study. All participants completed the Beck Depression Inventory, Expanded Disability Status Scale, and the Five Facet Mindfulness Questionnaire. All participants underwent an MRI to collect T2-weighted, FLAIR, and MPRAGE structural scans that were used to assess lesion load volume. Disease severity was measured as a composite score of lesion load volume, disease duration, and self-reported EDSS scores. Consistent with the literature, we found disease severity to be positively associated with depression, such that individuals experiencing greater MS burden also experienced higher levels of depression. We found trait levels of mindfulness, however, to moderate this association. Specifically, in individuals low in dispositional mindfulness, there was a significant positive relationship between disease severity and depression. However, there was no relationship found between disease severity and depression in those high in trait mindfulness. These results show that dispositional mindfulness may play a protective role in patients with MS by guarding against depression as their disease progresses.

C25

PIECE OF CAKE: AFFECTIVE REACTIVITY TO AND COGNITIVE REGULATION OF FOOD CUES

Nicole Giuliani[1], Rebecca Calcott[1], Elliot Berkman[1]; [1]University of Oregon — Recent research on neural processes underlying eating behavior has focused on reward-related reactivity. However, a recent "seesaw" model of self-regulation proposed that failures result from increases in reactivity, decreases in regulation, or both. In the current study, we apply this model to the consumption of energy-dense foods. In the task, subjects were instructed to passively view healthy or energy-dense foods or engage a process called reappraisal, where they cognitively altered the meaning of the food stimuli by, for example, focusing on the negative consequences of consumption. Behaviorally, energy-dense foods induced greater self-reported desire to eat healthy foods, and reappraisal reduced that desire to a level not significantly different from viewing healthy foods. There was no relationship between self-report and ad hoc consumption of energy-dense foods two weeks later. Neurally, reactivity (look energy-dense > look healthy) induced activation in the occipital lobe (e.g., precuneus, angular gyrus). Reappraisal (regulate energy-dense > look energy-dense) induced activation in the left inferior frontal gyrus (IFG), dorsolateral prefrontal cortex, and a cluster encompassing bilateral dorsal anterior cingulate and the pre-supplementary motor area (SMA). Only reappraisal-related activation of the left IFG and pre-SMA predicted eating behavior, such that those individuals who ate a lot activated these regulatory regions to a greater degree than those who did not eat or ate very little. These findings support the regulation seesaw model, and suggest that, while individuals who consume large quantities of energy-dense foods can self-regulate, they must try harder, thus engaging regulatory brain regions to a greater degree.

C26

DYNAMIC LARGE-SCALE BRAIN NETWORKS FOR EMOTIONAL PROCESSING

Enrico Glerean[1], Raj Kumar Pan[1], Mikko Sams[1], Lauri Nummenmaa[1,2]; [1]Aalto University School of Science, [2]Turku PET Center — Emotions coordinate activity of cognitive and physiological systems in survival-salient situations, but how is this coordination undertaken from the perspective of dynamic brain networks? Here we reveal for the first time the functional large-scale networks encoding emotional qualities of highly naturalistic sensory input. Participants' brain activity was measured with fMRI while they watched movies triggering unpleasant, neutral, and pleasant emotions. After scanning, participants watched the movies again and rated continuously their experience of pleasantness-unpleasantness (valence) and of arousal–calmness. We modelled the fMRI data as a dynamic whole-brain network using instantaneous pairwise synchronization between each possible pair of gray matter voxels. The se pairwise connectivity time series were then modelled using subject-wise valence and arousal time series. This resulted in a multilayer complex network with separate network layers being modulated by valence and arousal. Central nodes in these layers were subsequently identified with graph-theoretical tools. Main hubs of the valence layer were located in the right amygdala, left thalamus, anterior cingulate and medial prefrontal cortex as well as right middle and polar temporal areas and cerebellum. The arousal layer had hubs in the middle cingulate, precentral and orbitofrontal cortex, visual cortex, and right cuneus. The right putamen was a significant hub in both valence and arousal networks. Our findings delineate the dynamic networks encoding appetitive and aversive value (valence) vs. intensity (arousal) of sensory events. They further highlight that valence and arousal are represented as two parallel dynamic neural systems distributed across partially overlapping fu nctional networks.

C27

TRUST ALL, LOVE A FEW: NEURAL CORRELATES OF SOCIAL INTERACTIONS WITH PEERS

Berna Guroglu[1,2], Eduard Klapwijk[2,3], Geert-Jan Will[1,2]; [1]Institute of Psychology, Leiden University, the Netherlands, [2]Leiden Institute for Brain and Cognition (LIBC), the Netherlands, [3]Child and Adolescent Psychiatry, Curium - Leiden University Medical Center, the Netherlands — When people interact with other people they have all sorts of expectations about others' intentions, which guides social decisions in interactions. In this fMRI study we investigated the neural correlates of trust related social decision-making in which participants interacted with personally familiar peers from their classroom. Before the scanning session where the participants (N=16, Mage = 20.6 years) played a repetitive Trust Game as the first player, they briefly met the three players: a friend (i.e., a liked peer), an antagonist (i.e., a disliked peer), and an unfamiliar peer they had not met before (a confederate). Although amounts of trust displayed by the participants towards the three different interaction partners were similar on average, there were differences in activation in brain regions related to mentalizing and reward during the interactions. Preliminary findings showed higher insula activation during no-trust choices and higher anterior medial prefrontal cortex activation during trust choices. Two brain regions important for mentalizing, the temporoparietal junction (TPJ) and the dorsal medial prefrontal cortex (dmPFC), were more active during interactions with friends than during interactions with antagonists. Furthermore, brain regions involved in mentalizing (e.g., TPJ) and reward related learning (e.g. lateral orbitofrontal cortex and caudate) were differentially involved in received feedback, showing highest activation during defect feedback following no-trust choices. Taken together, the findings provide insight into the neural basis of feedback processing in social interactions and highlight the moderating role of real-life relationships with interaction partners in social cognition.

C28

CORTICAL NETWORK FLEXIBILITY DURING ADMINISTRATION OF BETA-ADRENERGIC ANTAGONISTS: AN AUTISM SPECTRUM DISORDER STUDY

John P. Hegarty II[1], Brad J. Ferguson[1], Rachel M. Zamzow[1], Shawn E. Christ[1], Micah O. Mazurek[1], David Q Beversdorf[1]; [1]University of Missouri — Behavioral interventions for autism focus on increasing quality of life whereas pharmacological interventions are directed at managing the secondary manifestations such as anxiety. Pharmacological research directed at the core features of autism is limited. Propranolol, a beta-adrenergic antagonist, improves verbal problem solving in controls as well as people with autism. Current theories suggest that autism may be due to altered network flexibility within cortical regions important for information processing. fMRI allows for the measurement of a correlate of flexibility, functional connectivity. We have previously shown the beneficial effects of propranolol during verbal problem solving may be due to increased functional connectivity, and wish extend this line of research to facial and emotional processing. We hypothesize that during propranolol administration subjects will show increased connectivity. We examined a pilot sample of individuals with autism during administration of propranolol, nadolol, and placebo. Nadolol provides a control for general vascular effects on fMRI. Stimuli consisted of faces either exhibiting an angry, fearful, or neutral expression. The facial matching task activated our main regions of interest, fusiform and amygdala, allowing for the use of these regions as seeds for functional connectivity analyses. We found a significant effect for drug such that functional connectivity was significantly altered during propranolol trials compared to placebo. Better understanding of the effects of the beta-adrenergic system on neuronal processing, especially in

the autism population, and modulation of the beta-adrenergic system pharamacologically could lead to development of additional treatments for the core features of autism.

C29

CUE-REACTIVITY PREDICTS CHANGES IN SMOKERS' DESIRE TO QUIT Sarah Henderson[1], Catherine Norris[1]; [1]Dartmouth College — Although past research has identified a network of brain regions that are reliably activated when smokers view cigarettes, little research has investigated if activity in these regions predicts behavioral outcomes related to quitting. Even less research has investigated how the emotional content of smoking cues might further impact patterns of neural activity. The current study sought to understand the relationship between neural activity to positive, negative, or ambivalent smoking stimuli and changes in self-reported desire to quit smoking. Using functional magnetic resonance imaging (fMRI), thirty cigarette smokers viewed pleasant or unpleasant smoking images paired with positive or negative smoking-related text, rated how they felt about each stimulus pairing, and answered questions about their smoking attitudes. Changes in desire to quit were assessed by comparing self-reports several weeks prior to the neuroimaging session with self-reports immediately following scanning. We then conducted four whole-brain regressions, one for each stimulus pairing, to examine relationships between changes in desire to quit smoking and patterns of neural activity. Regardless of stimulus pairing, we found that less activity to smoking cues in typical cue-reactivity regions, including the left ventral striatum, right anterior insula, and the left frontal pole (BA 10), was associated with increased desire to quit. Conversely, we found that greater activity to smoking cues in left dorsolateral PFC (BA 9), an area implicated in self-regulation, was associated with increased desire to quit. Taken together these findings suggest that reduced cue-reactivity and greater self-regulatory activity to cigarette cues predict increased desire to quit smoking.

C30

PHYSIOLOGICAL EFFECTS OF THETABURST STIMULATION ON INSTRUCTED AND SPONTANEOUS EMOTION REGULATION. Birthe Henne[1], Ignazio Puzzo[1], Yanbo Hu[1], Tom Johnstone[1]; [1]University of Reading — This study was conducted to determine the effect of thetaburst stimulation (TBS) to the lateral prefrontal cortex on physiological arousal during spontaneous and intentional emotion regulation. 16 participants completed an instructed reappraisal task as well as an n-back working memory task with threat of shock in 50% of blocks. TBS stimulation targets were chosen on the basis of individual's fMRI data collected previously. Effects of stimulation to the left and right hemisphere were compared, with sham stimulations performed as a baseline. Skin conductance responses (SCR), heart rate and corrugator EMG were recorded. For the instructed reappraisal task, analyses compared negative/decrease to negative/attend conditions with left vs. right target hemisphere and sham vs. TBS as factors. Compared to sham, TBS to the right but not the left hemisphere significantly reduced heart rate during the negative/decrease relative to the negative/attend condition. Analysis of the working memory task compared threat vs. safe conditions with difficult vs. easy, left vs. right target hemisphere and TBS vs. sham as factors. Level of difficulty had no effect on SCR number or amplitude of responses. The number of SCRs was significantly greater under threat than during safe blocks. Furthermore, a significant target hemisphere by threat interaction revealed that TBS to the right but not the left PFC reduced the difference in SCR amplitude between safe and threat trials. From these results it can be concluded that TBS to the lateral prefrontal cortex has differential effects on measures of arousal during instructed and spontaneous emotion regulation.

C31

STRESS, AROUSAL AND MISINFORMATION: STRESS STATE AND HIGH SUBJECTIVE AROUSAL INTERACT TO DECREASE ENDORSEMENT OF MISINFORMATION FOR EMOTIONAL STIMULI Siobhan Hoscheidt[1], Kevin LaBar[1], Lee Ryan[2], Jake Jacobs[2], Lynn Nadel[2]; [1]Duke University, [2]University of Arizona — People exposed to misleading questions tend to remember false details as true components of a past experienced event (i.e. the misinformation effect). This phenomenon is of particular interest in the legal domain, as witnesses may be exposed to misleading details that can influence subsequent memory accuracy. Eyewitness events, however, are likely to be stressful and involve arousing and non-arousing information. Currently it is not well understood if stress and/or arousal moderate misinformation effects. The present study investigated the effects of misinformation on memory for negatively arousing and non-arousing stories encoded under stress. One hundred and three young adults participated in a between-groups design with three experimental sessions conducted 48 hours apart. Session one consisted of a psychosocial stress induction (or control task) followed by incidental encoding of a negatively arousing or non-arousing slideshow. On session two participants were asked questions about the slideshow and a random subgroup was exposed to misinformation. Memory was tested on the final session. Stress groups had enhanced memory for the arousing slideshow and impaired memory for the non-arousing slideshow compared to no-stress groups. Misinformed groups showed the misinformation effect, however these effects were moderated by subjective arousal during slideshow encoding within the arousing story condition. Misinformed-stress group participants with higher, relative to lower, subjective arousal ratings during encoding were less likely to endorse misinformation for the emotional phase of the story. Furthermore these participants showed better memory for emotional items that had been directly misinformed. These findings have important implications for eyewitness testimony.

C32

VOCALIZATION-SELECTIVE SUPERIOR TEMPORAL REGIONS ARE NOT CONSPECIFIC-SPECIFIC IN HUMANS Attila Andics[1,2], Márta Gácsi[1], Tamás Faragó[1], Anna Kis[1,3], Ádám Miklósi[1]; [1]Comparative Ethology Research Group, Hungarian Academy of Sciences - Eötvös Loránd University, Budapest, [2]MR Research Center, Semmelweis University, Budapest, [3]Comparative Behavioural Research Group, Institute of Cognitive Neuroscience and Psychology, Hungarian Academy of Sciences, Budapest — Regions along the bilateral superior temporal sulcus (STS) and in the bilateral temporal pole (TP) have been shown to be more sensitive to human vocalizations than to nonvocal sounds. Here we investigated the human-specificity of these 'temporal voice areas' in an fMRI experiment, that is, whether these regions are selective for human voices or they are also differentially active for nonhuman vocalizations, compared to nonvocal sounds. We presented human listeners with blocks of nonlinguistic human and dog vocalizations that were previously rated for perceived emotional valence and intensity, and with nonvocal stimuli. We found that both human and dog vocalizations elicited increased neural activity in the bilateral STS, compared to nonvocal sounds. In contrast, neural activity in the bilateral TP increased for human but not for dog vocalizations, compared to nonvocal sounds. Finally, reduced neural activity in the bilateral medial fusiform gyrus (FG) was found for human but not for dog vocalizations, compared to nonvocal sounds. These distinct activity patterns for STS, TP and FG persisted after factoring out emotional valence and intensity. Our findings suggest that TP regions are specialized for human voices, but that the vocalization-selective STS regions are also involved in processing non-conspecific vocalizations. The experiment also demonstrates that this species-aspecific selectivity to biological sounds in STS cannot be accounted for by the perceived emotionality in the stimuli. The FG deactivation to human but not to animal voices supports an account of topographical tuning for human voices over an account of selectivity for non-biological objects.

C33

TEMPORAL DYNAMICS OF FACIAL IDENTITY AND EXPRESSION RECOGNITION IN A DEVELOPMENTAL PROSOPAGNOSIC Stephanie Bastidas[1], Ann M Hu[2], Lauren Hill[1], Jason S Nomi[1], Lucy J Troup[1]; [1]Colorado State University, [2]Grinnell College — Facial recognition and expression recognition are encoded by distinct pathways (Haxby, Hoffman, & Gobbini, 2000). Individuals with prosopagnosia present impaired identity recognition with preserved expression recognition, supporting this view. EEG studies have found diminished amplitude of the N170 component for faces in individuals with prosopagnosia. The effect of facial expression on the face-specific N170 is still unclear, but the late positive potential (LPP) at 300ms after stimulus onset is likely to be modulated by type of emotion and emotion processing. This study aimed to confirm that participant TM – a female with developmental prosopagnosia – demonstrated a marked decrease in the N170 and to acquire the first ERPs related to emotional expression processing in an individual with prosopagnosia. Compared to

11 control participants (4 age-matched), TM presented impaired identity recognition (scores 2 standard deviations (SD) below age-matched controls) and gender discrimination (scores 4 SDs below age-matched controls). TM showed intact emotion and object recognition and emotional expression discrimination (scores <1 SD above controls). On a faces vs. houses comparison of ERPs, TM showed a smaller N170 at temporal and occipital electrodes to faces than controls, and a smaller difference between the two conditions. On a comparison of implicit (gender discrimination) vs. explicit (emotion discrimination) emotional processing task, TM's late positive potential was not modulated by emotion or condition, an effect that controls did show. These results further support the dissociation not only between identity and emotion recognition but also gender discrimination, reflected both in behavioral measures and in ERP components.

C34

EXPLAINING BEHAVIOR: PERSON PERCEPTION AND BIOLOGICAL MOTION BRAIN NETWORK DIFFERENCES DURING HELPFUL AND HARMFUL ACTIONS FROM HUMAN AND NON-HUMAN AGENTS

Beatrice H. Capestany[1], Lasana T. Harris[1]; [1]Duke University — People can quickly extract intentional and causal attributions for actions and behaviors originating from human (Fiske & Taylor, 1991, 2007) and non-human agents (Heider & Simmel, 1944) using mental state inference processes. The brain has adapted systems to support these inference processes, recognizing whether agents are animate (Blake & Shiffrar, 2007) so that we can determine the originator of action. This allows people to explain and predict the behaviors of an agent. Here, we assess the extent to which people use the same language to explain the behavior of human and non-human agents, and the extent to which person perception and biological motion brain networks respond to animate action from a variety of human and non-human agents. While in the fMRI scanner, participants explained non-random, "meaningful" motion in a series of animated video clips showing three different human and non-human agents (greebles, shapes, human faces) engaging in matched helpful or harmful actions (Heider & Simmel, 1944). Results demonstrate remarkable similarities in the use of mental state inferences across the three different agents. Moreover, brain systems implicated in biological-motion detection and person perception were differentially engaged depending on the type of agent (human, non-human) and valence of behavior (helpful, harmful). Specifically, mental state inferences during harmful behavior drive activations in both systems, particularly when involving human agents. This dissociates the influence of brain networks engaged in social cognition beyond self-report behavior, hinting at categories of stimuli and behaviors that maximally drive these brain systems consistent with evolutionary theories about human behavior.

C35

SELF- AND OTHER-REFERENT TRAIT INFERENCE DURING FACE PROCESSING. IMPLICATIONS FOR SOCIAL ANXIETY AND SOCIAL COGNITION

Ana Draghici[1,2], Kateri McRae[2], Jay Hull[1]; [1]Dartmouth College, [2]University of Denver — The study explored the hypothesis that the biased responding to facial expressions associated with trait social anxiety emerges from engaging a different set of mental operations while processing these stimuli. fMRI was used to compare brain responses to facial stimuli during blocks of instructed self-referent trait inference and other-referent trait inference in 9 right handed, neurologically healthy participants. Pictures of angry, happy, and neutral facial expressions were presented in an event-related manner. During each block, participants were asked to either consider what the next set of expressions communicate about them (self-referent trait inference), what they communicate about the people in the pictures (other-referent trait inference), or just imagine the people in the pictures are standing in front of them (spontaneous appraisal). Compared to self-referent trait-inference, other-referent trait inference was associated with increased BOLD response in a widespread set of brain regions, including left dmPFC, right vlPFC, right SPL, and insula bilaterally. In turn, self-referent as compared to other-referent trait inference was associated with increased activity in a more constrained set of regions: the right temporal pole, left cerebellum, and right dlPFC. Individual differences in trait social anxiety were negatively associated with the percentage of self-reported other-referent trait inference during the spontaneous appraisal condition ($r = -.831$, $p < .007$). This relationship was mediated by the spread of dmPFC activation during spontaneous appraisal. Results are discussed in terms of implications for social anxiety, and the function of mPFC in self-referent and other-referent cognition.

C36

A FUNCTIONAL NEUROIMAGING STUDY DISENTANGLING NEURAL PROCESSES OF EGOCENTRIC AND ALLOCENTRIC MENTAL SPATIAL TRANSFORMATIONS USING WHOLE-BODY PHOTOS OF SELF AND OTHER

Shanti Ganesh[1,2,3], Hein Van Schie[1,2], Floris de Lange[2], Emily Cross[1,2], Daniel Wigboldus[1]; [1]Radboud University Nijmegen, Nijmegen, Netherlands, [2]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands, [3]University of California, Berkeley, USA — Mental imagery of our own body moving through space is important for imagining changing visuospatial perspectives and for determining how we might appear to other people. Previous neuroimaging research on mental imagery of one's own body rotating through space has implicated the temporoparietal junction (TPJ) in this process. It is unclear, however, how this TPJ activity is related to the rotation perspectives from which mental spatial transformation (MST) of one's own body can take place, i.e. from an egocentric or an allocentric perspective. It is also unclear whether TPJ involvement is specific to MST of one's own body only. The current study aims to disentangle neural processes involved in egocentric versus allocentric MSTs of photographed human bodies representing self and other. We measured functional brain activity of 23 healthy participants while they performed egocentric and allocentric MST in relation to whole-body photographs of themselves and a same-sex stranger. Findings confirmed that egocentric versus allocentric MST recruits greater bilateral TPJ activity. Moreover, TPJ activity during egocentric MST correlated positively with the extent to which participants indicated feeling awkward while viewing whole-body photos of themselves. Described from the perspective of high awkwardness individuals (for viewing self-photos), results indicate that bilateral TPJ activity during egocentric versus allocentric MST was higher for self than for other. By disentangling neural processes of egocentric versus allocentric mental spatial transformations involving whole-body photos of self and other, the current study considerably advances our understanding of the role of the TPJ in egocentric bodily transformations and self-awareness.

C37

DOES EMPATHY EXPLAIN INTER-INDIVIDUAL DIFFERENCES IN THE PROCESSING OF FACIAL EXPRESSIONS?

Jessika Golle[1], Norman Rose[2], Fred Mast[1], Janek Lobmaier[1]; [1]University of Bern, [2]University of Tübingen — Visual adaptation paradigms are often used to investigate the processing of facial attributes such as identity, sex, attractiveness, and emotional expression. In this study, we investigated the facial expression after-effect (FEAE). Unlike previous studies on after-effects, we were interested in inter-individual differences and whether such differences can be explained by empathy. After-effects represent the perceptual manifestation of fast neural plasticity (Kanai & Verstraten, 2005). Thus, inter-individual differences in FEAE may reflect variable neural plasticity across the subjects for the processing of facial expressions. We tested the hypothesis whether people scoring high in empathy are more adaptable and therefore more flexible in their neural plasticity as measured by the FEAE. Thirty female participants underwent two pre-adaptation, adaptation and post-adaptation phases. They adapted to happy and sad faces and the task was to categorize the emotional expression of presented test faces. We collected an empathy questionnaire (SPF) measuring emotional and cognitive components of empathy. Using multilevel logistic regressions for repeated measurement, we found inter-individual differences in the magnitude of the after-effects. The emotional component of empathy (empathy concern) explained a significant proportion of the between-subject variance. The higher the ability to sympathize the larger the FEAE. These results suggest that people scoring high on emotional empathy show larger plasticity in neurons that process emotional expressions. Their visual system seems to recalibrate faster and as a consequence is more sensitive towards changes in emotional expressions of other people. This may explain why high empathic people are better in sympathizing than low empathic people.

C38

CROSS-SEX VS. OWN-SEX FACE PERCEPTION MODULATES EARLY ATTENTIONAL ERPS Robin I. Goodrich[1,2], Sierra P. Niblett[2], William Krenzer[2], Avi Ben-Zeev[2], Mark W. Geisler[2]; [1]University of California, Davis, [2]San Francisco State University — There is strong evidence that group membership and in-group biases influence perception across multiple social domains. Previous research on cross-race effects has shown that P2 amplitude is larger for cross-race than for own-race faces. Although other studies have found that sensitivity to gender information also emerges in the P2, differences in cross- vs. own-sex face perception on the P2 are unclear. The current study attempts to extend and elucidate the pattern of event-related potentials (ERPs) underlying the cross-sex effect. Participants completed a recognition task with either all-male faces (n = 19; seven male participants) or all-female faces (n = 21; seven male participants); stimuli were computer-generated in order to ensure perceptual homogeneity across stimulus sets. Preliminary analyses revealed significantly larger P2 amplitudes (μV) for cross-sex (M = 6.41, SE =.81) than for own-sex faces (M = 4.45, SE = .50), $t(38) = 2.107$, $p = .042$, consistent with previous research. Planned contrasts indicated that female participants in the cross-sex condition showed significantly larger P2 amplitudes, $t(36) = 3.119$, $p = .004$, than all other conditions, which did not differ from one another. These results suggest that female participants may be driving the cross-sex effect, which could reflect a stronger automatic in-group sex bias for females than for males (Rudman & Goodwin, 2004). The heightened cross-sex attentional effect seen for female, but not for male, participants might help to explain some of the previously inconsistent cross-sex ERP results.

C39

DIFFERENTIAL VMPFC RESPONSE TO THE PERCEPTION OF TARGETS VARYING ON FINANCIAL AND MORAL SOCIAL STATUS Ivo Gyurovski[1], Jasmin Cloutier[1]; [1]University of Chicago — Social status is believed to play a central role in guiding social interactions. Surprisingly, relatively little is know about the impact of social status information on person perception and its neural substrates. Previous research suggests that increases in ventromedial prefrontal cortex (VMPFC) activity may reflect positive evaluation of social targets paired with person-knowledge indicative of higher moral status (Cloutier et al., 2012). The current study was designed to examine the effects of social status on the neural substrates of person perception when social status is assigned to faces without the use of person-knowledge. Following a training procedure, participants took part in a block-design fMRI experiment, during which they passively viewed photographs of the targets varying on social status type (Financial vs. Moral) and level (Low, Medium, High). A region of interest analysis revealed a significant status type by level interaction, such that significantly less VMPFC activation was observed during the viewing of high relative to low financial status targets, and significantly more activation was observed in response to high relative to low moral status targets. These results, corroborated by explicit behavioral responses, confirm the involvement of VMPFC in the evaluation of targets varying in social status and provide novel evidence for the spontaneous use of social status information during person perception.

C40

DYNAMIC CAUSAL MODELLING OF EFFECTIVE CONNECTIVITY DURING MENTAL STATE ATTRIBUTION Hauke Hillebrandt[1]; [1]University College London — Biological agents are among the most complex systems humans encounter in their natural environment. This complexity renders modelling and predicting others' mental states computationally difficult. To achieve this humans generate a mental representation of other agents based on an internal neural model. In hierarchical predictive coding frameworks, high level cortical areas inform lower level sensory cortex about incoming sensory signals and unpredicted sensory information is passed forward to higher level areas. Given the complexity of predicting mental states, there should thus be greater connectivity between higher and lower level brain areas when making social predictions versus more simple predictions. We test this hypothesis by investigating effective connectivity of fMRI data from the Human Connectome project (WU-Minn Consortium). During the task, participants either viewed Heider-Simmel like animations of triangles that move purposefully and intentionally to evoke mental state attributions, or participants viewed triangles that move in random directions. We use a novel exhaustive model-selection approach to test all possible Dynamic Causal models and use diffusion-tensor derived tractography priors to enhance region selection. We find differential effective connectivity networks between higher level areas and lower level sensory areas when participants make inferences about mental states of the agent-like triangles to predict their behaviour as opposed to looking at randomly moving inanimate triangles.

C41

EXPERIENCE REMODELS AXONAL BOUTONS THAT CONNECT THE ORBITOFRONTAL CORTEX AND DORSOMEDIAL FRONTAL CORTEX. Carolyn Johnson[1], Hannah Peckler[1], Francisco Javier Munoz-Cuevas[1], Linda Wilbrecht[1]; [1]University of California, San Francisco — Adaptive goal directed behavior depends on the ability to update behavior in response to new information. The dorsomedial frontal cortex (dmPFC) and orbitofrontal cortex (OFC) likely work together to update associations and action plans, though the nature of the connection between these areas is poorly understood. Here, we investigated the anatomical connection between OFC and dmPFC and tested how experience in a decision-making task impacted this connection in mice. Using viral tracing methods, we found a direct bilateral connection from the OFC to dmPFC. Using channelrhodopsin, we confirmed that OFC axons make functional synapses onto dmPFC neurons. Using longitudinal 2-photon in vivo imaging through a cranial window, we followed individual axonal boutons across days in control mice and mice undergoing training. Experimental groups were trained on a foraging based reversal learning task previously shown to involve the dmPFC (Johnson and Wilbrecht, 2011) and imaged before and after training. In standard housed control mice, we found that OFC axons in the dmPFC showed higher levels of bouton turnover than in neighboring motor cortex. Training further elevated the turnover of boutons on OFC axons in dmPFC. Our data suggest that OFC connectivity with dmPFC is highly dynamic under baseline conditions and that this circuit is actively remodeled by experience.

C42

CORTICOSTRIATAL CONNECTIVITY, DOPAMINE, AND INDIVIDUAL DIFFERENCES IN EXPLORATION AND EXPLOITATION Andrew Kayser[1], Jennifer Mitchell[1], David Badre[2], Michael Frank[2]; [1]Ernest Gallo Clinic & Research Center, UCSF, [2]Brown University — Whether to continue to exploit a source of reward, or to search for a new one of potentially greater value, is a fundamental and underconstrained decision that humans face. A recent computational model of this exploration-exploitation tradeoff posits that variability in such decisions across individuals is influenced by differences in baseline dopaminergic tone within corticostriatal circuits. In behavioral and neurophysiological tests of this model, Frank and colleagues demonstrated that human subjects with less active genetic variants of the catechol-O-methyltransferase gene (COMT), whose protein product degrades synaptically-released dopamine, show greater exploratory behavior; and the degree of exploratory behavior correlates with activity within the right rostrolateral prefrontal cortex. Here we sought to address additional implications of these findings by assessing two further predictions of this model: (1) If COMT genotype and corticostriatal function underlie this behavior, then the strength of corticostriatal connectivity at rest should correlate with the degree of exploratory behavior; and (2) pharmacological inhibition of COMT should increase exploration. In this study, subjects received either placebo or the centrally-acting COMT inhibitor tolcapone in double-blind, randomized, counterbalanced fashion prior to performing an exploration-exploitation task. As predicted, greater resting state connectivity between the right rostrolateral prefrontal cortex and the right striatum correlated with greater exploration in the placebo condition. Moreover, subjects showed a trend toward greater exploration on tolcapone than placebo. These results support the idea that corticostriatal function is linked to exploratory behaviors, and that these influences may be impacted by changes in putatively cortical dopamine tone.

C43

STATE TRANSITION ASSOCIATED WITH INTRINSIC CONNECTIVITY NETWORKS: IMPLICATIONS FOR SEXUAL COMPULSIVITY. Edward Patzelt[1], Krista Wisner[1], Zeb Kurth-Nelson[1,2], Kelvin Lim[1], Michael Miner[1], Angus MacDonald[1]; [1]University of Minnesota, [2]University College London, UK — Sexual

compulsivity (SC) refers to a drive for sexual encounters that results in feeling distressed or addicted, and has been shown to facilitate the contraction of HIV. To understand how feedback integration and state transitions may be related to SC, we examined perseverations and excessive switching on a reversal learning paradigm in two studies. In study 1, a Bayesian Hidden Markov Model was applied to reversal learning task data from a sample of healthy controls (N= 27) who had been scanned using resting-state fMRI. The emotion-interoception intrinsic connectivity network consisting of insula, temporal pole, hippocampus, and anterior cingulate cortex was extracted using group ICA. The state transition parameter from the reversal learning model showed a significant relationship with this emotion-interoception network such that higher connectivity was associated with a lower state transition (rs = -.39, p = 0.043). In study 2, a second sample of subjects (n=58) were measured on sexual compulsivity, completed the reversal learning task. This group showed a trending relationship between number of sexual partners and transition (rs = -.23, p = 0.077), such that lower state transition was associated with increased numbers of sexual partners. Thus adherence to a particular state parallels sexual compulsivity in that the sexual behavior is pervasive despite increasing numbers of partners. These findings are consistent with the hypothesis that sexual compulsivity results from anxiety rather than under-controlled impulses and, by extension, that reduced connectivity within the emotion-interoception intrinsic connectivity network may be related to this behavior.

C44

DOES PERFORMANCE IN A NONVERBAL COGNITIVE CONTROL TASK PREDICT FMRI BRAIN ACTIVITY IN A VERBAL TASK IN BILINGUALS?

Aurora I. Ramos Nunez[1], Maya Ravid[1], Arturo E. Hernandez[1]; [1]University of Houston — Previous studies have found neural similarities between verbal and nonverbal processes. Given these findings, performance in one task may predict neural mechanisms in the other task. The current study investigated how performance in a nonverbal executive control task predicts brain activity in a verbal task using a regression analysis method. Spanish-English adult bilinguals (n=46) performed verbal language switching and nonverbal rule-changing tasks while inside the fMRI scanner. Participants overtly named objects in three conditions: Spanish only, English only and mixed (alternating between Spanish and English) in a picture-naming task. The nonverbal task was a rule-switching paradigm in which participants responded using a button box to color or shape, with the dimension of interest changing after a small number of trials, as indicated by a cue. We performed a regression analysis using the behavioral error rates from the nonverbal task as regressors to predict neural activity in the single language and mixed conditions of the verbal task. Our results show that participants with higher error rates in the nonverbal task showed increased activity in frontoparietal, cingulate, and caudate regions associated with cognitive control processes. Participants with lower error rates presented with increased activity in sensorimotor areas such as precentral and postcentral cortices, rolandic operculum, and occipital cortex in the verbal task. Our results suggest a direct connection between nonverbal control and verbal task performance. These findings are consistent with models suggesting a link between cognitive control and language processing in bilinguals.

C45

THE EFFECTS OF BILINGUALS' PROFICIENCY ON NONVERBAL COGNITIVE CONTROL PERFORMANCE—AN FMRI EXAMINATION

Maya Ravid[1], Aurora I. Ramos-Nunez[1], Arturo E. Hernandez[1]; [1]University of Houston — Previous research found that bilinguals outperform monolinguals on cognitive control tasks, but few studies have examined differences within the bilingual population. This study aims at comparing cognitive control performance in groups of bilinguals divided along their proficiencies in two languages. Spanish-English adult bilinguals (n=47) performed a nonverbal rule-switching task while inside the fMRI scanner. Participants were required to respond as quickly as they could using a button box to either the color or shape of stimuli, with the dimension of interest changing (switch trials) or staying the same (non-switch trials), indicated by a cue. Proficiency was measured using the vocabulary and sentence comprehension portions of the Woodcock Language Proficiency Battery-Revised in English and Spanish. Balanced bilinguals were defined as those individuals who have similar scores on both the English and Spanish tests. Unbalanced bilinguals are those with large differences between their English and Spanish proficiencies. Our results indicate that proficiency balance has significant effects on neural activation while bilinguals engage in a nonverbal rule-switching task. Specifically, unbalanced bilinguals present with large activation patterns in brain areas related to executive function in the rule-switch condition. In contrast, there are little to no activations in the unbalanced group in the non-switch condition, and under both conditions in the balanced group. From these results we can conclude that nonverbal task-switching is more effortful for the unbalanced group than the balanced group. These results are consistent with the view that the bilingual advantage most likely emerges from the consistent use of two languages.

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LEARNING THE VALUE OF OPTIONS: THE ROLE OF ANTERIOR CINGULATE CORTEX IN HIERARCHICAL REINFORCEMENT LEARNING

Akina Umemoto[1], Michael E. Yates[1], Clay B. Holroyd[1]; [1]University of Victoria — Much of human behaviour is complex and involves hierarchical structure. One influential approach for understanding action hierarchies is called hierarchical reinforcement learning (HRL). Whereas standard reinforcement learning algorithms are suited for dealing with simple decision problems, HRL solves more complex problems by organizing temporally extended sequences of primitive actions (e.g., cutting tomatoes) into "options" that are directed toward particular goals (e.g., making a sandwich) (Botvinick et al., 2009). By learning the values of options at this higher level of abstract representations, HRL reduces the number of decisions necessary to carry out extended sequences of behavior, hence making problem-solving computationally more efficient. A recent theory holds that anterior cingulate cortex (ACC) plays a key role in selecting and maintaining high-level options based on their learned values (Holroyd & Yeung, 2012). To test this theory, we employed a novel gambling task where participants played multiple gambling games in two different casinos and learned over time that one casino provided a better payoff than the other (cf. Diuk et al., 2012). By measuring the reward positivity, an event-related potential component believed to reflect reward-related signals carried to the ACC by the midbrain dopamine system, we show that the ACC is sensitive not only to reward feedback as is commonly observed but also to the value of high-level options such that more value is attributed to the good casino than the bad casino. Our results indicate the importance of ACC in guiding high-level action selection based on learned option values in a hierarchical context.

C47

OH THE PLACES YOU'LL GO: AN ADAPTIVE GAIN ACCOUNT OF MIND WANDERING BEHAVIOUR

Melaina T Vinski[1], Alex Gough[2], Kaian Unwalla[3], Kyle Fitzgibbon[4], Scott Watter[5]; [1]McMaster University — Incorporating the Adaptive Gain Theory of attentional allocation within the mind wandering paradigm, the current work investigates the role of norepinephrine (NE) and dopamine (DA) on decoupled states of attention. Online measures of NE and DA were collected during task performance to observe natural shifts in attentional allocation (Experiment 1) and following activation of the Hypothalamtic-Pituitary-Adrenal (HPA) Axis stress response (Experiment 2). The ebb and flow of catecholamine release was measured using an eye-tracker, with pupil dilation used as an indicator of current NE levels and blink rate as an indicator of DA levels. Mind wandering frequency, or the shift toward a task-irrelevant orientation, was measured using the Sustained Attention to Response Task (SART) and the HPA-Axis was activated using the Trier Social Stress Test (TSST). In Experiment 1, findings suggest that elevations in NE and DA precede early inattention to task features and predict attention-related performance errors on the SART. Findings from Experiment 2 reveal that acute stress induces atypical deficits in task performance by facilitating a TSST-oriented attentional focus. Pupillary evidence supports the behavioural account, with variation in NE release upon HPA-Axis activation contributing to the cognitive shifts. In both experiments, variation in catecholamine release was dependent on individual differences in negative mood and absent mindedness in daily life. The current work provides behavioural and psychobiological evidence for NE and DA as neuromodulators of attentional allocation in the preservation of task-oriented focus, supporting an Adaptive Gain account of attentional allocation within the mind wandering paradigm.

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WITHIN-SESSION TIME COURSE OF STRATEGIC ADAPTATIONS IN COGNITIVE CONTROL. Christopher Walker[1,2], Laetitia Ngamassi[1], Thomas Wozny[1], Nicola Polizzotto[1], Raymond Cho[1,2]; [1]University of Pittsburgh, [2]Center for the Neural Basis of Cognition — Cognitive control requires integrating multiple cognitive capacities, including the ability to maintain task-relevant information and goal representations. While temporally local behaviors (e.g. trial-to-trial behavioral adjustments) are well-investigated, the longer term control modulations remain relatively unexplored. Our recent findings suggest that typical practice and fatigue explanations may not fully explain the behavioral shifts that occur over the experimental session. We collected behavioral and electroencephalographic (EEG) data from a sample of 28 healthy controls performing a prepotent response inhibition task (i.e. the Preparing to Overcome Prepotency (POP) task). Condition averages were calculated across the task by grouping trials into four quartiles from beginning to the end of the task. Analyses of error rates revealed a condition by time-on-task interaction. As expected, participants gradually improved in the high-control condition; however, this was paralleled by worsening performance in the low-control condition. Reaction times showed main effects for condition (high > low) and time (decreasing). Preliminary EEG findings suggest an upward trend in gamma-band (i.e. 30-80 Hz) synchrony in the pre-trial baseline period with relatively stable between condition differences during a preparatory delay phase. This pattern of findings suggests strategic adjustments of a control state that optimizes performance as a function of trial-type statistics—with a high proportion of cognitively demanding trials, there may be shifts in the baseline control state to meet these demands, perhaps even incurring some expense during low control trial performance. Together, our findings indicate cognitive control modulations may be sensitive to more global as well as local task demands.

C49

SHARED AND DISTINCT CONTRIBUTIONS OF ROSTRAL PREFRONTAL CORTEX TO ANALOGICAL REASONING AND EPISODIC MEMORY RETRIEVAL: INSIGHTS FROM FMRI FUNCTIONAL CONNECTIVITY AND MULTIVARIATE PATTERN ANALYSES Andrew J. Westphal[1], Nicco Reggente[1], Yama Nawabi[1], Jesse Rissman[1]; [1]UCLA — The rostral prefrontal cortex (RPFC), positioned at the apex of the prefrontal processing hierarchy, has been implicated in a diverse array of high-level cognitive processes. These include abstract analogical reasoning and episodic memory retrieval, which may be linked by their common demands for relational integration. However, because reasoning and memory tasks have not been compared in the same studies, the degree of neuroanatomical overlap in RPFC is unclear. To address this gap, we developed a mixed block/event-related fMRI paradigm that required subjects to periodically shift between Reasoning, Memory, and Perception tasks. While these three task sets entailed dramatically different cognitive goals, all involved the presentation of 4-word stimulus arrays, with the tasks closely matched for response demands and reaction times. FMRI results from 20 participants revealed highly overlapping recruitment of RPFC during successfully solved analogy and source memory retrieval trials, without significant univariate activity differences. However, searchlight-based multi-voxel pattern analysis identified areas of RPFC wherein local activity patterns could facilitate robust decoding of these trial types. One such prominent cluster in left lateral RPFC was then seeded in a psychophysiological interaction analysis. Strikingly, this region showed divergent profiles of functional connectivity across task blocks, coupling more strongly with frontoparietal control network structures during Reasoning and with default mode network structures during Memory. These findings suggest that common areas of RPFC may differentially contribute to analogical reasoning and episodic retrieval via their coordinated interactions with distinct brain networks that respectively facilitate the integration of complex semantic or episodic relationships.

C50

THE EFFECTS OF RESPONSE NUMBER AND TASK ON THE ELECTROPHYSIOLOGICAL CORRELATES OF CONFLICT PROCESSING Sarah E. Donohue[1], Lawrence G. Appelbaum[1], Marty G. Woldorff[1]; [1]Duke University — Incompatible environmental stimuli that lead to differing behavioral responses have the capability to compete for attention, yielding slower response times and increased errors. The degree to which such behavioral costs are driven by the composition of specific types of competing stimuli versus the number of possible stimulus-response associations is not clear. To investigate how these two factors contribute to behavioral and neural conflict effects, we conducted an event-related potential (ERP) experiment in which participants performed versions of the Stroop and Flanker tasks where stimulus-response sets consisted of either 2 or 4 response options in different blocks. In this manner, we were able to experimentally cross the influence of stimulus conflict type (color-word conflict in the Stroop and spatial conflict in the Flanker) with response-set-size to determine how these factors induce differing levels of behavioral costs, as well as how these manifest in the early frontocentral negativity (N450/Ninc) that is a hallmark neural signature of conflict processing. Behaviorally, participants were slower to respond to incongruent trials in all the tasks, as well as slower on the four-response conditions than in the corresponding two-response conditions. The ERP data revealed an early conflict-related negativity (Ninc) for all four tasks. While the Ninc was similar in onset for all conditions, it appeared to last longer in duration for the four-response compared to the corresponding two-response conditions. These data suggest that response-set size, assessed across two different stimulus-conflict tasks, can induce a distinctive temporal modulation of the underlying conflict-related neural processing.

C51

THE HOT HAND FALLACY AND COGNITIVE CONTROL: AN EE...E STUDY Wout Duthoo[1], Elger Abrahamse[1], Maarten De Schuymer[1], Wim Notebaert; [1]Ghent University — In this study, we aimed to elucidate the neural correlates underlying prediction-driven adjustments in cognitive control. We recorded the EEG while participants were engaged in a Stroop task in which they also had to predict the (in)congruency of the upcoming trial, and measured how these predictions influenced conflict resolution. When taking into account the congruency level of the previous trial, analyses revealed that participants displayed a clear congruency level repetition bias (or so-called hot hand fallacy), even though congruency level repetition probability was set at 50%. Moreover, behavioural adjustments (e.g., congruency-based sequential effects) were only present following these repetition predictions, and not following alternation predictions. At the neural level, we found that these sequential effects were reflected in both the early, fronto-medial negativity (N450) and the late, parietal conflict slow potential, which contrasts previous studies (e.g., Larson, Kaufman, & Perlstein, 2009). Again, this pattern was only found following repetition predictions. Moreover, in the interval between prediction and stimulus presentation, we found fronto-central and centro-parietal preparatory activity that differentiated alternation and repetition predictions, with stronger activity for the latter. These results indicate that predictions can steer attentional control and suggest a role for repetition expectancies in bringing about sequential congruency effects.

C52

RESPONSE INHIBITION DURING A WALKING TASK COMPARED TO UPPER LIMB COMPUTER INHIBITION TESTS. Jacques Duysens[1,2], Zrinka Potocanac[1], Inge Leunissen[1], James Coxon[1], Bart Nienhuis[2], Stephan Swinnen[1]; [1]KU-Leuven, Belgium, [2]Sint Maartenskliniek, Nijmegen,The Netherlands — A number of studies stressed inhibitory deficits as possible causes of falls. Our aim was to assess response inhibition during a novel walking task, namely a form of obstacle avoidance (OA) based on the STOP&GO paradigm and compare this lower limb performance to two upper limb standardized computer motor inhibition tasks (Coxon et al., 2012). The walking task consisted of walking by stepping onto stepping stones projected onto the treadmill. Some stones suddenly changed color, indicating that they became obstacles to avoid (hence the need to suppress ongoing movement). The walking task was completed with and without an auditory Stroop dual task to evaluate possible interference of inhibitory processes (OA and Stroop). The Stroop task required suppression of responses to incongruent stimuli. Nine young, healthy adults participated in the experiment. OA failure rates on the walking task increased significantly with increasing difficulty ($p < 0.01$). The addition of the secondary task (dual tasking) further increased failure rates ($p < 0.01$). Increased walking task difficulty (less time to suppress responses) diminished Stroop task performance, reflected by increasing incorrect response rates ($p < 0.01$) and laten-

cies of correct responses ($p < 0.05$). Although inhibition is clearly needed for successful execution of the OA task, performance on the walking task was not correlated to stop signal reaction time as measured by 2 upper limb computer tests (Coxon et al., 2012). Interference between OA and Stroop supports the notion of a "global" mechanism of response inhibition when speed is essential.

C53

DO ACQUISITION AND TRANSFER OF A NEW STRATEGY REQUIRE CONSCIOUS PERCEPTION? Imen El Karoui[1,2], Kalliopi Christoforidis[1], Lionel Naccache[1,3,4]; [1]ICM Research Center, INSERM/CNRS/UPMC UMRS 975, Paris, France, [2]Ecole Doctorale Cerveau Cognition Comportement, UPMC, Paris, France, [3]Assistance Publique - Hôpitaux de Paris, Groupe Hospitalier Pitié-Salpêtrière, Paris, France, [4]Faculté de Médecine Pitié-Salpêtrière, UPMC, Paris, France — This study investigates whether a strategy established on conscious stimuli can be applied to non-conscious stimuli. We derived our experimental paradigm from the task used by Merikle et al (1995). Subjects were asked to respond to the color of a green or blue string of ampersands. Preceding this target, the word "GREEN" or "BLUE" was presented consciously or masked. In experimental blocks, 80 % of the trials were incongruent. Then the optimal strategy consists in preparing the response opposite to the one associated with the word (e.g.: prepare "green" response after the word "BLUE"). In each block, trials were either conscious or non-conscious. Crucially, we added rare non-conscious trials in conscious blocks to test if, once acquired, this strategy could be applied to non-conscious trials. Our paradigm also included a conscious and a masked baseline blocks, with 50% incongruent trials. We analyzed behavioral and electroencephalographic (EEG) data on 21 subjects. Behaviorally, subjects were able to use the optimal strategy in experimental blocks only when the cue was presented consciously. Neither the acquisition nor the transfer of this strategy could be observed when the cue was masked. Nevertheless, we found a N2 component modulated by trial difficulty in conscious and unconscious blocks, suggesting the detection of the conflict induced by the proportion of incongruent trials, even in non-conscious conditions. Current analyses of lateralized readiness potential (LRP) and P3b will precise the other specific stages of processing (response preparation; updating of working memory) affected by the absence of conscious perception.

C54

BILINGUAL INHIBITORY CONTROL: EVIDENCE FROM SCHOOL BILINGUALS Ingrid Finger[1], Luciana Brentano[1], Ana Beatriz Fontes[2]; [1]Federal University of Rio Grande do Sul - Brazil, [2]Penn State Beaver — Recent research on childhood bilingualism has indicated that the daily use of two or more languages sharpens the development of certain cognitive processes, such as selective attention and inhibitory control, as well as linguistic and metalinguistic processes, in bilingual children when compared to monolingual children of the same age (BIALYSTOK, 2001, 2005, 2006, amongst others). However, this advantage has only been observed with native bilingual children, i.e., children who are exposed to both languages at a very young age. To fill this gap, the present study aimed to investigate the effect of bilingualism on inhibitory control in bilingual children who experience bilingualism (or second language learning) exclusively in a school context, compared to the usual sample of bilingual children who experience bilingualism at home or in the community. Thus, 174 children of ages 9 to 12 from three different linguistic groups (75 school bilinguals; 57 home bilinguals and 42 monolinguals) participated in the study. Children completed both the Simon Arrows and the Stroop Tasks to assess their inhibitory control with both non-linguistic and linguistic stimuli. The analysis showed the smallest reaction times for the bilingual children from a school context, in comparison to the other two groups of participants, in both tasks. These findings suggest that children who deal with both languages on a daily basis, although only at a school context, also show cognitive advantages probably due to a bilingual experience.

C55

THE CONTEMPLATIVE BRAIN: A META-ANALYSIS OF MORPHOMETRIC NEUROIMAGING OF MEDITATION PRACTITIONERS Kieran C.R. Fox[1], Savannah Nijeboer[1], Matthew L. Dixon[1], Jelena Markovic[2], Kalina Christoff[1]; [1]University of British Columbia, [2]University of Toronto — While the investigation of the neural basis of contemplative practices remains in its infancy, numerous studies have now addressed how the brain engages in, and is shaped by, meditation. In nearly twenty studies examining morphometric measures of brain structure and their relationship to meditation, a panoply of differences have been found between meditators and controls (or in the same subjects after meditation training) in both gray and white matter throughout cortical and subcortical regions. We conduct a review and meta-analysis of over 100 morphometric group differences (meditators vs. controls) reported in 18 papers over the last decade. We also review the results of correlations between meditation experience level and brain structure. We summarize convergent results across meditation techniques and neuroimaging methodologies, and also compare findings from short-term training vs. long-term practitioners. A meta-analysis of all results to date found reliable, well-replicated structural differences in regions key to introspection (BA 10), exteroceptive and interoceptive body awareness (sensory cortices and insular cortex, respectively), memory (hippocampus), self-regulation (anterior cingulate), and interhemispheric communication (corpus callosum). Many of these regions have previously been implicated in functional neuroimaging studies of meditation, suggesting a strong overlap between functional and structural differences related to contemplative practice. Moreover, there is nearly total overlap between differences found in novices after short-term training, vs. those observed when comparing long-term practitioners to meditation-naïve controls, offering strong evidence that meditation is causally implicated in the observed changes.

C56

NEURAL RESPONSE TO HIGH-CALORIE FOOD WORDS IN OBESITY AND SUCCESSFUL WEIGHT LOSS MAINTENANCE. Jason Hassenstab[1], Elizabeth Kathleen Vernon[1], Lawrence Sweet[3], Jeanne McCaffery[2], Suzanne Phelan[4], Kathryn Demos[2], Ronald Cohen[5], Rena Wing[2]; [1]Washington University in St. Louis, [2]Brown University, [3]University of Georgia, [4]California Polytechnic State University, [5]University of Florida — Successful weight loss maintenance in obesogenic environments requires ongoing behavioral vigilance. Weight loss maintainers (WLMs) must actively inhibit responses to tempting food cues in order to maintain control over food intake. We used block-design versions of the traditional Stroop task and a Food Stroop task to evaluate inhibitory control and neural response to food words (high-calorie vs. low-calorie vs. neutral words) in 14 WLM's, 13 currently obese (OB), and 17 never-obese lean (NOL) adults (ages 27-65 years, 91 % female). WLMs were significantly slower to name the ink color of high calorie food words than OB or NOL ($p = .03$; Phelan et al., 2011). Contrasting the high-calorie condition against the control conditions (low-calorie, neutral), significant BOLD responses (all FDR q's <.05) were observed across all participants in 9 regions, including the precuneus, anterior cingulate, medial and lateral prefrontal cortices, and striatum. A significant group by condition interaction revealed that WLMs had altered patterns of activation relative to OB and NOL in regions associated with response inhibition, reward sensitivity, and sensory processing. WLMs exhibited greater activity in the left inferior frontal gyrus, right middle frontal gyrus, and the right caudate/putamen (all p's <.05). Interestingly, WLMs showed decreased activity in the right insula ($p<.01$). There were no behavioral or BOLD response differences between groups on the traditional Stroop task. Overall, these results suggest that WLMs show altered responses to high-calorie food stimuli, perhaps reflecting differences in cognitive processing that regulates food intake.

C57

THE INTERACTION OF PROBABILITY LEARNING AND WORKING MEMORY Filiz Gözenman[1,2], Didem Gökçay[2], Murat Perit Çakır[2]; [1]University of Nevada Reno, [2]Middle East Technical University, Ankara, Turkey — Probability learning is the ability to establish a relationship between stimulus and outcomes based on occurrence probabilities. Participants learn the task according to the cue-outcome relationship, and try to gain in depth understanding of this relationship throughout the experiment. While learning is at the highest level, people rely on their working memory. In this study 20 participants were presented a probability learning task, and their prefrontal cortex activity was measured with fNIRS. It was hypothesized that as participants gain more knowledge of the probabilities they will learn cue-outcome relationships and therefore rely less on their working memory. Therefore as learning precedes a drop in the fNIRS signal is expected. Significant negative correlation between dorsolateral prefrontal cortex activity

and learning was found. Similarly, response time also decreased through the task, indicating that as learning precedes participants made decisions faster. Participants used either the frequency matching or the maximization strategy in order to solve the task in which they had to decide whether the blue or the red color was winning. We had hypothesized that the people in frequency matching and maximization groups would show working memory differences which could be observed from the fNIRS signal. However, we were unable to detect this type of behavioral difference in the fNIRS signal. Overall, our study showed the relationship between probability learning and working memory as depicted by brain activity in the dorsolateral prefrontal cortex which widely known as the central executive component of working memory.

C58

PASSING THE GATE: DISRUPTING FEATURE BINDING IN VISUAL WORKING MEMORY

Jonathan Hakun[1], Susan Ravizza[1]; [1]Michigan State University — Areas of the inferior and medial temporal lobe (ITL/MTL) take part in the maintenance and rapid binding of multi-feature objects in visual working memory (VWM; Ranganath, 2006; Parra, et al 2009). Selection of relevant information for storage is, at least in part, reliant on a putative gating network that includes the basal-ganglia and prefrontal cortex (BG-PFC; McNab & Klingberg, 2008; Hazy, Frank, & O'Reilly, 2007). In the current study, we investigated the effect of visual information presented during VWM maintenance in view of revealing whether such a selection mechanism could be breached through distraction. Recent behavioral work suggests that behaviorally relevant information presented during maintenance is specifically disruptive of bound features in VWM (e.g. plausible study objects; Ueno, et al 2012). We extended this work by including not only unrelated (empty boxes) and related objects (colored-shapes that share no features with the study objects), but also new colored-shape objects that match the study sets' colors (matched condition). We found a significant cost related to all three distraction conditions; however, the greatest cost was associated with matched condition, while no difference was observed between the unrelated and related conditions. These results suggest that related information may induce contingent capture of attention but is no more consequential to maintenance than unrelated information. However, information that matches the contents of VWM may pass the putative BG-PFC selection gate and cause a rebinding of features in memory.

C59

MENTAL LOAD IN THE COMPLEX MENTAL MULTIPLICATION

Cheng-Ching Han[1,2], Chia-Yuan Lin[1,3], Nai-Shing Yen[1,2,3]; [1]Taiwan Mind & Brain Imaging Center, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, Taipei, Taiwan, [3]Department of Psychology, National Chengchi University, Taipei, Taiwan — Several studies in math cognition have identified areas of the brain that are involved in number processing (Dehaene, Piazza, Pinel, & Cohen, 2003) and complex problem solving (Anderson, 2007), and also found the arithmetic performance is highly correlated with working memory capacities (Iuculano, Moro, & Butterworth, 2011). Only a few research studied the relationship of the more complex arithmetic problem and brain activities. In the present study, we examined cortical activation as a function of different mental loads for mentally solving multi-digit multiplication problems. There are two types of problems in the experiment: 2-digit multiplied by 1-digit (2x1) and 4-digit multiplied by 1-digit (4x1); and two degree of mental digit loading: easy one and difficult one. It is 2 (types) x2 (degree of mental loading) within-subject design. The degree of mental loading is calculated from the highest digit loading of the school strategy (Rosenberg-Lee, Lovett, & Anderson, 2009). There are 100 trials in total. The participants took a rest after every 25 trials. The result showed that when the participants solved the problems had higher digit working memory demands in the mental multiplication, they produced greater activity in right frontal areas.

C60

RELATIONSHIP BETWEEN COGNITIVE AND MOTOR FUNCTIONS IN OLDER ADULTS

Toshikazu Kawagoe[1], Kaoru Sekiyama[1]; [1]Kumamoto University — Previous research suggests that older adults' working memory (WM) has a possibility to have relation to motor function. We focused on the relationship between motor functions, divided into mobility and dexterity, and cognitive functions, especially WM and general cognitive decline. For measuring diverse WM, we adopted N-back (1-back and 2-back) tasks using three distinct types of stimuli (numbers, locations and faces). Participants were older adults (age: 78.6 yrs, SD: 5.2 yrs; education: 11.9 yrs, SD: 2.69 yrs; no one had diagnosed as any dementia). Simple correlation analysis indicated that WM tasks correlated to motor functions to some extent and that the degree of cognitive decline is related to motor function as well as WM capacities. Partial correlation analysis revealed that older adults with higher mobility functions marked good performances of the location 1-back task, and that the participants who had little decline in general cognitive functions scored better performances of the face 1-back task and of dexterity. From these results, Older adults' WM capacities has the potentials to be the indices of their cognitive or motor functions by distinguishing different types of WM (for example, spatial WM for motor function and face WM for cognitive function). We conclude that the spatial WM is specifically related to motor function or mobility.

C61

THE P300 SUBSEQUENT MEMORY EFFECT ELICITED BY THE FIRST WORD IN THE LIST DEPENDS ON ITS OUTPUT POSITION DURING RECALL

Chris Kiley[1], Siri-Maria Kamp[1], Emanuel Donchin[1]; [1]University of South Florida — Several studies (e.g., Karis et al., 1984) have shown that when participants use simple study strategies, the amplitude of the P300 elicited by stimuli that "stand out" is correlated with the probability of later recalling these stimuli ("P300 subsequent memory effect"); furthermore, items that "stand out" are frequently the last item to be recalled during test (Fabiani and Donchin, 1995). In a recent study, Kamp et al. (2012) reported a P300 subsequent memory effect for the first word in a study list as well. In the present study we investigated whether the magnitude of the P300 subsequent memory effect elicited by the first word varies with this word's output position during subsequent recall. Thirteen participants studied and immediately recalled 40 lists of 15 words while their ERPs were recorded. The recall rates showed a strong primacy- and a recency effect. Compared to study items from the middle of the list, the first study word was more likely to be recalled first, however, this word was about equally likely to be recalled first or last. In agreement with prior findings, the first study word elicited a P300 subsequent memory effect. Words that were recalled last during test elicited the largest P300 at study, while words that were recalled first elicited the smallest P300. These results suggest that P300 amplitude elicited by the first study word does not only correlate with whether or not this word is subsequently recalled, but also with its precise output position during recall.

C62

DO ADULTS WITH ATTENTION DEFICIT/ HYPERACTIVITY DISORDER HAVE PROBLEMS IN WORKING MEMORY?

Soyeon Kim[1,2], Zhongxu Liu[1], Daniel Glizer[1], Rosemary Tannock[1,2], Steven Woltering[1,2]; [1]University of Toronto, [2]Hospital for Sick Children — Objectives: The aim of this study is to determine how underlying, covert factors such as attention resource allocation or arousal level contribute to working memory (WM) performance in adults with Attention-Deficit/Hyperactivity Disorder (ADHD) and a healthy comparison group. Methods: Dense-array (128-channel) electroencephalography will be used to capture a specific event related potential (ERP) -the P3, known to be associated with WM - during performance of a delayed match-to-sample task with low and high memory load conditions. Standardized neuropsychological tests, such as digit span and subtests of the Cambridge Neuropsychological Testing Automated Battery (CANTAB) will be used to provide behavioral measures of WM performance. Neural analyses will focus on the early encoding stage of WM in the delayed-match-to-sample task – an early stage of WM known to be influenced by attention and arousal. Results: The ADHD group had similar accuracy scores and reaction time compared to the comparison group on the delayed-match-to-sample task, and in performance on the neuropsychological WM tasks. However, the P3 amplitude was smaller in ADHD group than the comparison group on first stimuli and last stimuli. This main effect of group was also present on low and high load conditions collapsed across stimuli. Conclusions: This study provides the first evidence of neural impairments in the encoding stage of WM in adults with ADHD. Findings suggest that low arousal level as well as failure to allocate sufficient attentional resources, rather than poor WM per se, may accounts for the lower P3 amplitudes in the ADHD group.

C63

MORPHOLOGICAL PROCESSING IN A MINIMALLY INFLECTED LANGUAGE: EVIDENCE FROM MANDARIN CHINESE Yun-Hsuan Huang[1,2], Elisabeth Fonteneau[1,2], Caroline M. Whiting[1,2], Qing Cai[3,4], William Marslen-Wilson[1,2]; [1]Department of Psychology, University of Cambridge, [2]MRC Cognition and Brain Sciences Unit, Cambridge, U.K., [3]East China Normal University, China, [4]INSERM U992, Cognitive Neuroimaging Unit, France — Previous research in English and Polish provides evidence that two distinct but partially overlapping networks underlie spoken word processing. Morphological inflections, an assumed hallmark of human language, mainly engage a left-lateralized frontal-temporal network linking inferior frontal and posterior temporal regions; non-inflected simple words and derived words are supported by a more widely distributed bilateral fronto-temporal network (Bozic et al. 2010; Szlachta et al, 2012). The aim of this study is to examine the possible role of these two networks in a minimally inflected language, Mandarin Chinese. Native speakers of Mandarin passively listened to three types of disyllabic Mandarin words, where the second syllable contrasted different types of morphological complexity (simple compound words (hu shi 'to breath'), derived words (jing hua 'purify') , and inflected words (chang zhe 'singing'), while combined electro- and magneto-encephalography (EMEG) data were recorded. This allows us to track the transient real-time morphological computations underlying the three types of complexity. The alignment point was set to the onset of the second syllable, where information about word type and complexity becomes available. Minimum Norm Estimate (MNE) techniques were used to compute whole-brain source estimates. Early results suggest that derived words elicit more activation than inflected words in the bilateral fronto-temporal network at early time-windows, while inflected words preferentially activate left hemisphere frontal and temporal ROIs at a later time-window. This is preliminary evidence that, despite the reduced role of grammatical morphological combination in Mandarin, a similar functional differentiation can be observed in the underlying neurobiological systems.

C64

BEHAVIORAL AND MAGNETOENCEPHALOGRAPHIC EVIDENCE FOR THE CONTRIBUTION OF PHONETIC AND SEMANTIC RADICALS TO CHINESE CHARACTER RECOGNITION Yi-hui Hung[1,2], Daisy L. Hung[1,2,3], Ovid J.-L. Tzeng[1,2,4], Denise H. Wu[2,3]; [1]Institute of Neuroscience, National Yang-Ming University, Taiwan, R.O.C., [2]Laboratories for Cognitive Neuroscience, National Yang-Ming University, Taiwan, .R.O.C, [3]Institute of Cognitive Neuroscience, National Central University, Taiwan, R.O.C, [4]The Institute of Linguistics, Academia Taiwan, R.O.C. — Most Chinese characters have a horizontal structure with a semantic and a phonetic radical on the left and right side, respectively. Although pre-lexical involvement of the phonetic radical in Chinese character recognition has been established, there is little agreement on the contribution of the semantic radical. We used magnetoencephalography (MEG) to investigate the temporal dynamics of the processes elicited by semantic and phonetic radicals. When participants performed homophone judgment on a pair of Chinese characters with or without the same phonetic radical, sharing a phonetic radical facilitated the decision on two homophonic characters but interfered with the decision on two non-homophonic characters. The repetition of the phonetic radial resulted in a smaller M170 component, and further interacted with homophony of the stimulus pair in M250 and M350 components, indicating early involvement of the phonetic radical in orthographic/phonological computation of Chinese character recognition. When participants performed synonym judgment on a pair of Chinese characters with or without the same semantic radical, sharing a semantic radical facilitated the decision on two synonymic characters but interfered with the decision on two non-synonymic characters. The repetition of the semantic radial might be a post-lexical effect, however, as it did not modulate MEG components nor did it interact with synonymy of the stimulus pair. Although both the semantic and phonetic radicals affected response latencies of character recognition, the MEG results suggest that only the phonetic but not the semantic radial plays an early/dominant role in accessing the sound and the meaning of a Chinese character.

C65

PROCESSING CONSONANT LENGTH: ERP AND BEHAVIOURAL EVIDENCE FROM BENGALI Sandra Kotzor[1], Allison Wetterlin[1], Adam Roberts[1], Aditi Lahiri[1]; [1]University of Oxford — About half of the world's languages use consonantal length to contrast words; e.g. in Bengali: singleton [pata] 'leaf' vs. geminate [pat:a] 'whereabouts, location'. The main acoustic cue for differentiating length of consonants is closure duration, geminates being almost twice as long as single consonants (e.g., average singleton 80ms, geminate 180ms). Since duration contrasts are invariably relative, how would listeners process consonantal length if there were no other cues to differentiate them? To investigate this question we used both behavioural and evoked potential recordings in a crossmodal semantic priming paradigm. Two sets of Bengali disyllabic words were chosen as auditory primes; lexical singletons with no geminate counterparts, and underlying geminates with no corresponding singleton word. Nonword mispronounced primes were created by shortening or lengthening the medial consonant to create the corresponding (fake) geminate or singleton. Significant semantic priming confirming lexical activation was observed, reflected by lower mean N400 amplitudes and faster reaction times with nonword mispronunciations, but only when the real word was a singleton. This asymmetry shows that although the brain is very sensitive to durational differences, a perfect match of consonantal length is not required for lexical activation. Nevertheless, while increasing the length of the consonant appears to facilitate the recognition of the the real word, reducing its length does not result in facilitation.

C66

NEURAL PROCESSING OF WRITTEN LANGUAGE IN DEAF READERS: AN EVENT-RELATED POTENTIAL ANALYSIS Alison S Mehravari[1], Lee Osterhout[1]; [1]University of Washington — A majority of deaf students leave high school reading at or below a fourth grade level, but some deaf individuals do become highly proficient readers. There is disagreement about the causes of this reading difficulty, and by association, disagreement about the effectiveness of different strategies for teaching reading to deaf children. The goal of this project was to use real-time measures of neural language processing to better assess what leads to successful reading in deaf adults. Two groups of participants took part in this study: 1) adults who became severely or profoundly deaf before two years of age, and 2) age-matched normal hearing adults. Event-related potentials (ERPs) were recorded while participants read: a) sentences that were either well-formed or contained a subject-verb agreement, meaning, or combined agreement-meaning error, and b) pairs of words that were either unrelated or related in meaning, phonology, orthography, or both phonology and orthography. Standardized reading comprehension skill was measured in all participants. Deaf participants displayed both quantitatively and qualitatively different ERP responses to sentence violations and related words than did normal hearing participants. Additionally, greater variation was seen in ERP responses within the group of deaf participants. These data begin to suggest what patterns of neural language processing may be associated with better reading proficiency in deaf individuals.

C67

EFFECTS OF EXPERIMENTAL CONTEXT ON WORD FREQUENCY EFFECTS IN AN ERP MASKED PRIMING PARADIGM Priya Mitra[1], Marianna Eddy[1,2], Jonathan Grainger[3], Phillip Holcomb[1]; [1]Tufts University, [2]US Army NSRDEC, [3]CNRS and Aix-Marseille University — Event-related potential (ERP) masked priming paradigms have demonstrated that automatic word processing is sensitive to word frequency at sublexical and lexico-semantic stages of word recognition. Previous ERP research has shown that low-frequency word pairs consistently elicit sublexical (N250) masked priming effects. Intermixed high-frequency word pairs did not elicit this effect when presented with a long stimulus onset asynchrony (SOA), perhaps because the prime stimuli are processed so efficiently as to not overlap with target stimuli processing. However, in a subsequent experiment using only high-frequency pairs and a long SOA, our results did show N250 masked priming effects. The present study examines this discrepancy by comparing high- and low-frequency word pairs in separate experimental blocks, using the same presentation durations (53ms primes, 120ms SOA) previously shown to elicit an N250 priming effect for high-frequency words. We

replicate the finding that high-frequency words can elicit an N250 priming effect using this paradigm, and further show that the presence and size of this effect is dependent upon the order of stimulus presentation. Both high-frequency and low-frequency N250 priming effects were larger when the words were presented in the first block. High-frequency words only elicited a significant priming effect from 200-300ms when they preceded the low-frequency block. These findings suggest that the effects of word frequency on N250 masked priming effects are highly sensitive to experimental context. Both high- and low-frequency words are influenced by presentation order and N250 priming effects may be especially sensitive to presentation parameters when participants read extremely high-frequency words.

C68

HEMISPHERIC ASYMMETRY IN IMAGERY PROCESSING THAT LINKS TO LANGUAGE: AN EVENT-RELATED POTENTIAL STUDY

Li-Hsin Ning[1], Hsu-Wen Huang[2], Kara D. Federmeier[1]; [1]University of Illinois at Urbana-Champaign, [2]National Taiwan Normal University — This study used visual half-field (VF) presentation and event-related potential (ERP) measures to examine how the left (LH) and right (RH) hemispheres process concrete and abstract senses of polysemous nouns (e.g., "green book," referring to the concrete, physical object that is a book, versus "interesting book," referring to the abstract information that a book conveys) and, in particular, in their ability to switch between these senses. Participants read adjective-noun-adjective triplets, in which the first adjective and the noun were presented centrally and the second adjective was presented laterally, and were asked to judge which adjective was more appropriate as a description of the noun. Responses on the first adjective replicated standard ERP concreteness effects, with concrete adjectives eliciting a sustained frontal negativity (500–900 ms) that has been linked to imagery. With initial presentation to the LH, this concreteness effect was also seen on the second adjective, irrespective of the concreteness of the prior adjective. However, with presentation to the RH, sustained frontal negativity was seen only for concrete adjectives not preceded by a prior concrete adjective. That is, prior imagery eased additional imagery selectively for the RH. These results provide additional evidence for a critical role of the RH in creating, maintaining, and augmenting mental imagery during normal language comprehension.

C69

EARLY ELECTROPHYSIOLOGICAL COMPONENTS ARE ALTERED IN ADULTS WITH DEVELOPMENTAL DYSLEXIA DURING A LEXICAL DECISION TASK.

Darlene Oliveira[1], Patrícia Silva[1], Karen Ueki[1], Paulo Boggio[1], Elizeu Macedo[1]; [1]Social and Cognitive Neuroscience Laboratory - Mackenzie Presbyterian University — Developmental Dyslexia is a specific learning disorder characterized by difficulties in reading accuracy and fluency. Previous findings have been shown alterations on event related potential (ERP) latency and amplitude concerning different stages of word recognition on participants with dyslexia indicating core deficits and the use of compensatory mechanisms and/or inefficient reading. However, these are most described in children. Limited information is provided with respect to adults with this reading disability. c Therefore, we aimed to investigate the pattern of ERPs in adults with Dyslexia in a lexical decision task. 13 undergraduate dyslexics and 13 controls (mean age 23,5) matched by age, gender and educational level were enrolled in this experiment. The lexical decision task was composed by regular high frequency words (Brazilian Portuguese), quasi-words derived from real words and pseudowords not derived from real words. EEG were collected with the 128 electrodes Geodesic EEG System. Repeated measures ANOVAs were used to analyze behavioral and eletrophysiological data. Dyslexic subjects showed less accuracy and higher reaction times as compared to controls in all lexical categories. Occipital and occipito-temporal P1 and N1 amplitudes were lower in dyslexic group, reflecting an early-altered processing of the holistic characteristics of the stimuli. Moreover, parietal P600 amplitude was lower in dyslexics indicating deficits in reprocessing of linguistic items. Additionally, we find a significant effect of hemisphere for the control group that was not observed in the dyslexic group. Our data corroborate previous findings and introduce new data about the abnormal ERP pattern in dyslexic adults.

C70

DISTINCT PATTERNS OF BRAIN ACTIVITY CHARACTERIZE LEXICAL ACTIVATION AND COMPETITION IN SPEECH PRODUCTION

Vitoria Piai[1,2], Ardi Roelofs[1], Ole Jensen[1], Jan-Mathijs Schoffelen[1,3], Mathilde Bonnefond[1]; [1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, [2]International Max Planck Research School for Language Sciences, Nijmegen, The Netherlands, [3]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands — A fundamental ability of speakers is to quickly retrieve words from long-term memory. According to a prominent theory, concepts activate multiple associated words, which enter into competition for selection. Previous electrophysiological studies have provided evidence for the activation of multiple alternative words, but did not identify brain responses reflecting competition. We report a magnetoencephalography study examining the timing and neural substrates of lexical activation and competition. The degree of activation of competing words was manipulated by presenting pictures (e.g., dog) simultaneously with distractor words. The distractors were semantically related to the picture name (cat), unrelated (pin), or identical (dog). Semantic distractors are stronger competitors to the picture name, because they receive additional activation from the picture, whereas unrelated distractors do not. Picture naming times were longer with semantic than with unrelated and identical distractors. The patterns of phase-locked and non-phase-locked activity were distinct but temporally overlapping. Phase-locked activity in left middle temporal gyrus, peaking at 400 ms, was larger on unrelated than semantic and identical trials, suggesting differential effort in processing the alternative words activated by the picture-word stimuli. Non-phase-locked activity in the 4-10 Hz range between 400-650 ms in left superior frontal gyrus was larger on semantic than unrelated and identical trials, suggesting different degrees of effort in resolving the competition among the alternatives words, as reflected in the naming times. These findings characterize distinct patterns of brain activity associated with lexical activation and competition respectively, and their temporal relation, supporting the theory that words are selected by competition.

C71

THE NEUROANATOMY OF SENSORY-MOTOR INTEGRATION: A LESION STUDY

Tasha Poppa[1], Corianne Rogalsky[1], Kristin Raphel[2], Steve Anderson[3], Hanna Damasio[2], Tracy Love[4], Gregory Hickok[1]; [1]University of California, Irvine, [2]University of Southern California, [3]University of Iowa, [4]San Diego State University & University of California, San Diego — Numerous studies have demonstrated a tight link between sensory and motor speech processes. While many recent imaging and transcranial stimulation studies have focused on sensorimotor functions of frontal regions during speech perception, research on speech production has identified a region in the let temporal-parietal junction (area Spt) that serves as a sensorimotor interface for vocal tract effectors. The present lesion study investigates the neuroanatomy of sensorimotor integration by measuring speech repetition and perception abilities in 55 patients with left-hemisphere lesions. Subjects completed a psycholinguistic battery to assess their phonological, lexical, and sentence-level speech comprehension and production abilities. This battery included word and non-word repetition tasks. The non-word repetition task should particularly tax sensorimotor integration processes because these novel speech stimuli do not have lexical-semantic representations to assist in their production. Voxel-based lesion-symptom mapping identified a large voxel cluster spanning gray and white matter in the left temporal-parietal junction, including area Spt, where damage was significantly related to poor non-word repetition. The real-word repetition task analysis identified a very similar dorsal network including area Spt, as well as a small adjacent middle temporal gyrus region. Removing variance associated with speech perception abilities (as measured by d-prime scores on a syllable discrimination task) did not alter the overall lesion pattern for either task. These preliminary results suggest that area Spt is critically involved in both word and non-word repetition, and that its contribution is not driven by perceptual processes alone. Supported by NIH-DC03681.

C72

PREDICTIONS IN SPEECH COMPREHENSION: FMRI EVIDENCE ON THE METER-SEMANTIC INTERFACE

Kathrin Rothermich[1], Sonja A. Kotz[2]; [1]McGill University, School of Communication Sciences and Disorders, Montreal, QC, Canada, [2]Research Group — When listening to speech we not only form predictions about what is coming next, but also when something is coming. For example, metric stress may be utilized to predict the next salient speech event (i.e. the next stressed syllable) and in turn facilitate speech comprehension. However, speech comprehension can also be facilitated by semantic context, that is, which content word is likely to appear next. In the current fMRI experiment we investigated (1) the brain networks that underlie metric and semantic predictions by means of prediction errors (2) how semantic processing is influenced by a metrically regular or irregular sentence context and (3) if task demands influence both processes. The results are three-fold: First, while metrically incongruent sentences errors activated a bilateral fronto-striatal network semantically incongruent trials led to activation of fronto-temporal areas. Second, metrically regular context facilitated speech comprehension in the left-fronto-temporal language network. Third, attention directed to metric or semantic aspects in speech activate engaged different subcomponents of the left inferior frontal gyrus (IFG). The current results suggest that speech comprehension relies on different forms of prediction, and extends known speech comprehension networks to subcortical sensorimotor areas.

C73

EVENT-RELATED POTENTIALS ELICITED BY SINE-WAVE SPEECH STIMULI BEFORE AND AFTER SPEECH RECOGNITION TRAINING

Kathryn Schelonka[1], Chris Graulty[1], Enriqueta Canseco-Gonzalez[1], Michael Pitts[1]; [1]Reed College, Portland, OR — Previous studies have suggested that linguistic information is processed differently from non-linguistic sounds at early and late stages of auditory perception; however, the neural mechanisms responsible for discrimination between speech and non-speech sounds have been notoriously difficult to identify due to the physical acoustic differences between speech and non-speech stimuli. Sine-wave speech (SWS) is a unique auditory phenomenon in which the same physical stimulus can be perceived as noise or as speech depending on perceptual expectations. In this study we compared event-related potentials (ERPs) elicited by SWS stimuli in both non-speech and speech conditions. Participants completed a discrimination task between four SWS sounds before and after they had been trained to hear the sounds as speech. We found that the N1 auditory component was larger in the non-speech condition, likely reflecting increased attentional demands for the more difficult task of sound discrimination compared to speech discrimination. The speech and non-speech elicited ERPs also diverged around 300 ms over the frontal scalp, resulting in a lasting positive shift in the speech condition compared to the non-speech condition. This latter difference may reflect upper-level speech processes. Follow-up studies controlling for task difficulty and word repetition will also be discussed.

C74

TOO WEIRD TO CATEGORIZE? ARE INFERENCES SUPPORTED BY CATEGORY-RESISTANT VALENCES?

Connie Shears[1], Shaun Flax[1], Christine Brown[1], Adriana Ariza[1], Francesco Onorati[1]; [1]Chapman University — Consideration of the influence emotions have on many cognitive processes has recently flooded studies of language comprehension (Gygax et al., 2007). Language that conveys or connotes an emotional state of a fictional character (emotional language) has been arbitrarily dichotomized as 'positive' or 'negative', which avoids the rich variance between pleasure, relief, triumph or sadness, anger, fear (Sauter, 2010). Utilizing two methods of measuring the formation of causal inferences (yes/no key press responses to comprehension questions or target word recognitions), we examined readers' response times and accuracy to two-sentence stimulus pairs conveying emotions that resist positive or negative categorization. Pride, awkward, boredom, resentment, regret, and sympathy all significantly affected readers' formation of inferences. When readers' answered comprehension questions, they were faster and more accurate following pride sentences. When readers' responded to target words, they were slowest following resentment sentences and least accurate following pride sentences. Both methods of measuring inference processes suggest these valences support inferences. However, the data indicate that questions, rather than targets, are a stronger measure of these category resistant or "weird" valences. A post-test survey of reader's ratings of these valences as positive or negative indicated that readers who think pride is a positive emotion, made more causal inferences than readers who think pride is negative.

C75

A SITUATION AT HAND: SIGN LANGUAGE LEARNING DYNAMICALLY RE-ORGANIZES SPOKEN LANGUAGE COMPREHENSION AND THE BRAIN

Emily Gaudet[1], Bonnie Buis[1], Jeremy Skipper[1]; [1]Hamilton College — We have proposed that the organization of language and the brain is supported by multiple dynamically organizing networks. The weighting of these networks varies as a function of the "contextual" information available to listeners and their prior experience with that information. By this model, experience with a manual language will weight networks that extract information from co-speech gestures more strongly. We tested this hypothesis with students enrolled in an introductory American Sign Language (ASL) class who watched an actress telling a spoken English story while undergoing 4-dimensional electroencephalography neuroimaging. We predicted that ASL students would show greater sensorimotor network activity when viewing gestures compared to spoken language-learning matched controls. As predicted, ASL learners showed significantly greater activity in parietal cortex during imagistic and less-imagistic gestures and frontal "motor" and anterior temporal "language" regions during imagistic gestures. A direct contrast confirmed that the ASL group had increased activity in these regions for imagistic gestures. Furthermore, parietal, motor, and language regions formed a network for the ASL group with motor preceding language region activity, followed by a reduction of activity in early auditory areas. In conclusion, results suggest that learning ASL weights "co-speech gesture networks" more strongly and does so because the information in more informative (imagistic) gestures can more readily be used in a predictive manner to reduce auditory processing demands. More generally, results are consistent with the hypothesis that the networks underlying the organization of language and the brain are dynamically organized, in part, as a function of prior experience.

C76

THE INFLUENCE OF LANGUAGE ON EXACT ADDITIONS IN BILINGUAL ADULTS

Amandine Van Rinsveld[1], Martin Brunner[2], Karin Landerl[3], Christine Schiltz[1], Sonja Ugen[1]; [1]University of Luxembourg, [2]Free University of Berlin, [3]University of Graz, Austria — To which degree is language involved in arithmetic? We investigated this question in a German-French bilingual setting. In Luxembourg, bilingualism is acquired through education: mathematics are taught in German in primary and in French in secondary school. Interestingly, the decades and units within two-digit number names follow the unit-decade order in German but the decade-unit order in French. Forty-eight bilingual adults performed simple and complex additions. Participants had to orally respond either in German or in French. Additions were presented in different conditions: (1) visual Arabic presentation, (2) auditory presentation (in German or in French), and (3) as a dual task in which visually presented additions were preceded by visually presented semantic judgments to indirectly activate a German or French language context. The results showed that participants performed complex calculations better in the dominant language (German), while there were no differences for simple calculations. Thus, language proficiency seems to be crucial for the computation of more complex calculations, whereas arithmetic facts can be retrieved equally well in both languages. Further, adding language at the input level (auditory presentation) enhanced performances for simple calculations, especially in the non-dominant language (French), while it was exactly the opposite effect for complex calculations. Additionally, visual additions were better performed within a surrounding linguistic context (3) than alone (1) in their non-dominant language, suggesting the crucial role of the linguistic context of an addition task in bilinguals. Taken together, these results support the view of a strong language impact on calculations.

C77

THE INTERPLAY BETWEEN EMOTION AND ATTENTION ON THE PROCESSING OF SYNTACTIC ANOMALIES: EVIDENCE FROM P600

Constance Vissers[1,2], Martine Verhees[2], Dorothee Chwilla[2]; [1]Centre of Excellence for Neuropsychiatry, Vincent van Gogh Institute for Psychiatry,

Venray, The Netherlands, [2]Donders Institute for Brain, Cognition and Behaviour, Centre for Cognition, Radboud Univeristy Nijmegen, The Netherlands — Little is known about the relationship between language and emotion. In an earlier event-related potential (ERP) experiment, an interaction was observed between mood and the processing of syntactic anomalies for which three explanations were offered: one in terms of syntactic processing, one in terms of heuristic processing, and one in terms of more general factors like attention. The present aim was to determine the locus of the effects of mood on language by investigating whether attention contributes to the mood-related modulation in P600 effect to syntactic anomalies. We compared the P600 effect to subject-verb agreement errors relative to correct sentences while ERPs were recorded and mood was manipulated by presenting happy or sad film clips. Attention was directed using a task manipulation: participants either had to focus attention on syntactic features or on physical features. The main findings were as follows. The mood induction procedure was effective: participants were happier after watching happy film clips and sadder after watching sad film clips compared to baseline (ps<.01). For the P600 time window, interactions with mood, task and correctness were obtained, reflecting that mood and attention both modulated P600. The mood manipulation led to a reduction in P600 for sad mood as compared to happy mood, in the syntactic task (ps<.05). The task manipulation led to a reduction in P600 in the physical task as compared to the syntactic task, in happy mood (ps<.04). These data show that attention contributes to the mood-related modulation in P600 effect to syntactic anomalies.

C78

IDIOM COMPREHENSION DURING SENTENCE PROCESSING IN CHILDREN WITH AUTISM Matthew Walenski[1,2], Ashlee Heldreth[1], Stephanie Hubbell[1], Connor McCabe[2], Tracy Love[1,2]; [1]San Diego State University, [2]University of California San Diego — The language of children with autism is characterized by, among other things, the excessively literal interpretation of idioms (e.g., responding "No, it's raining water" to "It's raining cats and dogs").Such abnormal usage is generally ascribed to deficits of pragmatic language and inference making, though other accounts instead posit that poor idiom comprehension reflects structural language deficits. In the current study, we used cross-modal lexical priming to investigate the real time auditory comprehension of idioms in sentences by children with autism, as compared against two control groups: typically-developing (TD) children and children with specific language impairment (SLI). Children listened to sentences containing idioms like "hit the sack" (e.g., "The toddler in a dinosaur shirt hit the sack * at eight o'clock after a long day of playing outside with his best friend."), and responded to visual targets presented immediately at the offset of the idiom (*). We tested for priming of the literal and the figurative meanings of the idiom. Results indicate that the TD and SLI groups primed the figurative but not literal meaning, consistent with prior findings from typical adults. The children with autism showed a different pattern, instead priming only for the literal meaning. The results are consistent with prior findings of abnormal idiom comprehension in autism, and suggest that the difficulty with idioms in autism is rooted in early automatic language processes, and moreover that it reflects a different dysfunction than found in SLI (which does not appear to affect idiom comprehension at this stage of processing).

C79

THE EFFECTS OF SCHEMATIC SUPPORT AND UNITIZATION ON THE ASSOCIATIVE DEFICIT IN OLDER ADULTS Fahad Ahmad[1], Myra Fernandes[2], William Hockley[3]; [1]Wilfrid Laurier University, [2]University of Waterloo, [3]Wilfrid Laurier University — Cognitive aging is associated with a decline in episodic memory, but stability in semantic memory. According to the Associative Deficit hypothesis proposed by Naveh-Benjamin(2000), there is an age-related decline in episodic memory because older adults cannot bind together unrelated information at encoding into a coherent whole needed for recognition of item pairs. Here we examined the effect of schematic support on reducing the associative deficit in older adults. During encoding younger and older adults studied compound (e.g., store keeper) and non-compound word pairs (e.g., needle birth), the former of which provided greater schematic support. Participants were instructed to combine items in the word pair into a sentence for better performance on subsequent recognition of word pairs (associative test). We found older adults' memory accuracy, and discrimination, for intact compound word pairs was higher than for non-compound word pairs. Schematic support provided by the compound nature of words can ease unitization of word pairs, and contribute to a significant reduction in the associative deficit in older adults. Our results are in line with Craik's (1986) environmental support theory: schematic support provided at encoding is beneficial in reducing the associative deficit in older adults, likely making the task less resource-demanding.

C80

SIMILARITIES AND DIFFERENCES IN ADULT AND CHILD RESPONSES TO IRRADIATION AND IMPLICATIONS FOR NEURAL RECOVERY Carol Armstrong[1,2], Robert Lustig[1,2], Jane Minturn[1,2], Michael Fisher[1,2], Zelig Tochner[2], Christine Hill-Kayser[1,2], Peter Phillips[1,2]; [1]Children's Hospital of Philadelphia, [2]University of Pennsylvania, Perelman School of Medicine — Introduction and Purpose: There are phasic effects on brain function following therapeutic irradiation (XRT) that demonstrate cognitive injury, but also recovery of function. Selective long-term memory processes are cognitive biomarkers for delayed effects of irradiation on cognition. After a period of decline after XRT, there is a temporal period of recovery of long-term memory processes. Comparison of this technique for measuring irradiation effects on cognition, and the nonlinear change over time in adults versus children, will probe neural plasticity. Methods: Results from 41 irradiated and 29 nonirradiated adults with primary brain tumors were submitted to a mixed effects model (time, group, age, surgical status, medications, practice). Results were compared to the model for 35 children with primary brain tumors and XRT. Data from both groups were collected pre-XRT and three times post-XRT to two years. Six tests of associative and configural memory and other cognitive tests were investigated in adults to identify cognitive processes specific to XRT (independent of tumor locus). The XRT-specific tests were then examined in children. Results: Findings were decline 2m after full dose, and recovery by one year of memory dependent on semantic cortex and hippocampal memory system only in XRT-treated adults; there was double dissociation from visual memory. Children demonstrated the same patterns in memory, except decline continued for one year, and recovered by two years. Conclusions: The delay in recovery of long-term memory processes in children implies attenuated neural recovery; potential clinical causes such as ablation of neurogenesis and other pathophysiological mechanisms are discussed.

C81

SLEEP-DEPENDENT MEMORY CONSOLIDATION IN OLDER ADULTS – PRELIMINARY RESULTS Kathryn Atherton[1], Christopher Butler[1], Anna C Nobre[1]; [1]University of Oxford — There is now a large body of evidence demonstrating that sleep plays a role in memory consolidation. The overwhelming majority of these studies have used young adults as participants and there is comparatively little research on sleep-dependent memory consolidation in older adults. Here we present a new dataset showing that sleep is beneficial for memories of arbitrary associations between pairs of word stimuli even in older adults (mean age 62±1.51). Memory was tested twelve hours after the training session, following a night of sleep or a day of wake. Interfering pairs of words were learnt ten minutes before the memory test. This interference learning has been shown in previous studies with young adults to 'unmask' the benefit of sleep for memory. Each participant took part in both conditions and the order was counterbalanced. Retention was significantly better in the sleep condition than the wake condition. Learning was not significantly different in the two conditions, arguing against a circadian interpretation of the data. Once analysed, polysomnographic features recorded during the sleep condition will be correlated with overnight memory retention. However, while the same participants demonstrated complex motor sequence learning on a serial reaction time task, there was no evidence that this skill was preferentially consolidated during sleep.

C82

FUNCTIONAL COMPENSATION IN RESPONSE TO INCREASING TASK DIFFICULTY: COMPARING SEMANTIC AND EPISODIC MEMORY TASKS IN YOUNG AND OLDER ADULTS. Elsa Baena[1], Lee Ryan[1]; [1]University of Arizona — Neuroimaging studies have shown that older adults who perform similarly to young adults on memory tests activate bilateral frontal regions, compared to younger adults who show

unilateral activations. This increase has been described as functional compensation. Whether or not functional compensation is specific to older adults is unknown. The present fMRI study compared patterns of brain activation of 24 young (18-24) and 24 older (62-83) healthy adults while performing two memory tasks –episodic and semantic–as task difficulty increased. Difficulty was manipulated with word frequency. In the semantic task, participants judged whether pairs of words were either synonyms or antonyms. In the episodic task that followed, participants made yes/no recognition judgments for the word pairs previously presented. Behavioral results showed a double dissociation -older adults were adversely affected in the episodic but not the semantic task, while young adults were affected adversely only in the semantic task. fMRI activations showed linear increases in bilateral frontal and parietal regions as a function of task difficulty in the older adults, for both tasks, regardless of their behavioral performance. Young adults showed bilateral increases only as difficulty increased in the semantic task. ROI analyses on left middle frontal gyrus, bilateral medial and inferior frontal gyrus, yielded significant activations between groups. The results suggest that both younger and older adults may demonstrate functional compensatory processes when faced with increasing task difficulty. This suggests that younger adults show a compensation response that is task-network related, while older adults show a fronto-parietal compensation that is task-independent

C83

APOE E4 GENOTYPE PREDICTS MEMORY FOR EVERYDAY ACTIVITIES

Heather Bailey[1], Jesse Sargent[2], Shaney Flores[1], Petra Nowotny[1], Alison Goate[1], Jeffrey Zacks[1]; [1]Washington University St. Louis, [2]Francis Marion University — The apolipoprotein E (ApoE) ε4 allele is associated with neuropathological buildup of amyloid in the brain, and with lower performance on some laboratory measures of memory in some populations. In two studies, we tested whether ApoE genotype affects memory for everyday events. In Study 1, participants aged 20-79 years old (n = 188) watched movies of actors completing daily activities and completed memory tests related to the activity in the movies. In Study 2, cognitively healthy and demented older adults (n = 97) watched and remembered similar movies, and also underwent structural MRI scanning. All participants provided saliva samples for genetic analysis. In both samples we found that ApoE ε4 carriers demonstrated worse everyday memory performance than did ε4 non-carriers; however, this effect only held in older adults (ages 50-79 in Study 1 and the entire sample for Study 2). ApoE ε4 carriers had smaller MTL volumes, and MTL volume mediated the relationship between ApoE genotype and everyday memory performance. Thus, these easily administered everyday memory measures may be a useful clinical tool in identifying ε4 carriers who may be at risk for MTL atrophy and further memory decline that is a common characteristic of the earliest stages of Alzheimer's disease.

C84

AGE-RELATED LATERALITY AND SUB-SYSTEM DIFFERENCES IN THE INTRINSIC FUNCTIONAL CONNECTIVITY OF THE DEFAULT MODE NETWORK

Amy Belfi[1,3,4], Michelle Voss[2,4], Merry Mani[2], Chelsea Wong[5,6], Gillian Cooke[5], Matthew Sutterer[1,3,4], Rachel Clark[4], Daniel Tranel[1,4], Edward McAuley[7], Arthur Kramer[5]; [1]University of Iowa, Department of Neurology, [2]University of Iowa, Department of Psychology, [3]University of Iowa, Department of Neurosurgery, [4]University of Iowa, Department of Neuroscience, [5]University of Illinois, Beckman Institute for Advanced Science and Technology, [6]University of Illinois, Department of Neuroscience, [7]University of Illinois, Department of Kinesiology — Functional integration of the default mode degrades with aging. However, whether and how such changes relate to cognitive and behavioral functioning in older adults is not well understood. Recent evidence suggests that the DMN is comprised of two functionally distinct subsystems: a dorsal-medial prefrontal cortex (DMPFC) subsystem involved in self-oriented cognition and a medial temporal lobe (MTL) subsystem involved in memory and scene construction. Both subsystems interact with the posterior cingulate and the medial prefrontal regions that form the DMN core. The present study investigated age-related differences in intrinsic functional connectivity of these two subsystems. Participants (n = 60) were between the ages of 19-83 (mean = 46.3). Following previous work (Andrews-Hanna et al., 2010), a seed-based functional connectivity approached was used that corrected for small-scale motion. Functional connectivity within the right, but not left, core DMN regions negatively correlated with age (r = -.26, p = .05). Additionally, there was an effect of aging on within, but not between, subsystem connectivity, suggesting no loss of specialization of the two DMN subsystems. Further, functional correlations between regions in the right MTL subsystem negatively correlated with age (r = -.29, p = .02), but this was not seen in the left MTL or either left or right DMPFC subsystem. Previous research has suggested that age-related cognitive decline might preferentially affect the right hemisphere (e.g., Dolcos et al., 2002). Our results are consistent with this within the DMN and further demonstrate MTL specificity for age-related DMN changes.

C85

DIFFERENCES IN FUNCTIONAL CONNECTIVITY PATTERNS IN THE LATERAL PARIETAL CORTEX DURING A RESTING-STATE SCAN

Amy Frithsen[1], Michael Miller[1], Nicole Marinsek[1]; [1]University of California Santa Barbara — There has been much debate in the field as to what functional role the left lateral parietal cortex may have during successful memory retrieval. Recent research has suggested that within this area, different sub-regions may be responsible for different functions. In addition to the dorsal/ventral dissociation, an anterior/posterior distinction within the ventral regions has recently been proposed. This heterogeneity of the lateral parietal cortex may explain why some researchers have found ostensibly conflicting results when discussing possible functional roles of the region. In this study, we used a resting state functional connectivity analysis to investigate whether different sub-regions within the lateral parietal cortex displayed different connectivity patterns. Specifically, we were interested in comparing anterior and posterior regions of the left inferior parietal lobule. Using an anterior seed located in the angular gyrus and a posterior seed located within the supramarginal gyrus we computed ROI and seed-to-voxel functional connectivity maps throughout the entire brain. Results revealed a strong positive correlation between the posterior seed region and regions commonly described as part of the default mode network (most notably the posterior cingulate cortex). Interestingly, the anterior seed region showed a slightly negative correlation with these same default regions. Although some caution must be taken when inferring functionality from resting state analyses, our results seem to suggest that different sub-regions within the lateral parietal cortex may be playing different roles during memory retrieval. This project was supported by the Institute for Collaborative Biotechnologies through grant W911NF-09-0001 from the U.S. Army Research Office.

C86

CROSS-FREQUENCY DYNAMICS IN HUMAN PARIETAL CORTEX DURING RECOGNITION MEMORY DECISIONS

Alexander Gonzalez[1], J. Benjamin Hutchinson[2], Melina R. Uncapher[1], Brett L. Foster[1], Vinitha Rangarajan[1], Josef Parvizi[1], Anthony D. Wagner[1]; [1]Stanford University, [2]Princeton University — Posterior parietal cortical (PPC) correlates of recognition memory have been reported in numerous scalp-EEG and fMRI studies. ERPs have revealed a parietal 'old/new effect', wherein greater positivity is observed at left parietal electrodes 500-800ms after stimulus onset when subjects correctly recognize old items (Hits) vs. correctly reject new items (CRs). In fMRI studies, multiple memory-related functional patterns are observed across lateral PPC, including greater BOLD activity in (a) the intraparietal sulcus (IPS) during Hits vs. CRs, and (b) angular gyrus (AG) during Hits associated with recollection of event features. In the present experiment, we characterized memory-related electrophysiological responses in human PPC by directly recording electrocorticography (ECoG) while four patients (with left coverage), undergoing pre-surgical mapping for epilepsy, performed a recognition memory task with words. Theta and high gamma amplitude and phase were derived from electrodes on IPS, AG and the superior parietal lobule (SPL). Electrodes from which we could classify Hits vs CRs using high gamma and theta power were selected for cross-frequency coupling analyses. Event-locked theta phase–high gamma amplitude coupling differed between Hits and CRs as early as 375 ms, with greater phase-locking values (within electrode) for Hits in SPL electrodes. Notably PLV in IPS and SPL electrodes peaked around 550ms (Hits > CRs), while in AG the peak was later in the trial at 700ms. These findings shed new light on the temporal dynamics of PPC subregion activity during memory-guided decisions.

C87

STAGING THE FUTURE: CONTRIBUTIONS OF EXECUTIVE DYSFUNCTION TO LOW SPECIFICITY OF FUTURE THINKING IN DEPRESSION Sylvia Hach[1], Lynette J Tippett[1], Joseph Smith[1], Tessa Bird-Ritchie[1], Donna Rose Addis[1]; [1]The University of Auckland, New Zealand — A range of psychiatric conditions including depression are associated with a decrease in specificity of autobiographical memory (i.e., overgeneral memory). That is, when relating events from their past, patients with a history of depression more frequently recall generic events compared to people without a history of depression. Moreover, decreases in specificity of autobiographical memory correlate with similar changes in autobiographical future thinking. The CaRFAX model proposes that reduced specificity of memory results from a combination of mnemonic interlock, rumination, functional avoidance and executive dysfunction. We tested the contributions of the CaRFAX model components, and subcomponents of executive function (working memory, inhibition, set-shifting and strategy use), to decreased specificity of future events in participants with a history of dysphoria or depression. Three main findings emerged. First, event descriptions generated by dysphoric/depressed participants were less specific than those of matched controls. Second, while measures of avoidance and rumination as well as neuropsychological indices of working memory, inhibition and set-shifting failed to show a relationship with event specificity, an index of strategic retrieval strongly correlated with specificity. Preliminary regression analyses show that the measure of strategic retrieval but not the severity of depressive symptoms predicts the proportion of specific events in dysphoric/depressed participants. These results confirm the reduction of specificity in autobiographical future thinking in participants with a history of depression, and provide a first indication that the ability to effectively employ retrieval strategies plays a special role in combining the mnemonic elements necessary for high specificity in imagining or "staging" one's future.

C88

AN FMRI INVESTIGATION OF THE NEURAL BASIS OF INVOLUNTARY MEMORY: HOW DO THEY DIFFER FROM ESTABLISHED VOLUNTARY MEMORY NETWORKS? Shana Hall[1], Amanda Miles[2], Simon Davis[3], Dorthe Berntsen[2], Roberto Cabeza[1], David Rubin[1]; [1]Duke University, [2]Aarhus University, [3]University of Cambridge — Involuntary memories are memories that come to mind spontaneously. They often arise faster after a cue than voluntary memories. The neural basis for involuntary memories, and how they differ from their voluntary counterparts, is poorly understood. One view of the difference between voluntary and involuntary memories is that involuntary memories can be attributed to a lack of effort during retrieval. Therefore, we predict that voluntary retrieval will evoke activity in frontoparietal regions associated with retrieval effort and involuntary memories will not. Participants heard sounds, some of which were paired with pictures during encoding. We had two groups: one in which participants were told to try to remember the pictures had been paired with the sounds, and the other group was not. They reported their incidence of involuntary memories in a post-scan session. Consistent with our hypothesis, a group of ventral occipitotemporal regions, including ventral parietal cortex and parahippocampal gyrus, were more active for retrieved pictures than unpaired sounds in both groups. Furthermore, time-course analysis revealed a distinct temporal dissociation between early differences between paired and unpaired stimuli in medial temporal regions (across both voluntary and involuntary conditions), and later differences between voluntary and involuntary conditions in frontoparietal regions (across paired and unpaired conditions). These results clarify the distinct role of dorsal frontoparietal and ventral occipitotemporal regions in predicting retrieval effort and retrieval information, respectively, and suggest that while there are neural differences in retrieval effort, involuntary memories share neural components with established voluntary memory systems.

C89

EYE-MOVEMENT-BASED RELATIONAL MEMORY EFFECTS PRECEDE EXPLICIT DEADLINE-BASED RECOGNITION RESPONSES. Deborah Hannula[1], Jeremy LeVeque[1]; [1]University of Wisconsin-Milwaukee — Past work has shown that eye movement behavior is sensitive to memory for learned item-context relationships (e.g., scene-face pairings). These eye-movement-based memory effects are evident soon after display onset, precede explicit recognition responses, have been documented across a variety of instructional manipulations, and depend critically on the integrity of the hippocampus. However, previous work has not addressed questions about whether the time-course of these effects persists even when a response deadline is imposed, or whether these effects differ as a function of memory confidence. To address these questions, we conducted an experiment in which participants were asked to commit several scene-face pairs to memory. During a corresponding recognition test, participants were presented with a scene cue, followed by three studied faces, one of which was the studied associate of that scene. Eye movements were recorded and participants were instructed to make deadline-based recognition responses, indicating thereafter how confident they were in the accuracy of their choice. As in past work, disproportionate viewing of correctly identified associates was evident within 500-750ms of 3-face display onset. This effect was evident irrespective of confidence, though the difference was most robust for associates endorsed with high confidence. Furthermore, eye-movement-based memory effects preceded explicit responses, even when the response deadline was met, and when estimates of time required to make button press responses were taken into account. Results suggest that these effects precede and may contribute to explicit identification of studied relationships and will be discussed in the context of current models of memory.

C90

SUCCESS AND PRECISION: AN IMPORTANT DISTINCTION IN RECOLLECTION. Iain M. Harlow[1], Andrew P. Yonelinas[1]; [1]University of California, Davis — Episodic recollection is a crucial component of cognition, linking the present self with past experience. Recollection is a thresholded process, supporting conscious retrieval of detailed memories when successfully engaged, but it is not an infallible window into the past. Impairments in recollection, such as those associated with aging, might result from either less frequent or less precise recollection. We build on previous work, using response errors on a cued recall task to separately measure the successful engagement and precision of recollection. Participants studied word-location pairs, and at test were required to recall the location for a given word as accurately as possible. Additionally, participants made two concurrent but distinct confidence ratings on each trial, judging 1) the probability that they recollected the correct location, and 2) the precision of the location information recalled. A distinct pattern emerges: On any given trial, participants either recollected the target location with considerable (but variable) precision, or they retrieved no location information at all. Importantly, participants could dissociate recollection engagement from the quality of recollected information: Probability confidence reliably predicted whether locations were recollected, while precision confidence instead reflected the precision of the locations retrieved. The results demonstrate both that the precision of a retrieved memory is separable from the probability that it is successfully recollected, and furthermore that participants can judge the precision of their memory on a trial-by-trial basis. Future work should distinguish between the engagement and quality of recollection, and carefully designed confidence ratings can provide useful insights into both properties.

C91

CONTRIBUTIONS OF SLEEP-DEPENDENT MEMORY CONSOLIDATION TO REALITY MONITORING Chris A. Hawkins[1], Lauren C. Rendon[1], Carmen E. Westerberg[1]; [1]Texas State University — Reality-monitoring errors occur when imagined events are mistakenly remembered as perceptually experienced events, and likely arise when rich perceptual details accompany memories of imagined events. Memory consolidation processes active during sleep are hypothesized to strengthen connections between various aspects of a memory, serving to stabilize memories for long-term storage. Thus, sleep may reduce reality-monitoring errors, as connections between a memory and its source (perceived or imagined) become more thoroughly bound together. We tested this possibility by asking participants to generate mental images of words viewed one at a time. For half of the words, a photographic depiction of the word was also shown immediately after the word. Next, one group of participants took a nap monitored with polysomnography, whereas another group remained awake. After 90 min, all participants took a reality-monitoring test. For each auditorily-presented test word, they indicated whether a picture of the word was previously perceived. Participants who napped made fewer reality-monitoring errors

than those who did not. Furthermore, for participants who napped, time spent in stage-2 sleep positively correlated with reality-monitoring success, whereas as slow-wave power at frontal sites (.5-4.5 Hz) negatively correlated with reality-monitoring success. Collectively, these results indicate that sleep reduces reality-monitoring errors, and that different aspects of sleep may contribute to memory consolidation in different yet complementary ways. Stage-2 sleep may facilitate the binding of source information to a memory, whereas slow-wave activity may strengthen other aspects of memory representations that in typical circumstances are advantageous for long-term retention.

C92

HOW CONSISTENT ARE HIPPOCAMPAL ACTIVATIONS FOR SCENE AND OBJECT STIMULI ACROSS INDIVIDUALS? Carl Hodgetts[1], Jonathan Shine[2], Mark Postans[2], Andrew Lawrence[1], Hilary Watson[3], Paul Downing[4], Kim Graham[1]; [1]Wales Institute of Cognitive Neuroscience, School of Psychology, Cardiff University, [2]Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University, [3]Department of Psychology (Scarborough), University of Toronto, [4]Wales Institute of Cognitive Neuroscience, School of Psychology, Bangor University — Recent studies suggest that regions within the medial temporal lobe (MTL) are involved in representing specific visual categories, with the hippocampus (HC) containing scene representations necessary for perception and memory (Graham et al., 2010). Unlike the case of category-specific regions in extrastriate cortex (Peelen & Downing, 2005), no study has yet looked at the consistency of category-specific activations in the hippocampus across individuals. To address this, we analysed fMRI data obtained at 3T from 53 participants who had performed a one-back matching task while viewing blocks of objects, scenes and scrambled objects. To extract individual-level activations, and to ensure consistency across MTL and extrastriate analyses, separate probabilistic masks of the HC and parahippocampal gyrus (PHG) were transformed into subjects' native space. We found that 79% of subjects had significant ($P < 0.05$) clusters within HC for the contrast scenes versus scrambled objects. The contrast objects versus scrambled objects revealed HC clusters in only 11% of individuals. As expected, 92% of participants had clusters in PHG for the scene versus scrambled objects contrast, and only 8% for the objects versus scrambled objects contrast. Probabilistic overlap techniques indicated that the location of individuals' scene clusters were not limited to a particular area of the HC. These results imply a relatively high degree of consistency in eliciting HC activations for scenes at the individual level, and add to the existing literature on the role of the HC in scene memory by demonstrating this using a working memory task.

C93

EMOTIONAL MODULATION OF VISUAL CORTEX DURING MEMORY MISATTRIBUTIONS Christoph Hofstetter[1,2], Aline Pichon[1,2], Patrik Vuilleumier[1,2]; [1]University Medical Center, University of Geneva, Switzerland, [2]Swiss Center for Affective Sciences, University of Geneva, Switzerland — Previous studies revealed that sensory cortices show memory reactivation reflecting the content of the memory. Further, such reactivation was found to be stronger when memory retrieval was cued with an emotional stimulus compared to a neutral one. However, these studies focused on correct recall and hence it remains unknown whether sensory cortices may also reactivate during memory errors. Here we compared brain activations during different memory responses in 17 healthy participants who encoded faces paired with either negative or neutral scenes. Participants were tested the next day with a scene-cued recall test while undergoing function magnetic resonance imaging. Preliminary results from a face-responsive region of interest in left fusiform cortex show stronger activation for Hit compared to Miss responses. Activation for Misattribution (MA) errors (recall of an incorrect face) was intermediate between Hit and Miss. In addition, emotional cues modulated these activation patterns. For MA cued by a negative scene the activation in left fusiform cortex was comparable to Hits, while MA in neutral context was similar to Miss responses. No modulation by emotion was found for Hit or Miss responses. The results suggest that emotion can enhance activation for memory recall in sensory cortices only when the cue is recognized but source memory is absent.

C94

ELECTROPHYSIOLOGICAL DIFFERENCES BETWEEN YOUNG ADULTS AND SENIORS REVEAL THAT SUCCESSFUL SOURCE MEMORY ENCODING REQUIRES ACTIVITY FROM FRONTAL REGIONS AND INCREASED THETA POWER Michael Hoppstädter[1,2], Christian Bäuchl[1,2], Carsten Diener[1,2], Herta Flor[1,2], Patric Meyer[1,2]; [1]Central Institute of Mental Health, Medical Faculty Mannheim, Heidelberg University, [2]Bernstein Center for Computational Neuroscience Heidelberg/Mannheim — Item memory tasks are generally solvable by relying on familiarity based processes, whereas subjects usually have to engage in recollective processing to perform accurately in associative or source memory tasks. Successful recollection has been linked to a hippocampal-prefrontal network and communication within this network was shown to occur at theta frequency. Already during encoding of associations, processing differences between subsequently recognized and forgotten contextual information emerge. These subsequent memory effects and corresponding changes in theta power occur on a fast timescale and can be investigated using electroencephalography (EEG). To examine encoding processes of subsequent successful versus failed recollection, we tested young controls and seniors in a spatial four-choice source memory paradigm. During retrieval, older people performed significantly worse than younger adults in associating an object with its correct source whereas item memory performance was comparable. Electrophysiologically, younger adults exhibited a pronounced positive component predicting later recollection at frontal electrodes at encoding. Preceding this subsequent memory effect, higher theta power across frontal and posterior sites differentiated between later correct and incorrect source judgments. Contrary to this, seniors showed a prominent posterior subsequent memory effect. Whereas the prefrontal positivity in younger adults might reflect efficient item-context binding, the posterior effect in older subjects possibly reflects their reliance on item memory while item-context binding failed. At least in the young subjects, this successful associative encoding might be subserved by foregoing large-scale synchrony in the theta band.

C95

AN ERP INVESTIGATION OF UNITIZATION OF ABSTRACT VISUAL STIMULI: THE ROLE OF CONCEPTUAL INFORMATION Ryan Hubbard[1,2], Brian Gonsalves[1,2]; [1]University of Illinois, [2]Beckman Institute — According to dual-process theories of memory, recognition memory is dependent upon two distinct processes: familiarity (a sense of oldness for a particular item) and recollection (retrieval of contextual information). Generally, performance on associative memory tasks, in which participants must remember pairs of items, is thought to be dependent on recollection; however, it has been proposed that items that are encoded as a single representation, or "unitized", can be supported by familiarity without recollection. Yet it is unclear whether these unitization effects reflect the perceptual binding of items into a single unit, or a more conceptual / semantic process, as even studies with visual stimuli use clearly nameable objects. The current study attempts to address this question by using pairs of novel, abstract visual stimuli. Participants were told to either mentally combine the pairs into a single unit, or to declare which item of the pair they prefer (resulting in separate encoding). They were then given a memory test containing intact, rearranged, and new pairs. ERPs were recorded during test to assess any electrophysiological differences between conditions. Preliminary evidence shows canonical old/new effects in the brain; namely, greater amplitudes for correctly identified old items than correctly identified new items in frontal, central, and parietal electrodes. Further analyses will explore the necessity of conceptual information for the process of unitization.

C96

DYNAMIC NEURAL CONNECTIVITY OF AUTOBIOGRAPHICAL MEMORY RETRIEVAL PROCESSES Cory Inman[1], G. Andrew James[2], Carolina Campanella[1], Thanujeni Pathman[3], Robyn Fivush[1], Patricia Bauer[1], Stephan Hamann[1]; [1]Emory University, [2]University of Arkansas for Medical Sciences, [3]University of California, Davis — Recollection of autobiographical memories (AM) is a complex process that recruits multiple cognitive operations, including access and elaboration. Previous studies have focused on differences in connectivity between memory access and elaboration within coordinated multi-region networks and on changes in regional brain acti-

vation, rather than interregional interactions involving specific regions such as the hippocampus and prefrontal cortex. Determining the functional role of changes in interregional connectivity across AM retrieval is critical for understanding mechanisms of AM retrieval and testing theoretical accounts of dynamic AM retrieval processes. Healthy adults (n=16) generated AMs from neutral cue words in a pre-scan session and were later cued to retrieve the AMs for 16 seconds while being scanned with fMRI. We used a moving window connectivity analysis to examine dynamic changes in connectivity within and across regions involved in AM retrieval processes. Connectivity between neighboring regions dynamically varied as a function of the hypothesized process (early-access or late-elaboration). Bilateral connectivity between the amygdala and hippocampus increased and sustained its strength from the onset through the end of memory retrieval, likely reflecting construction and mnemonic binding processes throughout memory retrieval. Connectivity between the retrosplenial cortex, precuneus, and inferior parietal lobule increased later in retrieval, potentially related to elaboration processes. As predicted, connectivity between the hippocampus and prefrontal cortex increased during early access processes whereas fronto-parietal connectivity increased during later elaboration processes. These changes in interregional connectivity are consistent with models of AM retrieval that predict dynamic coordination of brain regions supporting retrieval, self-reference, episodic construction, and elaboration.

C97

REMEMBER-KNOW PROCEDURE AND EPISODIC FEELING OF-KNOWING: ROLE OF RECOLLECTION AND FAMILIARITY IN YOUNG AND OLDER ADULTS

Michel Isingrini[1], Helene Stoehr[1], Mathilde Sacher[1], Laurence Taconnat[1], Badiaa Bouazzaoui[1]; [1]University François Rabelais of Tours, CeRCA CNRS 7295, France — The present study examined the hypothesis that feeling of knowing (FOK) in episodic memory may be influenced by the quality of the learning experience related to the cue and the unrecalled target pair. To this end, a first experiment, conducted on younger adults, was designed to test for the first time the contribution of that quality, as indexed by recollection and familiarity. The remember-know procedure (RK) was combined with the episodic FOK procedure. This new procedure enabled to distinguish two type of FOK predictions, associated to the recollection of the context information (R-FOK) or associated to a feeling of familiarity (K-FOK). Results indicate that the capacity to relate the cue item, presented at study with the unrecalled target item, to the learning episode, on the basis of either a recollection process or a feeling of familiarity, leads to above-chance level FOK judgment and accuracy. Nevertheless, results also show that the influence of recollection on FOK judgment and accuracy is significantly greater than that of familiarity. This result supports the recollection hypothesis of episodic FOK, assuming that the conscious recollection of what was experienced at the learning time should lead to better FOK predictions. In a second experiment comparing young and older adults, results shown that, contrary to the young adults, older adults do not benefit from this recollection effect. This suggests a lack in older adults in the quality of contextual details retrieved pertaining to the unrecalled target that are required to make accurate FOK judgments.

C98

REMEMBERING OTHER PEOPLE'S POLITICAL VIEWS: AN FMRI STUDY OF EMOTIONAL SOURCE MEMORY ENCODING

Vijeth Iyengar[1], Erik Wing[1], David Chou[1], Roberto Cabeza[1]; [1]Duke University — It is well known that strongly agreeing or disagreeing with another person's political views can be quite arousing, and that arousal tends to enhance subsequent memory. Yet, the effects of arousal on memory for political views and the underlying neural mechanisms for these memories are largely unknown. To investigate these issues, we conducted an fMRI study where we scanned participants in an alternating encoding-retrieval task. During encoding, participants viewed unfamiliar faces paired with political statements (e.g., Believes the U.S. should prohibit the death penalty) and rated the statements on a scale ranging from strongly disagree to strongly agree. During retrieval, participants viewed previously encoded faces paired with the original statements (intact trials) or with statements previously paired with other faces (recombined trials) and responded with an intact or recombined judgment, while also rating their confidence for this decision. Retrieval responses were used to back-sort encoding trials as subsequently remembered or forgotten. Behavioral findings showed a U-shaped function with better source memory for statements with which participants strongly agreed/disagreed in contrast to those eliciting more moderate agree/disagree ratings. Subsequent memory effects (remembered>forgotten) were found in regions within the medial temporal lobes including the parahippocampal gyrus and amygdala. Further, the effects of subjective agreement/disagreement on encoding success were mediated primarily by the medial prefrontal cortex (mPFC). This finding is consistent with evidence linking mPFC with self-reference processing and emotional evaluation. To our knowledge, this is the first evidence on the neural mechanisms of source memory for other people's political views.

C99

UNITIZATION OF MULTIPLE CONTEXT DETAILS IN EPISODIC MEMORY

Hsiao-Wei Tu[1], Rachel A. Diana[1]; [1]Virginia Tech — In recognition memory, recollection is defined as retrieval of the context associated with an event, whereas familiarity is defined as retrieval based on item strength alone. Both behavioral and neuroimaging investigations (Diana et al., 2008; Ford et al., 2010; Haskins et al., 2008) have shown that conventional recollection-based tasks, in which context details are manipulated for source memory assessment at test, can also rely on familiarity when context information is "unitized" with the relevant item information at encoding. Unlike natural episodic memories that include many context details, previous studies of unitization have manipulated only a single context detail. To further understand how unitization operates on item and context information, we manipulated the encoding process used for two context details (font size and background color) of each item and tested the contribution of recollection and familiarity to source recognition of each detail. Receiver operating characteristic curves showed that when only information about font size was unitized, familiarity contributed more to the recognition of font size than that of background color. However, when background color alone was unitized, recognition of background color was not significantly based on familiarity. When both font size and background color were unitized for a single item, source recognition relied on familiarity more heavily than would be expected if unitization of the individual details had an additive effect. These findings suggest that source information may not be processed independently in episodic memory.

C100

INTRINSIC DEFAULT MODE NETWORK CONNECTIVITY PREDICTS SPONTANEOUS VERBAL DESCRIPTIONS OF AUTOBIOGRAPHICAL MEMORIES DURING SOCIAL PROCESSING

Xiao-Fei Yang[1], Julia Bossmann[2], Birte Schiffhauer[3], Matthew Jordan[1], Mary Helen Immordino-Yang[1]; [1]University of Southern California, [2]University of Düsseldorf, [3]University of Bielefeld — Neural systems activated in a coordinated way during rest, known as the default mode network (DMN), also support autobiographical memory (AM) retrieval and social processing/mentalizing. However, little is known about how individual variability in reliance on personal memories during social processing relates to individual differences in DMN functioning during rest (intrinsic functional connectivity). Here we examined 18 participants' spontaneous descriptions of autobiographical memories during a two-hour, private, open-ended interview in which they reacted to a series of true stories about real people's social situations and responded to the prompt, "how does this person's story make you feel?" We classified these descriptions as either containing factual information ("semantic" AMs) or more elaborate descriptions of emotionally meaningful events ("episodic" AMs). We also collected resting state fMRI scans from the participants and related individual differences in frequency of described AMs to participants' intrinsic functional connectivity within regions of the DMN. We found that producing more descriptions of either memory type correlated with stronger intrinsic connectivity in the parahippocampal and middle temporal gyri. Additionally, episodic AM descriptions correlated with connectivity in the bilateral hippocampi and medial prefrontal cortex, and semantic memory descriptions correlated with connectivity in right inferior lateral parietal cortex. These findings suggest that in individuals who naturally invoke more memories during social processing, brain regions involved in memory retrieval and self/social processing are more strongly coupled to the DMN during rest.

C101

WHICH MEMORIES ENDURE? PREFERENTIAL CONSOLIDATION THROUGH SLEEP REPLAY

Delphine Oudiette[1], James W Antony[1], Jessica C Creery[1], Ken A Paller; [1]Northwestern University — Only a very small number of our daily experiences can be remembered later. Whereas most information storage in the brain fades over time, memories that are rehearsed tend to be retained. Sleep may benefit memory because of a type of rehearsal that involves the reactivation of newly learned material during sleep. Given that information varies in value, this covert memory reactivation during sleep may be responsible for the fundamental selectivity of memory storage. We propose that sleep preferentially enables the reactivation of information expected to be of high value in the future. Thirty young subjects learned 72 object-location associations while hearing characteristic object sounds. Their learning was influenced by potential rewards; a number on each object indicated reward value during a future memory test. After a 90-min nap, recall accuracy declined to a greater extent for low-value than for high-value objects (Experiment I). When reactivation of low-value items was externally triggered by their associated sounds, change in memory across the nap did not differ as a function of value (Experiment II). The evolution of stored information during a period that included sleep depended systematically on the value accorded to the information. Although recall accuracy benefitted less for information expected to be of low value, this information could be rescued from forgetting using externally triggered sleep reactivation. We thus conclude that sleep reactivation is a major factor determining the selectivity of memory consolidation and, ultimately, the fate of our memories as a function of future value.

C102

INDIVIDUAL VARIATION IN FORNIX MICROSTRUCTURE CORRELATES WITH SCENE, BUT NOT FACE, VISUAL DISCRIMINATION ACCURACY

Mark Postans[1,2], Carl Hodgetts[1], Matthew Mundy[4], Andrew Lawrence[1,3], Derek Jones[2,3], Kim Graham[1,3]; [1]Wales Institute of Cognitive Neuroscience, School of Psychology, Cardiff University, UK, [2]Cardiff University Brain Research Imaging Centre (CUBRIC), School of Psychology, Cardiff University, UK, [3]Neuroscience and Mental Health Research Institute, Cardiff University, UK, [4]School of Psychology and Psychiatry, Monash University — Transection of the non-human primate fornix has been shown to affect learning of configurations of spatial features (Buckley et al., 2004). Similarly, damage to the fornix in humans results in memory impairment, although whether this white matter pathway is selectively involved in scene memory (compared to other visual categories) is currently unclear (Rudebeck & Lee, 2009). We asked whether diffusion-MRI indices of fornix microstructure, in particular fractional anisotropy (FA) and mean diffusivity (MD), would correlate with the ability to make accurate discrimination decisions for scenes, but not faces. Diffusion-weighted MR images were obtained from 21 healthy participants (age range: 18 – 22) who had completed a task in which they made rapid same/different discriminations to two categories of highly visually similar stimuli: (a) virtual reality scene pairs and (b) face pairs. Mean FA and MD measures were then extracted from the entire fornix of each participant, which had been reconstructed using a deterministic white-matter tractography protocol. Both fornix FA and MD were significantly correlated (positively and negatively respectively) with overall discrimination accuracy for the scene, but not face, pairs. This finding is consistent with Buckley et al., and highlights a potential role for the fornix in discriminating between highly similar complex scenes.

C103

NEURAL CORRELATES OF PERCEPTUAL SEQUENCE LEARNING AND PERCEPTUAL RECOGNITION MEMORY

Clive R. Rosenthal[1], Stephen L. Hicks[1], Christopher Kennard[1], David Soto[2]; [1]Univerity of Oxford, [2]Imperial College London — The learning of new information is determined by how we attend. It is unknown, however, how activity in attention networks support visuospatial sequence learning, when attentional selection occurs in the absence of motor-based representations. Here, we used blood oxygenation level–dependent neuroimaging to examine changes in activity associated with perceptual sequence learning, and the relevance of these changes for later perceptual recognition memory. Participants were instructed to fixate and follow a higher-order sequence of visuospatial stimuli, and thereby restrict their responses on the perceptual sequence learning and old/new recognition memory tasks to covert reorienting of visuospatial attention. Eye position was continuously monitored inside the MRI scanner to ensure that the participants maintained central fixation. Learning was associated with activity within the frontotemporal pole, the cingulate gyrus and premotor areas, and areas that implement early visual processing (primary visual cortex). Interactions between frontal and visual cortical areas supported perceptual sequence learning. Changes in activity within these regions indicate important differences in attentional selection between perceptual and motor sequence learning; these differences are likely to reflect mechanisms that are related to predictive coding, visuomotor integration, and response selection. Perceptual recognition memory was associated with activity in the precuneus, the supramarginal gyrus, and post- and post-central gyrus, and thus did not readily overlap with the regions identified in numerous prior studies of recognition memory. Hence, the generality of these prior studies warrants close scrutiny because the neural bases of recognition memory appear to be sensitive to the nature of the retrieved information.

C104

BRAIN-DERIVED NEUROTROPHIC FACTOR VAL66MET POLYMORPHISM INFLUENCES THE MAGNITUDE OF HUMAN LONG-TERM POTENTIATION WHICH PREDICTS MEMORY PERFORMANCE.

Chris Thompson[1,7], Nicolas McNair[2], Ushtana Antia[3,7], Kieran Kennedy[4,7], Andrew Shelling[5,7], Bruce Russell[3,7], Jeff Hamm[1,7], Karen Waldie[1,7], Timothy Teyler[6], Ian Kirk[1,7]; [1]Research Centre for Cognitive Neuroscience, School of Psychology, University of Auckland, New Zealand., [2]Centre for Research in Brain, Cognition and Behaviour, School of Psychology, Plymouth University, United Kingdom., [3]School of Pharmacy, University of Auckland, Auckland, New Zealand., [4]School of Medicine, Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand., [5]Department of Obstetrics & Gynaecology, Faculty of medical and Health Sciences, University of Auckland, Auckland, New Zealand., [6]Medical Science, University of Idaho, Moscow, ID, USA., [7]Centre for Brain Research, University of Auckland, New Zealand. — Long term potentiation (LTP) is a long lasting enhancement of synaptic communication, and is the principal candidate for the mechanism of memory. LTP has been studied extensively at the cellular and molecular level in animals. Recently, models been developed that allow in vivo induction and measurement of LTP in humans. LTP involves a complex cascade of events, with brain derived neurotrophic factor (BDNF) identified as an important modulator of synaptic plasticity in humans. A single nucleotide polymorphism in the BDNF gene resulting in a valine-to-methionine substitution at codon 66 (val66met) has been shown to affect activity-dependent secretion of BDNF and is associated with lower performance in memory tasks. The present study tested whether the BDNF val66met polymorphism was associated with induction of LTP-like changes in visual evoked potentials. We also tested whether LTP-like changes and BDNF val66met polymorphism was predictive of memory. Individuals containing met variants of the polymorphism had significantly lower LTP, as indexed by amplitude changes in the late phase of the N1 component of visual-evoked potentials. Also, Val/Met and Met/Met individuals performed significantly worse than Val/Val individuals on measurements of visual memory as indexed by the Wechsler Memory Scale. The degree of LTP and performance on visual memory tasks were also significantly correlated. These results add further weight to the suggestion that the LTP-like phenomena that is induced and measured by visual stimuli is LTP, and provides further evidence for the suggestion that polymorphisms for BDNF act on human memory processes via effects on LTP.

C105

TEST-POTENTIATED ENCODING OF PAIRED ASSOCIATES AS REVEALED BY FUNCTIONAL MAGNETIC RESONANCE IMAGING

Peter Vestergren[1,2], Lars Nyberg[1,2]; [1]Umeå University, [2]Umeå Center for Functional Brain Imaging — The goal of this study was to test the hypothesis that previous testing potentiates the effectiveness of subsequent encoding of the tested material. We predicted higher functional Magnetic Resonance Imaging (fMRI) blood-oxygen-level-dependent (BOLD) contrast signal in the medial temporal lobe and left prefrontal cortex for items that had been previously tested compared to those that had been studied only. The experiment had a within-subjects design where participants studied 120 Swahili-Swedish word pairs five times during day 1. Day 2 started with one study

session including all items, followed by a cued-recall task with no feedback for one random half and another study session for the other half of the items. All items were then restudied in a random order during an event-related fMRI-session, followed by cued-recall and multiple-choice recognition tests outside the scanner. Item-event categories were based upon recall performance prior to and after fMRI. A linear contrast revealed that BOLD activity was higher in left hippocampus and left inferior frontal cortex for previously tested compared to studied-only items. Furthermore, the results suggested that the activations were of equal magnitude for previously recalled and non-recalled items. Similar effects were observed in bilateral insular and bilateral inferior/mid occipital cortex. As hypothesized, the findings suggest that previous testing potentiates subsequent encoding, for both previously recalled and non-recalled items. These findings have implications for research on the beneficial effects of testing and educational practice alike.

C106

THE ROLE OF SLEEP AND REINFORCEMENT IN MEMORY INTEGRATION Denise Werchan[1], Rebecca Gomez[1]; [1]The University of Arizona — Research has shown that sleep and reinforcement enhance memory consolidation. However, it is not well known how reinforcement and sleep impact more complex forms of memory, such as inferential memory. Inferential memory requires the integration of memory to make inferences and is often tested using transitive inference or associative inference paradigms. Previous work using transitive inference suggests that reinforcement is critical for the formation of inferences, and that sleep further enhances this effect (Werchan & Gomez, 2012). However, the source of these effects are unclear, as it is debated whether the formation of transitive inferences are a result of memory integration (Eichenbaum et al., 1999; Zeithamova et al., 2012) or due to differences in implicit reinforcement values of stimuli (Van Elzakker et al., 2003; Frank et al., 2003). Here we investigated whether reinforcement and sleep enhance inferences by facilitating memory integration using an associative inference paradigm, which requires memory integration to make inferences and does not have alternative interpretations. Participants learned via reinforcement or observation then were tested after sleep vs. wake. We found that: 1) reinforcement is required for the formation of inferences; 2) sleep enhances inferences only when reinforcement occurs during learning. Only subjects who were reinforced during learning and who slept showed memory integration. These results suggest that reinforcement and sleep enhance the formation of inferences by facilitating memory integration, and provide intriguing possibilities for a potential role of dopamine release during reinforcement learning in the transformation of memories during sleep.

C107

ACTIVITY IN LEFT TEMPORAL-PARIETAL REGIONS CHARACTERIZES LONG-TERM RETENTION AFTER REPEATED TESTING Carola Wiklund-Hörnqvist[1,2], Linnea Karlsson[1,2], Johan Eriksson[1,2], Micael Andersson[1,2], Bert Jonsson[1], Lars Nyberg[1,2]; [1]Umeå University, Sweden, [2]Umeå center for Functional Brain Imaging (UFBI) — It is well established that retrieval practice enhances long-term retention of the material being learned, a phenomenon known as the "testing effect". However, some material will inevitably be forgotten even though retrieval was successfully practiced. The objective of this study was to investigate the neurocognitive differences between words remembered and those forgotten one week after successful retrieval practice, defined as the beneficial testing effect. Participants (n=14) underwent event-related fMRI while being tested on 60 Swahili-Swedish word-pairs three consecutive times. One week after the initial fMRI session, all participants returned for a follow-up fMRI session. Participants were again tested on the word-pairs, but only once. Based on words successfully retrieved three times day one, we examined the activity differences at the follow-up session by contrasting words that were remembered at the 1-week follow-up test against words subsequently forgotten at the 1-week follow-up test. Subjects remembered significantly more words than they forgot. Compared with forgotten words, remembered words showed higher activity in several regions, including the left superior/inferior parietal cortex, left mid/inferior temporal cortex and in a confined cluster within the left frontal region. These findings suggest that the beneficial testing effect is characterized by the engagement of regions involved in controlled retrieval of long-term semantic knowledge, thus reflecting executive semantic processing. The results generate novel information regarding the neurocognitive mechanisms of the beneficial testing effect and thus contribute to bridge the current gap between cognitive neuroscience and educational research.

C108

FALSE RECOGNITION OF OBJECTS FOLLOWING MTL DAMAGE Lok-Kin Yeung[1], Rachel N. Newsome[1], Gillian Rowe[1,2], Rosemary A. Cowell[3], Jennifer D. Ryan[1,4], Morgan D. Barense[1,4]; [1]Univesity of Toronto, Toronto, ON, [2]Baycrest, Toronto, ON, [3]University of California at San Diego, San Diego CA, [4]Rotman Research Institute, Toronto ON — A recent rat study suggests that recognition memory impairments following medial temporal lobe (MTL) damage are caused by the misidentification of novel stimuli as familiar, but this impairments can be eliminated by reducing perceptual interference (McTighe et al., 2010). This finding challenges a fundamental assumption underlying most accounts of amnesia – that memory impairments arise because previously studied information is either lost rapidly, or made inaccessible – and lends support to an alternative account in which object-level representations in MTL are critical for recognition memory because they shield from perceptual interference (Cowell et al., 2006). In this study, we investigated whether these findings extend to humans with focal MTL lesions. With eye movements recorded as an indirect measure of perceived novelty (observers make more fixations to novel items), participants incidentally viewed familiar (previously studied) and novel (previously unstudied) objects from the same semantic category (e.g., lamps). The novel objects were either perceptually similar (high-interference) or perceptually dissimilar (low-interference) to the familiar objects. An amnesic individual with a unilateral temporal lobe resection showed normal novelty detection for low-interference novel objects, but false recognition for high-interference novel objects. This supports the counterintuitive notion that recognition memory impairments following MTL damage are driven by the misidentification of novel items as familiar, rather than by the misidentification of familiar items as novel. This adds support to a 'representational-hierarchical' account of MTL amnesia, in which memory loss is explained in terms of increased susceptibility to interference due to impoverished object-level representations in the MTL.

C109

PROCEDURAL LEARNING OF AUDITORY CATEGORIES: NEW EVIDENCE FROM AN IMPLICIT MEASURE Yafit Gabay[1], Frederic K. Dick[2], Lori L. Holt[1]; [1]Carnegie Mellon University, [2]Birkbeck College, University of London — Most studies of auditory category learning have used overt categorization tasks with explicit feedback, but real-world category learning is typically more incidental. The current study investigated incidental auditory category learning in the context of a simple visual detection task in which reaction time is measured. On each trial, a sound stimulus preceded the appearance of the visual target. Unknown to participants, these sounds were drawn from four distinct sound categories that were consistently paired with one of four possible locations of the visual target. Reaction times increased in trial blocks within which this consistent stimulus-response mapping was violated by random sound-location pairings, but did not increase when novel exemplars drawn from the sound category consistent with the learned mapping were presented. Both results suggest participants learned the sound categories in the course of the simple visual detection task by virtue of the sound-location correspondence. This conclusion is further supported by the fact that participants consistently categorized familiar and novel sound category exemplars in a later explicit categorization task. These same sound categories have been shown to be difficult to learn through passive exposure alone (Emberson et al., in press). Thus, the results highlight the importance of consistent mapping relations for acquiring knowledge about categorical properties of the input in incidental tasks.

C110

ROLE OF DORSAL SPEECH STREAM ACTIVATION TIMING IN DETERMINING SPEECH REPRODUCTION ACCURACY. Alexander Herman[1], John Houde[2], Sophia Vinogradov[2,3], Srikantan Nagarajan[1]; [1]Dept. of Biomedical Imaging, Univ. of California, San Francisco, [2]Dept. of Otolaryngology, Univ. of California, San Francisco, [3]Dept. of Psychiatry, Univ. of California, San Francisco, [4]San Francisco VA Hospital — Despite significant research and important clinical correlates, direct neural evidence for a phonological loop

linking speech perception, short-term memory and production, remains elusive. To investigate these processes, we acquired whole-head magnetoencephalographic (MEG) recordings from human subjects performing a variable-length syllable sequence reproduction task. The MEG sensor data was source-localized using a time-frequency spatially adaptive filter, and we examined the time-courses of cortical oscillatory power and the correlations of oscillatory power with behavior, between onset of the audio stimulus and the overt speech response. We found dissociations between time-courses of behaviorally relevant activations in a network of regions falling largely within the dorsal speech stream. In particular, verbal working memory load modulated high Y power (HYP) in both Sylvian-Parietal-Temporal (Spt) and Broca's Areas. The time-courses of the correlations between HYP and subject performance clearly alternated between these two regions throughout the task. Our results provide the first evidence of a reverberating input-output buffer system in the dorsal stream underlying speech sensorimotor integration, consistent with recent phonological loop, competitive queuing and speech-motor control models. These findings also shed new light on potential sources of speech dysfunction in aphasia and neuropsychiatric disorders, identifying anatomically and behaviorally dissociable activation time-windows critical for successful speech reproduction.

C111

PERTURBED AUDITORY FEEDBACK AND RESTING STATE FUNCTIONAL NETWORKS IN TONE-DEAFNESS

Janani Iyer[1], Psyche Loui[2], Gus Halwani[2], Mary Kathryn Abel[2], Gottfried Schlaug[2]; [1]UC Berkeley, [2]Harvard Medical School and Beth Israel Deaconess Medical Center — Although music is perceived and produced ubiquitously from a young age, a subset of the population cannot perceive and produce fine-grained differences in musical pitch, suggesting the inability to perceive feedback from one's own voice. Tone-deafness (TD), also known as congenital amusia, is a disorder of pitch perception and production. The affected brain network includes superior temporal gyrus (STG), middle temporal gyrus (MTG), and inferior frontal (IFG) regions, connected by white matter in the arcuate fasciculus. Here we ask whether TD subjects are affected in their ability to hear feedback from their own voice, and what task-related and intrinsic functional neural substrates might be underlying the auditory feedback system and its possible disruption. Thirty-one subjects (12 TD) performed a pitch-matching task under perturbed (pitch-shifted) and unperturbed (non-shifted) auditory feedback conditions during sparse-temporal sampling fMRI. All subjects showed significant activity in bilateral STG, MTG, and middle and inferior posterior frontal gyri (MFG, IFG) during pitch production. In the perturbed vs. unperturbed pitch production contrast, non-TD subjects showed additional activity in left anterior STG, left precentral gyrus (PCG), and left pre-supplementary motor area (pre-SMA). To identify possible differences in baseline patterns of functional connectivity, 25 subjects (7 TD) underwent resting state functional connectivity MRI. Rs-fcMRI data showed decreased functional connectivity in TD subjects between anterior and posterior IFG (BA44 and BA45), and between posterior IFG and MTG. Results support a distributed network of temporal and frontal regions that is disrupted in tone-deaf individuals both intrinsically and while monitoring auditory feedback.

C112

RECRUITMENT OF RIGHT HEMISPHERIC ANALOGS FOR SPEECH PERCEPTION IN MUSICIANS AS REVEALED BY EEG.

McNeel Jantzen[1], Bradley Howe[1], Rebecca Scheurich[1], KJ Jantzen[1]; [1]Western Washington University — Musical training may enhance the processing of acoustic information for speech sounds as musicians have demonstrated a more accurate temporal and tonal representation of auditory stimuli than their non-musician counterparts (Kraus & Chandrasekaran, 2010; Parbery-Clark, Skoe, & Kraus, 2009; Zendel & Alain, 2008; Musacchia, Sams, Skoe, & Kraus, 2007). Previous research has found that musicians are more sensitive to acoustic features such as onset timing and frequency (Levitin, 2006). In the current study, we sought to provide neural evidence that musicians process speech and music in a similar way. We hypothesized that for musicians, right hemisphere areas traditionally associated with music are also engaged for the processing of speech sounds. In contrast we predicted that in non-musicians processing of speech sounds would be localized to left hemisphere language areas. Twenty-four subjects, twelve musicians and twelve non-musicians, were presented with a voiced unaspirated stop consonant in one ear and a voiceless unaspirated stop consonant in the other ear such that all combinations were presented. Through four dichotic listening tasks, subjects either indicated aural location for a specified speech sound or identified a specific speech sound from a directed aural location. Musical training effects and organization of acoustic features were reflected in the EEG as observed by location and amplitude of the ERP's. Results show early neural response to the acoustic features was both faster and greater in musicians compared to non-musicians. In addition, musicians showed greater acoustic related processing in the right hemisphere.

C113

THE INTERACTION BETWEEN ATTENTION AND ACTION EXPECTATION. AN ERP STUDY.

Alexander Jones[1,2], Gethin Hughes[3], Florian Waszak[1,2]; [1]Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [2]CNRS (Laboratoire Psychologie de la Perception, UMR 8158), Paris, France, [3]University of Essex, United Kingdom — Performing a voluntary action involves the anticipation of the intended effect of that action. Action-expected stimuli have been shown to be attenuated compared to action-unexpected stimuli. Moreover, attention typically increases sensory processing for attended compared to unattended stimuli. In other words, expectancy and attention may produce opposite effects on stimulus processing. Here we use a novel paradigm to investigate attention and action-expectancy orthogonally. In an acquisition phase, high and low tones were associated with left and right key presses. In the following test phase, high and low tones were presented at random and participants attended to only one ear whilst ignoring tones presented to the unattended ear. In the test phase a tone could therefore be presented at the attended or unattended ear, as well as being expected or unexpected based on prior action-effect learning. We demonstrate early and late effects of auditory endogenous attention. Moreover, we showed independent action-expectation effects at frontal areas with a larger P3a for unexpected compared to expected stimuli. Interestingly we demonstrated an intermediate interaction, showing action-expectancy effects for tones which were unattended, whilst no effect for attended tones. This interaction pattern suggests attention and expectancy are not opposing processes but can both operate to modulate prediction. As such, the present study provides valuable new insight in to the relationship between attention and expectation in the sensory processing of action effects.

C114

INVESTIGATING THE NEURAL BASIS OF VIDEO-GAME-BASED CATEGORY LEARNING

Sung-Joo Lim[1,3], Julie A. Fiez[2,3], Mark E. Wheeler[2,3], Lori L. Holt[1,3]; [1]Carnegie Mellon University, [2]University of Pittsburgh, [3]Center for the Neural Basis of Cognition — A video-game-based training paradigm (Wade & Holt, 2005) has been shown to promote effective learning of both novel non-speech and non-native speech categories (Lim & Holt, 2011). This training is a significant departure from traditional explicit response-feedback paradigms in its implicit nature. The task does not require directed attention to sounds and feedback is linked to game performance, not categorization per se. Moreover, the training is more naturalistic in that listeners experience rich correlations among multimodal cues and the functional use of sounds guides successful game actions. Using fMRI, we investigated the neural basis of non-speech sound category learning in this paradigm. All participants experienced a set of unidimensional sound categories differentiable without training and a set of complex high-dimensional sounds that required training to categorize. One group played the videogame with the complex sounds drawn from a linearly separable category space, whereas the other heard similar sounds without an orderly structure. The different organization of the sound category structure evoked differential engagement of a left middle temporal (LMT) region identified through a speech vs. non-speech localizer contrast. During game play, this LMT region showed greater activation for subjects who experienced an orderly vs. random category structure. Moreover, an orderly category space led to exhibit differential LMT responses to within- vs. between-category sounds under a habituation protocol, whereas experience with unstructured sounds exhibited an effect of acoustic complexity. We conclude that implicit forms of learning can successfully reshape the perceptual responses in speech-related regions to form non-speech category representations.

C115

NEURAL REPRESENTATIONS OF AUDITORY OBJECT BOUNDARIES REVEALED BY EEG Amanda R. McMullan[1], Matthew S. Tata[1]; [1]University of Lethbridge — One of the most complex tasks that the brain undertakes is scene analysis. This includes segregating objects from their background and perceiving the boundaries between them. Responses to different types of boundaries have been well studied in vision science. However, responses to analogous boundaries in auditory science are relative less understood. In vision, objects that differ from their background in terms of luminosity are termed first-order and objects that differ in terms of isoluminant color or texture are termed second-order. In audition, first-order boundaries are defined by energy transients and second-order boundaries can be defined by differences in motion, pitch, or timbre. For example, research on auditory boundaries has considered mistuned harmonics, dichotic pitch, and iterated rippled noise. Our goal was to further characterize the ways in which the auditory system represents differenent kinds of boundaries in the auditory scene. We used a discontinuous motion stimulus to create the percept of new auditory objects. Each trial consisted of six 1000ms sweeps of sound that panned 180 degrees spanning the midline. First-order sweeps were preceded by a 500ms silent gap, while second-order sweeps were continuous. Event-related potentials (ERPs) evoked by these two different types of boundaries show increased amplitude for first-order compared to second-order boundaries.

C116

MUSICAL TRAINING IN TEENAGERS WITH CONGENITAL AMUSIA Genevieve Mignault Goulet[1], Benjamin Rich Zendel[1], Nicolas Robitaille[1], Isabelle Peretz[1]; [1]University of Montreal — Congenital amusia is a neurodevelopmental disorder characterized by difficulties in processing music and pitch, and is related to abnormal electrical brain responses. The goal of this study was to measure brain plasticity via electroencephalography (EEG) in amusic teenagers after three months of weekly guitar lessons. To this aim, guitar tones corresponding to the E4, B3, C4 and D4 notes were presented while the subject watched a silent subtitled movie. As a marker of brain plasticity, we measured the P2 component of the auditory evoked response before and after training. Since guitar training involves tuning strings to E4 and B3, we predicted a P2 enhancement for these two pitches after training. Eight amusic and eight matched controls (12-15 years old) were identified using the Montreal Battery of Evaluation of Amusia and a singing task. Four of the amusic participants were impaired in melodic and pitch perception while the other four were unable to sing in tune. Since both types of amusia are believed to result from poor pitch representation, a larger P2 to the trained pitches (E4 and B3) would suggests that enhanced frequency tuning is possible in the amusic brain. Accordingly, parallel improvements in melodic perception and singing performance should also be observed over time. Preliminary findings support this tendency and ongoing analysis will allow us to draw further conclusions regarding brain plasticity in congenital amusia.

C117

GOAL-BASED AUDITORY PREDICTIONS OF SELF-PRODUCED SPEECH Caroline A. Niziolek[1], Srikantan S. Nagarajan[1], John F. Houde[1]; [1]University of California, San Francisco — Efference copy is thought to reflect the expected sensation of self-produced motor acts, such as the auditory feedback heard while speaking. If the feedback matches the efference copy prediction, sensory responses are suppressed, a phenomenon known as speaking-induced suppression (SIS). Does the auditory prediction reflect precise sensory consequences, or a higher-level, goal-based target? Production variability enables us to test these alternatives in natural speech. Here, we used magnetoencephalography (MEG) to measure how SIS varied over repeated word productions in two different contexts. In Experiment 1, subjects produced three different vowels; in Experiment 2, subjects were cued by tonal prompts to produce a single vowel on three different pitches. SIS was defined as the suppression of the auditory M100 response to spoken vowels relative to an audio playback condition. We found that SIS was reduced in the productions farthest from the median formants. In other words, natural vowel productions at the edges of the distribution appear more error-like, suggesting that not all output variation is built into the neural prediction. Furthermore, this reduction in SIS depends on task context. When comparing productions based on distance from the median pitch, we found that SIS varied only in Experiment 2, in which pitch was an explicit target. These results demonstrate that SIS varies across normal, unperturbed utterances based on the goodness of the match with a task-specific target. This is consistent with a forward model in which the auditory prediction is goal-based and articulatory variation is introduced downstream.

C118

MOTOR SIMULATION UNDERPINS TEMPORAL COORDINATION IN JOINT ACTION. Giacomo Novembre[1], Luca F Ticini[1], Simone Schütz-Bosbach[1], Peter E Keller[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — The interpersonal coordination of movements in everyday life relies on one's ability to represent and integrate simultaneous self- and other-related behavior. The present study combined on-line brain stimulation methods with a music performance task in order to investigate whether this function is underpinned by motor simulation, i.e. the brain's capacity to represent a perceived action in terms of the neural resources required to execute it. Ten pianists performed the right-hand part of a piano piece in synchrony with a recording of the left-hand part, which had (Trained) or had not (Untrained) been practiced beforehand. This manipulation was intended to call upon specific motor simulation processes associated with the perception of actions that, through training, exist in an individual's motor repertoire. Pianists were required to adapt their performance to occasional tempo changes in the left-hand part. In critical conditions, tempo changes were preceded by double-pulse Transcranial Magnetic Stimulation (dTMS) delivered over the right primary motor cortex. Accuracy of tempo adaptation following dTMS or control TMS (sham stimulation) was compared in the Trained and Untrained conditions. Results showed that dTMS impaired tempo adaptation accuracy only when the left-hand part had been trained, suggesting that motor simulation processes mediated temporal coordination. The magnitude of this interference-effect was stronger in participants who had relatively high 'perspective-taking' scores on a questionnaire assessing empathy. Motor simulation therefore provides a functional resource for the temporal coordination of one's own (goal-directed) behavior with others, thus serving as a fundamental component of successful joint action.

C119

INTERVAL TIMING IN GBA AND PARKIN MUTATION-CARRYING, AND IDIOPATHIC PARKINSON'S DISEASE PATIENTS Brian C. Rakitin[1], Llency Rosado[1], Roy N. Alcalay[1], Helen Mejia-Santana[1], Karen Marder[1]; [1]Columbia University — Interval timing abilities were assessed in 42 fully medicated Parkinson's disease (PD) patients in order to determine whether genetic heterogeneity contributes to timing deficits in PD patients. Patients were recruited from the Consortium of Risk for Early PD (CORE-PD) Columbia University center, assessed with the Unified Parkinson's Disease Rating Scale (UPDRS) and classified as having mutations either in the parkin ("parkin+", n=18, age=47.5±9.5, AAO=31.6±8.2, UPDRS=39.7±8.6) or glucocerebrosidase ("GBA", n=14, age=59.6±8.1, AAO=50.1±10.7, UPDRS=37.5±14.2) genes, or neither ("idiopathic", n=10, age=55.2±12.6, AAO=45.4±10.8, UPDRS=35.9±12.2) using denaturing high performance liquid chromatography and multiplex polymerase chain reaction. In the single-interval production (SIP) timing task, participants reproduced three previously demonstrated and practiced intervals (1.1, 2.2 and 3.3 seconds duration) without feedback in a randomized block design. Analyses of timing accuracy (mean produced interval – target) indicated a statistically significant interaction between target interval duration and mutation type, $F(4, 62) = 3.92$, $p < 0.05$, such that the parkin+ group overestimated the longer target intervals to a greater extent than the shorter ones. This tendency was much smaller in the GBA, and absent in the idiopathic groups, and persisted after covarying for age, AAO, UPDRS, levodopa and dopamine agonist drug dose, within groups. These results suggest that timing deficits in PD may be gene-specific phenotypes. The parkin mutation variant, while associated with slower disease course is also associated with more severe dopamine pathology, supporting previous assertions that the PD timing deficit is dopaminergic in nature.

C120

SENSITIVITY ATTENUATION: SOMETHING MORE THAN SENSORY ATTENUATION. Cédric Roussel[1,2], Gethin Hughes[1,2], Florian Waszak[1,2]; [1]Université Paris Descartes, Sorbonne Paris Cité, Paris, France, [2]CNRS (Laboratoire Psychologie de la Perception, UMR 8158), Paris, France — The visual system is subject to sensory attenuation and this is thought to be related to motor based sensory prediction (Cardoso-Leite, et al 2010). In this study we develop a model to account for how this prediction might be implemented in the brain. This model supposes that the voluntary action selection involves the preactivation of learnt action-effects (Waszak, Cardodo-Leite, Hughes, 2011). By modeling motor induced preactivation in sensory pathways we predict that sensory attenuation is due to a nonlinear increase of the internal response. One novel prediction of this model is that it should result in a change of discrimination sensitivity. We tested this hypothesis by conducting a contrast discrimination task, in EEG, for visual stimuli that were either congruent or incongruent with previously learnt action-effect contingencies. Participants selected on each trial which of two buttons to press. Each button press was followed, by the presentation of either an A or an H, at one of two contrast levels. Participants were required to report the perceived contrast. We observed a significantly ($F(1,14) = 11.294$, $p <= 0.005$) reduced contrast sensitivity for trials where the stimulus was congruent ($M=1.15$) with the learnt action-effect contingency, compared to when it was incongruent ($M=1.47$). This result was supported by ERPs. We isolated a visual N1 component affected by contrast ($F(1,14)= 4.83$ $p=0.045$) and by congruency ($F(1,14)=8.01$ $p= 0.01$). Hence the prediction made by our preactivation model was confirmed and provides a new way to consider how the brain predicts the sensory consequences of the action.

C121

STRUCTURAL AND FUNCTIONAL NEURAL SUBSTRATES OF METACOGNITIVE ABILITIES DURING A VISUO-MOTOR TASK Indrit Sinanaj[1], Yann Cojan[2], Patrik Vuilleumier[1]; [1]Laboratory of Neurology and Imaging of Cognition, Department of Fundamental Neurosciences, University of Geneva, Switzerland, [2]Laboratorio de Neurociencia Integrativa Buenos Aires, Universidad de Buenos Aires, Argentina — Compelling evidence suggests that we have a limited conscious knowledge of the monitoring of our own motor corrections. Research in the perceptual decision–making domain has suggested that such monitoring processes might implicate specific metacognitive abilities. However, the brain and behavioral correlates of metacognition during motor action monitoring remain poorly known. Here we investigated the neural mechanisms of metacognitive monitoring on a motor task. We employed a visuo-proprioceptive conflict-inducing paradigm, adapted from Fourneret and Jeannerod (1998), where participants were required to draw straight trajectories toward a visual target by moving a joystick with their right hand, while these trajectories were variably and unpredictably perturbed by online-adjusted near-threshold deviations. Participants had then to judge whether they detected any perturbation and rated the confidence level of their judgment. Behaviorally, we replicate findings in perceptual-domain research that suggests that subjective confidence correlates with objective accuracy despite lack of veridical feedback. Metacognitive sensitivity was calculated using signal detection theory measures and showed that participants were optimal in monitoring their motor correction. Functional MRI results during this task showed differential activations in motor, cingulate, and striatal networks in relation to correct detection of deviation during visuomotor performance. Structural MRI analyses showed that metacognitive sensitivity correlated with gray-matter volume of both the right fusiform gyrus and right insula, suggesting that accurate metacognitive judgments rely on both sensory-visual and internal-agency representations.

C122

MOTOR FUNCTIONING AND MOTOR LEARNING IN CHILDREN WITH LEARNING DISABILITIES Bouwien Smits-Engelsman[1], Katrijn Van Aken[1]; [1]Department of Kinesiology, K.U. Leuven, Belgium — Children with intellectual disabilities and/or learning disabilities (LD) have problems in acquiring motor skills (Smits-Engelsman et al. 2012). This substantiates that motor performance and cognitive development are interrelated. They are intertwined at both cognitive and neurological levels, for instance through the brain structures and networks associated with the cognitive processes involved in attention, executive function, visuomotor skill, timing and learning. However, motor control studies in the population of children with LD are scares. This study investigated underlying motor control weaknesses, thereby questioning if a short term training led to changes in performance on a rhythmical visuo-manual tracking task, and how children with LD (mean IQ 70) responded to augmented visual and auditory feedback to improve performance. The children with LD showed impaired visuo-manual tracking performance. However, both groups (LD group n=47 and control group n=100) improved their performance when feedback was available. Additionally it is examined whether there was an improvement in performance through repetitions of the task (short term changes). None of the groups improved their tracking performance after 84 trials, possibly due to task difficulty or too few repetitions. (We are currently expanding the number of sessions). The movements of children with LD were less fluent compared to the controls. They were also less accurate in their timing of the movements, as shown in the significantly larger absolute time errors compared to the controls ($F= 54.05$; $p<0.0001$). Children with LD moved faster than controls and did not seem to be able to change their movement speed for accuracy.

C123

ERROR-RELATED NEGATIVITY ELICITED BY A CORRECT RESPONSE WITHIN AN ERRONEOUS MOVEMENT SEQUENCE. Jose J. Torres[1], Samantha N. Habhab[1], Lauren M. Eckles[1], Mohamed-Ali Sareini[1], William J. Gehring[1]; [1]University of Michigan — The error-related negativity (ERN) is an event-related potential component that reflects posterior medial frontal cortex activity related to errors during choice reaction time tasks. Theories of the ERN have failed to identify the motor representation involved in the computation underlying the ERN. This study tests whether the ERN elicited by a movement sequence corresponds to an abstract representation of the sequence vs. a representation of individual movements. 17 subjects performed a modified Eriksen flanker task in which each of 3 target letters (H,S,B) was assigned to a specific right hand finger response sequence (Index; Index-Middle; Index-Middle-Ring). We focused on trials in which the index-middle (two-movement) sequence was required but flanking letters signaled only the index-finger movement. The reaction time interval between the two movements was longer when incongruent flanker letters signaled a single movement than when the flankers were congruent: subjects initially programmed only the single movement, but then initiated the second movement upon continued processing of the stimulus. ERP data showed an ERN time-locked to the (correct) first movement on trials where the interval between the two movements was long (>90th percentile). ERPs time locked to the second (delayed) movement failed to show an ERN. Because the index finger response eliciting the ERN was itself correct, but the movement sequence at that point was not, the response representation underlying the ERN must be more abstract than that corresponding to a single effector. We suggest that the representation underlying the ERN corresponds to the accuracy of the entire movement sequence.

C124

ELECTROENCEPHALOGRAPHIC AND MODELING EVIDENCE FOR LEARNING-DRIVEN ATTENTIONAL CAPTURE Cameron D. Hassall[1], Olave E. Krigolson[1]; [1]Dalhousie University — In order to maximize utility, we pay attention to stimuli that predict reward, thus overcoming a limited cognitive processing capability. Recent evidence suggests that this is done in both a top-down (goal-directed) and bottom-up (automatic) fashion. In the present study, we investigated the role of low-level medial-frontal reinforcement learning systems in controlling and changing the allocation of visual attention towards valuable stimuli. Participants received rewards and punishments in a two-armed bandit gambling task while electroencephalographic (EEG) and behavioral data were recorded. Following learning, we observed an increase in the amplitude of the N1, a component of the human event-related brain potential (ERP) associated with the allocation of attention in visual space. Importantly, the magnitude of the N1 contralateral to higher-valued stimuli increased with learning, and correlated with changes in the feedback error-related negativity, an ERP component linked to the processing of rewards and punishments by a reinforcement learning system within medial-frontal cortex. We propose a combined reinforcement learning and attention model to account for our EEG and behavioral data. The model reproduces the magnitude of the fERN (thought to reflect a reinforcement learning prediction error), the N1, and human behavioral

performance. In particular, our model learns optimal responses in a two-armed bandit gambling task, and shifts its attentional allocation to higher-valued stimuli, a result that mirrors our empirical data. Taken together, our EEG and modeling data suggest one possible mechanism through which attention shifts with learning.

C125

SHAME AND EXCULPATION: INTEGRATING MODELING AND NEUROIMAGING APPROACHES TO SOCIAL EMOTIONS

Ming Hsu[1], Daniel Walsh[1], Taisuke Imai[2], Takeshi Murooka[1], Masataka Watanabe[3]; [1]University of California, Berkeley, [2]California Institute of Technology, [3]University of Tokyo — Imagine just winning the lottery. How much would you give to friends and acquaintances? Would your choice be different if no one knew you had just won? For many people, choices depend upon not only the material outcomes involved, but also on the beliefs and expectations of other people. Violation of these social expectations may result in negative emotions such as shame. Here we study behavior and neural responses to such expectations in the context of a simple economic game—the stochastic dictator game. In the game, a dictator chooses to allocate money between herself and an anonymous recipient while the pot of money available varies across rounds. Crucially, whereas the dictator always knows the pot size, the recipient can find out only with some probability. Behaviorally, we found that dictators gave more to the recipient when there was a greater likelihood of the recipient finding out the true pot size. In addition, subjects indicated a preference to hide the pot size from the recipient when it was large, but to reveal when the pot size was small. Using a model-based approach, we characterized subjects' preferences as a weighted combination of material payoffs, payoff inequity, and the risk of being shamed. Functional neuroimaging showed that shame risk was negatively correlated with activity in the medial prefrontal cortex, whereas the relief of shame was positively correlated with activity in the striatum. Taken together, these results shed light on the cognitive processes underlying higher-order emotions, as well as their neural substrates.

C126

THE NEURAL MECHANISMS OF SEQUENTIAL DECISION-MAKING AS REVEALED BY ALPHA-BAND OSCILLATIONS

Shen-Mou Hsu[1]; [1]National Chengchi University, Taipei, Taiwan (R.O.C.) — Great progress has been made in characterizing the neural mechanisms underlying decision-making on single percepts. By contrast, much less is known about how decisions on current percepts are affected by preceding material. The current study recorded magnetoencephalographic signals while participants performed a binary categorization task on a sequence of facial expressions. The expressions were continua of morphs from fear to neutral. To probe decision-related neural signatures, I contrasted neural activity of the trials in which the ambiguous expressions were reported as fear with the trials in which the same ambiguous expressions were reported as neutral. The analysis showed that both oscillatory alpha activation at the parieto-occipital sites and beta activation at the left frontal sites reflected perceptual decisions. Nevertheless, only alpha-band oscillations were found to be closely correlated with the sequential effects revealed in the behavioural results, in which current ambiguous morphs would be more likely to be categorized as fear if immediately preceded by nearby fearful morphs as compared to if preceded by fearful prototypes. This study thus suggests that preceding stimuli may act on oscillatory alpha activity of the current percepts and in turn influence final categorical decisions, whereas oscillatory beta activity may simply represent general decision-making processes.

C127

NEURAL CORRELATES OF THE DECOY EFFECT IN DECISIONS

Jianping Hu[1], Shuangju Zhen[1], Yanzhen Zhang[1,2], Wei Zhang[1]; [1]Department of Psychology,South China Normal University, [2]Shantou University Medical College — Human choices are remarkably susceptible to the context in which options are presented. The so called "decoy effect" represents a striking violation of the proposition that human decisions are "context-invariant", although its underlying neural mechanisms is not well understood. To elucidate its neural basis, we used a novel gambling task in conjunction with functional magnetic resonance imaging. Participants were more likely to choose 'target' options whose subjective values were boosted by corresponding decoy options. In the stimulus presentation phase, our data revealed that inferior parietal gyrus was more active when no decoy was presented than when decoy option was shown, whereas the occipital gyrus was more activated by decoy option trials, suggesting that the parietal based deliberation process is switched to the intuition process which may involve the occipital gyrus, when decoy option is available. In the response phase, the left anterior insula was more active when decoy boosted targets rather than decoy irrelevant competitors were chosen. Moreover, across individuals, activity in anterior cingulate cortex predicted a reduced susceptibility to the decoy effect, suggesting that resisting decoy effect requires extra cognitive control. Our findings highlight the power of decoy effect in laboratory settings and document its neural mechanisms of decoy effect.

C128

IMPORTANCE OF NUMERIC INFORMATION PROCESSING FOR THE VALUATION OF MONETARY REWARDS

Frank Kanayet[1], John Opfer[1], Wil Cunningham[1,2], Per Sederberg[1]; [1]The Ohio State University, [2]University of Toronto — Processing monetary rewards has been linked to activity in OFC, striatum, and IPS (Kable & Glimcher, 2009), though the roles of each area are still not well understood. One possibility is that interpreting the value of money requires two distinct cortical systems: one for processing the subjective value of stimuli (OFC and striatum) and another for processing the meaning of numbers (IPS). To test this hypothesis, we manipulated the numeric magnitude, currency and valence to construct a range of economic rewards (e.g., +$1, +100¢, -$1, -100¢) received by participants after a simple decision. Consistent with our hypothesis, BOLD activity in IPS was related to changes in numeric magnitude, independent of the objective monetary value, whereas activity in OFC, insula and striatum were associated with objective monetary value, independent of numeric magnitude. Finally, by using representation similarity analysis, we found that the information represented in IPS was more consistent with the expected patterns associated with processing numeric magnitude, whereas activity in OFC was more consistent with patterns of information expected for monetary value. Together, these findings show the importance of considering the cognitive properties of numeric information processing for understanding how the brain processes monetary rewards.

C129

MOTOR COSTS MODULATE PRIMARY MOTOR CORTEX EXCITABILITY

Aysha Keisler[1], Samantha Frank[1], Eric Wassermann[1]; [1]National Institutes of Health — Evaluation of costs and rewards is critical for identifying optimal behaviors. Recent research shows that dopaminergic cortico-striatal circuitry plays a significant role process. However, while much progress has been made elucidating the subcortical components of this network, we know little about the cortical component. Here, we examined how motor costs affect cortical excitability using transcranial magnetic stimulation. Participants completed a visual discrimination task. To manipulate motor costs, participants were required to make either a low-effort or a high-effort motor movement with the left hand when responding on the discrimination task. Accuracy feedback was given on some trials and not on others. Stimulation was applied to the left primary motor cortex shortly either (a) before the response or (b) after reward onset. Motor evoked potentials were recorded from the right hand. We found that accuracy feedback plays a critical role in the modulation of cortical excitability. When participants received feedback on their performance, excitability increased with motor costs; importantly, however, the same motor movements do not affect excitability when they are not associated with the visual task. Interestingly, effort did not affect excitability in the absence of feedback. These data suggest that feedback triggers a state of effort sensitivity in the motor cortex.

C130

YOU WILL LIKE IT AS MUCH AS IT HURTS : INTERPLAY OF STRIATUM AND DACC DURING CHOICE-MAKING

Hye-young Kim[1], Yeonsoon Shin[1], Sanghoon Han[1]; [1]Yonsei University, Seoul, Korea — Although post-choice attitude change phenomenon is relatively well-known, few studies identified the actual neural mechanism of dissonance-induced attitude change, especially focusing on the act of choosing. In an fMRI study, 15 participants were scanned while performing a multiple-alternatives-forced-choice task. Participants first rated attractiveness on various art posters, and 4 different choice sets were configured based on each individual's rating (3 large sets with 4 alternatives and 1 small set with 2 alter-

natives). Each participant chose one item among multiple alternatives in a set and reported perceived choice difficulty and re-rated attractiveness of every presented alternative. Trial-by-trial dissonance-induced attitude change score was defined as difference between the increased attractiveness for a chosen item and the decreased attractiveness for rejected items. Participants reported greater choice difficulty and attitude change when choosing from large sets compared to small sets. Greater choice difficulty was strongly related with larger attitude change. We found that choice difficulty and attitude change on each trial are reliably predicted by activity levels in dACC & insula, and dorsal striatum respectively during choice-making. The dACC and striatum showed stronger functional coupling while making a choice from large sets, which showed greater choice difficulty and attitude change. The same regions were also hired more actively among subjects with larger general attitude change. These results demonstrate that higher choice difficulty leads to greater dissonance-induced attitude change and it is derived by interplay of striatum, dACC, and insula. This adaptive process occurs simultaneously at the moment of choice, not as post-choice rationalization.

C131

NEURAL COMPUTATIONS OF LEARNING WITHIN A SOCIAL HIERARCHY GAME

Brooks King-Casas[1,2,3,4,5], Lusha Zhu[1,2], Pearl H. Chiu[1,2,3,4]; [1]Virginia Tech Carilion Research Institute, [2]Salem VA Medical Center, [3]Department of Psychology, Virginia Tech., [4]Department of Psychiatry, Virginia Tech Carilion School of Medicine, [5]VT-WFU School of Biomedical Engineering and Sciences — Many social species organize within social hierarchies, including our own. Within such hierarches, preferences for dominance or submission can serve to motivate mobility within the hierarchy, or maintain the extant hierarchy. In modern human society, however, social dominance and aggression are often associated with violence and destructive behavior, and are characteristic of significant psychopathologies including anti-social personality disorder and borderline personality disorder. Despite extensive work in non-human species, relatively little is known about the behavioral and especially neural mechanisms underlying social dominance in humans. Here, we focused on the expression of dominance within an iterated resource contest to examine the neural mechanisms underlying how individuals learn and navigate within a social hierarchy, by combining functional neuroimaging with computational modeling. We formulated a Bayesian learning model, proposing that the dynamics of the limited social hierarchy are shaped by the interplay between a player's preference for social dominance and ability to anticipate opponent's future behavior. We examined neural correlates of multiple prediction errors derived from our computational model at a trial-by-trial basis. Our results suggest (1) social outcomes are reinforced through multiple separable neural signals, including feedback for outcomes and feedback regarding the actions of opponents, and (2) there exists a tradeoff between these two neural prediction errors across subjects, providing neuromechanistic insight into individual differences in aggression and preference for dominance. The combination of our experimental paradigm and neurobehavioral correlates suggests a potentially useful approach for identifying quantitative biomarkers of aggressive social behavior in a variety of mental and neurological disorder.

C132

DEVELOPMENT OF OPERATION MODULATION AND INVARIANT NEURAL REPRESENTATION FOR ARITHMETIC PROBLEMS

Ting-Ting Chang[1], Miriam Rosenberg-Lee[1], Arron, W. S. Metcalfe[1], Tianwen Chen[1], Vinod Menon[1]; [1]Stanford University — Addition and subtraction are two complementary arithmetic operations with distinct problem solving strategies. Although past imaging studies have demonstrated differential functional engagement of posterior parietal cortex (PPC) for the two operations, the underlying neural representations and their development is poorly understood. Here we investigate how maturation shapes brain responses during addition and subtraction problem solving by comparing twenty-eight adults (age 19-22) and twenty-eight children (age 7-10). We first conducted conventional univariate analyses to assess activation levels for each operation and then used a novel multivariate representational similarity (RS) analysis to examine invariance of neural representations across operations. The results showed significant age-related differences in operation-specific modulation of PPC with greater responses in adults than children. Critically, multivariate analysis revealed high levels of RS for addition and subtraction problems not only in intraparietal sulcus and supramarginal gyrus of PPC, but also in fusiform gyrus within ventral occipito-temporal cortex and middle and superior frontal gyri of prefrontal cortex (PFC). RS between the two operations was non-significant in children. These results suggest that in PPC, the maturation of arithmetic problem solving skills is marked not only by differential operation-specific functional engagement but also by development of invariant neural representation. Furthermore, although the relative functional engagement of ventral occipito-temporal cortex and PFC mature by age 10, the underlying neural representations continue to converge between operations beyond childhood into adulthood. Our findings provide novel insights into the maturation of neural representations for arithmetic problem solving and highlight the importance of examining multivariate representations in development.

C133

LONGITUDINAL CHANGES IN CHILDREN'S IPS RESPONSES ARE NUMBER-SPECIFIC AND MATHEMATICS-RELATED

Robert Emerson[1], Vy Vo[1], Jessica Cantlon[1]; [1]University of Rochester — In this study we examine longitudinal changes in children's number-related IPS responses over a 1-2 year delay. Children (4-9 years, Mean 6.6 years) were tested on a matching task with numbers, faces, shapes, and words during functional magnetic resonance imaging (fMRI). Number-related neural activity, defined as greater responses during number matching than the other three categories, included the prefrontal cortex (PFC) and the intraparietal sulcus (IPS). Children then completed the same fMRI task 1 to 2 years later. In the IPS, only the neural response amplitudes from the numerical stimuli were correlated between the two testing sessions. Neural responses from faces, shapes, and words were not correlated in the IPS. In contrast, longitudinal correlations in PFC activity were not specific to numerical stimuli and instead were observed for both words and numbers. Secondly, we tested the hypothesis that longitudinal changes in number-related activity predict changes in children's math test scores. Children completed a standardized mathematics test (TEMA-3) outside of the scanner at both time points. Children's mathematics tests scores significantly improved over the 1 to 2 year delay (Average Raw Score Increase of 14 points, $p < .0001$). The longitudinal changes in the right IPS response amplitudes correlated with changes in children's mathematics test scores, independently of age. In contrast, number-related response amplitudes in PFC did not correlate with age or mathematics ability. These are the first longitudinal data to show a consistent and specific involvement of the IPS in numerical processing as children mature.

C134

SIZE MATTERS! AGE AND GENDER DIFFERENCES IN ERPS ELICITED BY FEEDBACK.

Jill Grose-Fifer[1,2], Renee Migliaccio[1], Erica Twomey[1], Lillian Pena[3], Tina Zottoli[4]; [1]John Jay College of Criminal Justice, CUNY, [2]The Graduate Center, CUNY, [3]Queen's College, CUNY, [4]St. Joseph's College of New York — Effective feedback processing is an important element in decision making. However, relatively few developmental studies have examined the neural basis of these mechanisms and most have focused on the feedback-related negativity (FRN). This study investigated whether there are age and/or gender differences in the neural correlates of feedback processing in adolescents (13 –17 years) and adults (25 –35 years). The FRN and feedback p3 (fP3) were measured in a simple monetary gambling task. Consistent with previous studies, the FRN was larger for losses than for wins, and larger in adolescents compared to adults. As we have reported previously, the FRN in females was not modulated by the size of the win or loss, whereas in males, large wins produced larger FRNs than small wins. Boys also showed longer latency FRNs to large losses. The current analyses also showed that the fP3 amplitude is larger for gains than for losses, but unlike the FRN, it is not modulated by magnitude, age or gender. In general, the fP3 was later for losses than for wins, but this effect was qualified by an interaction with gender and magnitude, such that in males large wins elicited a relatively short latency fP3 compared to large losses, but low magnitude wins and losses elicited fP3s with similar latencies. Taken together, the FRN and fP3 data suggest that large rewards are processed differently by males (and especially adolescent males) compared to females and therefore, might help to explain greater risk taking in real-life situations.

C135

COGNITIVE NEUROCHEMISTRY: HOW NEUROCHEMICALS ARE LINKED TO COGNITIVE ACHIEVEMENTS IN THE DEVELOPING BRAIN OF GIRLS

Beatrix Krause[1], Roi Cohen Kadosh[1], Claire Brown[1], Julie Shah[1], Kathrin Cohen Kadosh[1], James Near[2], Charlotte Stagg[1], Stuart Wilson[1]; [1]Oxford University, [2]McGill University — Academic achievements impact an individual's future prospects greatly. A thorough understanding of the underlying biological basis of learning is crucial in order to design early identification and intervention methods for learning disabilities. Here we examined the association between neurochemicals and one of the most important academic abilities: mathematics. At younger ages, children primarily recruit the prefrontal cortex for mathematical processing, whereas they recruit posterior brain regions, such as the parietal lobe later on. The neurotransmitter gamma-aminobutyric acid (GABA) modulates learning via the formation of long-term potentiation and depression. We hypothesized that GABA would relate to mathematical achievement in the prefrontal cortex but not the parietal lobe during the early years of mathematical education. Fifteen girls aged 7-10 years underwent magnetic resonance spectroscopy (MRS). GABA concentrations were quantified in the left inferior frontal gyrus (IFG) and right intraparietal sulcus (IPS). Inferior occipital gyrus (IOG) measures served as a baseline control. Mathematical achievement was assessed using a standardized test (WIAT-II UK). Girls with lower mathematical abilities showed higher levels of GABA in the IFG than girls with higher scores. This negative correlation was not found in the IPS, in line with the notion that parietal involvement might occur at a later point in life. Notably, GABA concentrations in the IFG were specific to mathematical achievement and did not correlate with working memory or reading abilities. These results provide novel opportunities to examine developmental cognitive changes with potential biomarkers for learning disabilities and cognitive difficulties.

C136

NEURAL BASIS OF EXACT SUBTRACTION IN EARLY ELEMENTARY SCHOOL CHILDREN

Liane Moneta-Koehler[1], Edward Hubbard[2], Bruce McCandliss[1]; [1]Vanderbilt University, [2]University of Wisconsin-Madison — fMRI studies suggest exact and approximate numerical representations are mediated by different neural networks, with exact number processing recruiting the angular gyrus (AG) and approximate number processing recruiting the intraparietal sulcus (IPS). Recent developmental findings from our group, however, suggest that increases in precision of approximate number abilities from K to 3rd grade coincide with the rise of exact number properties in IPS responses for symbols (i.e. symbols 5-9). Here we examine whether these findings extend beyond approximate number abilities to inferences children can make about exact numbers, as in the case of exact non-symbolic subtraction. A cross-notation fMRI dishabituation study (55 children grades K-3rd) presented arrays of dots of an adapting quantity (6 or 8) interrupted by symbolic deviants (5 or 9). Adaptation dot arrays and symbol deviant quantity were crossed to provide 1-away (exact dishabituation) versus 3-away (approximate dishabituation) fMRI responses. In a separate, non-symbolic task, individual differences in accuracy for exact subtraction was assessed for a similar range of numbers. Individual differences in exact subtraction correlated with exact, but not approximate, dishabituation responses in bilateral AG, consistent with its role in exact number processing. Importantly, exact subtraction also correlated with exact, but not approximate, dishabituation in bilateral IPS. These results suggest that sensitivity to exact quantities in each neural system contributes to exact arithmetic ability in young children, and further suggests that a common developmental process may underlie the precision of both brain networks.

C137

THE IMPACT OF ACUTE AND CHRONIC STRESS ON DECISION MAKING AMONG OLDER ADULTS

Georgina Moreno[1], Whitney Strong[2], William Hedgcock[1], Daniel Tranel[1], Natalie Denburg[1]; [1]University of Iowa, [2]University of Nebraska-Lincoln — It is a well-known phenomenon that stress can lead to hippocampal damage and a subsequent decline in anterograde memory. We are now learning that stress may also damage the prefrontal cortex (e.g., Lupien et al., 2009), a brain region involved in important everyday abilities such as divided attention, judgment, and decision making. Interestingly, several of the brain regions vulnerable to increased levels of stress, such as the hippocampus and prefrontal cortex, are also known to undergo disproportionate decline during normal aging (e.g., Cabeza, Raz, & Park, 2005; Gunning-Dixon, 2009). Therefore, it is surprising that no published research to date has examined the effects of stress on decision making in the elderly. In order to address these gaps in the literature, we investigated how acute and chronic stress impact decision-making performance in a healthy older adult sample. Acute stress was induced by the administration of the Trier Social Stress Test (TSST). Chronic stress was measured by: chronic stress questionnaires, the UCLA Life Stress Interview, and diurnal salivary cortisol. Decision-making performance was measured by tasks that assess: 1) decision making under risk; 2) decision making under ambiguity; and 3) temporal discounting. Preliminary analyses suggest a trend towards less risky decision-making among stressed older adults for the Cups Task. Regarding chronic stress, negative correlations were observed between measures of cognition and measures of chronic stress, including the chronic stress questionnaires and interview.

Poster Session D

D1

PARENTING INTERACTS WITH DRD4 TO PREDICT YOUNG CHILDREN'S ATTENTION Alice M Graham[1], Cameron S Laue[1], Theodore A Bell[1], Helen J Neville[1]; [1]University of Oregon — Previous research has identified children carrying the 7r allele of the dopamine D4 receptor (DRD4) as exhibiting higher levels of externalizing problems in the context of insensitive parenting (Bakermans-Kranenburg & van Ijzendoorn, 2006). Here, we examine whether selective auditory attention, as indexed by event-related potentials (ERPs), is more sensitive to variation in parenting attitudes for children carrying the 7r allele of DRD4. We used a dichotic listening paradigm to compare selective auditory attention in children recruited from Head Start preschool programs. ERPs were recorded to stimuli embedded in attended and unattended narrative stories. The Parental Modernity Scales (PMS) questionnaire was used to assess parents' beliefs about childrearing practices. The Parent Feelings Questionnaire (PFQ) was used to assess parental affect toward the child. SES was computed using the Hollingshead Index of Social Position (ISP), and buccal swab samples were collected for DRD4, with coding based on the presence of the 7r allele. For children with the 7R allele parental emphasis on control predicted greater selective auditory attention in the lower SES group. The results are consistent with previous work on DRD4, but extend this work to domains of cognition and brain functions supporting attention. 7r carriers showed greater sensitivity to environment in our analysis, suggesting the generalizability of 7r sensitivity to parenting across various cognitive outcomes, as well as suggesting that the magnitude of genetic effects may vary based on SES (Turkheimer et al, 2003).

D2

COMPUTER-BASED COGNITIVE SKILLS TRAINING IMPROVES COLLEGE STUDENTS' ATTENTION Beth Rogowsky[1], Pericles Papamichalis[1], Sabine Heim[1], Laura Villa[1], Paula Tallal[1]; [1]Rutgers University — This study investigated the effect of Fast ForWord® "brain fitness" exercises on college students' cognitive skills, specifically selective and sustained attention. Fast ForWord is a series of software programs (disguised as computer games) that focus on building foundational cognitive skills (memory, attention, processing rate, and sequencing) in the context of language/listening and reading tasks. A pretest-posttest, randomized comparison group, crossover experimental design was used. 76 college students were randomly assigned to Training Group 1 (n = 39) or Training Group 2 (n = 37). During the first training session, Training Group 1 was trained for 6-weeks using Fast ForWord Literacy (FFW-L) and Fast ForWord Reading Level 3, 4, and 5 (FFW-R3, 4, 5) while Group 2 served as a waiting group control. Results from the first training session showed that students in Group 1, who received the training, made statistically greater improvement in attention (pre- vs. posttest scores on the Mindstreams® Cognitive Assessment Attention Scale) than the waiting control group (Group 2). During the second training session, the waiting control group (Training Group 2) received training for 11-weeks using FFW-L and FFW-R 3, 4, and 5. Results from the second training session replicated the previous results. That is, the trained group, in this case Training Group 2, made statistically greater improvements in attention after Fast ForWord training. Furthermore, Training Group 1, who had made significant gains in attention immediately following their training, maintained these significant gains 4 months later, despite receiving no additional training.

D3

THE ROLE OF OSCILLATORY DYNAMICS FOR THE FRONTO-PARIETAL ATTENTION NETWORK IN AUDITORY CATEGORIZATION Mathias Scharinger[1], Molly Henry[1], Thomas Gunter[2], Jonas Obleser[1]; [1]Max Planck Research Group 'Auditory Cognition', Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, [2]Department of Neuropsychology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig — Feature-selective attention during auditory categorization is beneficial in demanding listening situations, but the neural dynamics of auditory attention are not well understood. Relative de- and increases in functional magnetic resonance imaging (fMRI) have often been reported in a fronto-parietal network for visual attention tasks, but how does hemodynamic change relate to direct measures of neural activity? In a simultaneous electroencephalography (EEG) and fMRI paradigm (N=7), listeners performed a behavioral task that required categorization of multidimensional tones with varying acoustic salience (determined as increased distance to the median, most ambiguous stimulus) and differing quality (spectral degradation, introduced in the second half of the experiment). Intriguingly, BOLD in inferior frontal gyrus [IFG] was increased for the spectrally degraded tones, while the opposite pattern held for the inferior parietal sulcus [IPS]. As salience decreased, post-stimulus theta/low-alpha power (4–10 Hz) increased at right-central electrodes. These power changes were negatively correlated with the BOLD signal in a bilateral frontal-parietal network similar to that sensitive to spectral degradation (IFG and IPS). In a mixed-effect model analysis using R, we examined the interrelationships between the acoustic stimulus, oscillatory dynamics, and hemodynamic changes: Acoustic salience in a given trial could be recovered from theta/low-alpha power. Crucially, a hemodynamic predictor (right IPS response) amplified the predictive effect of EEG theta power on salience. Given the extensive framework regarding oscillatory dynamics and functional inhibition, EEG can help disambiguate the role of the frontal–parietal BOLD network in supporting selective attention to task-relevant acoustic features.

D4

THE CONTRIBUTION OF SPECTRAL AND TEMPORAL SPEECH INFORMATION TO VOWEL LENGTH DISCRIMINATION: A MISMATCH NEGATIVITY STUDY Bogdana Ulytska[1,2], Christian J. Fiebach[1,2], Thomas Lachmann[3], Claudia Steinbrink[3]; [1]IDeA Center for Individual Development and Adaptive Education, Frankfurt am Main, [2]Department of Psychology, Goethe University Frankfurt am Main, [3]Department of Psychology, TU Kaiserslautern — Phoneme perception is critical for learning to read. In German, correct vowel length perception is important for mapping phonemes onto letter sequences representing long vs. short vowels, which is a meaningful distinction in German. In naturally occurring speech, vowel length is signalled by both temporal and spectral information. We used event-related brain potentials and the mismatch negativity (MMN) paradigm (n = 20) to investigate the contribution of different perceptual features to vowel length discrimination. We compared natural (i.e., spectrotemporal) vowel length differences with (artificially modified) stimulus pairs varying only in temporal or spectral characteristics. All conditions, i.e., spectrotemporal, temporal, and spectral vowel length differences produced a reliable MMN over central electrode sites, indicating that each speech cue in isolation is sufficient for the perception of vowel length. However, MMNs in the temporal and spectral conditions had greater amplitudes than the MMN in the spectrotemporal condition. This leads to the counter-intuitive interpretation that vowel length differences are less efficiently detected when more relevant information is present in the speech signal. However, the speech processing system is highly tolerant against variability in the speech signal, which may lead to weaker mismatch responses in natural as compared to artificial stimuli.

D5

AUDITORY FEATURE-SELECTIVE ATTENTION IN HUMANS AND RHESUS MACAQUES Jessica Verhein[1], Joshua Downer[1], Kevin O'Connor[1], Nigel Noriega[1], Jeffrey Johnson[1], Mitchell Sutter[1]; [1]University of California, Davis — Research in auditory attention has mainly focused on sound location and pitch. While the ability to attend to specific auditory features within a given acoustic stimulus is also a crucial environmental skill, it is not well understood. A comparison of human and macaque feature-selective auditory attention can lead to a better understanding of similarities and differences between the species' auditory perceptual and cognitive abilities, and aid in developing a physiological model of auditory attention. In this study, two rhesus macaques and three humans were visually cued (by block) to selectively attend to one of two target features (amplitude modulation or bandwidth restriction) within a broadband noise carrier in

a choice task and to report the presence or absence of the cued feature. Our results suggest macaques can selectively attend to specific auditory features, as evidenced by increased detection of the cued feature when the animals were presented with co-modulated stimuli. Preliminary results of this cross-species study suggest similar response patterns in humans and macaques. However, humans demonstrated higher accuracy in detecting the cued target and were less likely than macaques to show increased responsiveness to the non-attended feature. This difference is likely driven by humans' greater cognitive capacity, but may arise from cross-species perceptual differences as well (O'Connor et al 2011). These results provide support for the use of rhesus macaques as a model for studying how auditory feature-selective attention modulates single neuron activity in the auditory system.

D6

THE INFLUENCE OF ATTENTION ON NEUROPHYSIOLOGICAL PROCESSING OF SPEECH-IN-NOISE Benjamin Rich Zendel[1,2,3,4], Charles-David Tremblay[4], Sylvie Belleville[2,4], Isabelle Peretz[1,3,4]; [1]International Laboratory for Brain, Music and Sound Research (BRAMS), [2]Centre de Recherche, Institut Universitaire de Gériatrie de Montréal (CRIUGM), [3]Centre for Research on Brain, Language and Music (CRBLM), [4]Université de Montréal — Understanding a word in background noise requires both perceptual segregation of the target word, followed by semantic processing of the perceptually segregated word. Without the presence of background noise, both these processes are relatively automatic. With the addition of background noise, it is likely that increased attentional resources would be required for both perceptual segregation and semantic processing of a word; however the influence of attention on brain activity related to segregating speech from background noise is not well understood. To examine this, auditory event-related potentials (ERPs) were recorded to words presented in three levels of multi-talker babble noise (none, 15, and 0 dB signal-to-noise ratio), in two listening conditions. In the active condition, participants repeated the word aloud, while in the passive condition they watched a silent movie. To focus on the influence of attention, the difference in ERPs between active and passive listening was calculated. The amplitude of an early attention-dependant component that overlapped the N1-P2 response (N170) was little affected by background noise, although its latency increased. On the other hand, the amplitude of a second attention-dependent component (N400) increased and was delayed in the presence of background noise. These results suggest that deployment of attentional resources to the perceptual segregation of a word was slowed by background noise, while the increased difficulty in understanding a word in background noise was reflected in enhanced neural activity that was likely related to the semantic processing of the word.

D7

FUNCTIONAL NEUROANATOMY OF VISUAL SEARCH FOR CONJUNCTIONS Neena K. Rao[1], Michael A. Motes[1], Bart Rypma[1]; [1]Center for BrainHealth, University of Texas at Dallas — In visual search, when a target can be discriminated from distractors by a single feature (i.e., an elementary search), search time is independent of the number of distractors, but when a target can only be discriminated from distractors by the conjunction of two or more features (i.e., a conjunction search), search time increases with the number of distractors. Proposed models suggest that preattentive, parallel processes mediate elementary searches but that additional "control" processes must be brought online to perform conjunction searches. We used fMRI to examine the functional neuroanatomy mediating these two types of visual search. Eighteen young adults completed a visual search task while fMRI data were collected. In a rapid event-related design, they searched for a green 'T' among a field of red T's and red inversed T's (i.e., elementary search) or for a green 'T' among a field of red T's and green inversed T's (i.e., conjunction search). Two, eight, and 14 distractor set-sizes were used. Reaction-time significantly increased with the number of distractors for conjunction but not elementary searches, consistent with previous findings. Within occipital regions, BOLD signal-change significantly increased with distractor set-size for both conjunction and elementary searches, but within right dorso-lateral PFC, medial PFC, and bilateral parietal cortex, BOLD signal-change significantly increased with distractor set-size only for conjunction searches. Furthermore, within right dlPFC and mPFC, significant BOLD signal-change was only detected for conjunction searches. The results are consistent with frontal regions mediating the additional processes brought online to perform the conjunction search.

D8

A ROLE OF THE RIGHT MIDDLE FRONTAL GYRUS (RMFG) IN ENDOGENOUS AND EXOGENOUS VISUAL ATTENTION: A CASE STUDY Maureen Satyshur[1], Shruti Japee[1], Ikuko Mukai[2], Leslie Ungerleider[1]; [1]Laboratory of Brain and Cognition, NIMH, NIH, [2]Laureate Institute for Brain Research — Previous research on neural mechanisms of visual attention has identified a top-down goal-directed endogenous network, and a bottom-up, stimulus-driven exogenous network. It has been proposed that the rMFG may serve as a node of interaction between these two networks (Corbetta et al. 2008, Chica et al. 2012). In this study, we examined the contribution of the rMFG to both endogenous and exogenous attention by comparing performance on an orientation discrimination task of a patient with a rMFG resection and healthy controls. On endogenous attention trials, a valid central cue predicted with 90% accuracy the location of a perithreshold Gabor patch. On the 10% invalid trials, the Gabor patch appeared in the opposite location to the cue. On exogenous attention trials, a cue appeared briefly at one of two peripheral locations, followed, after a variable interstimulus interval (ISI; range 0 to 700 ms), by a Gabor patch in either the same (valid) or opposite location (invalid). Analysis of behavioral data showed that for both patient and controls, valid cues facilitated faster reaction times compared to invalid cues, on endogenous and short ISI exogenous trials. However, at longer ISI exogenous trials, the patient was unable to withhold his responses resulting in reduced performance compared to controls. This may be related to the patient's inability to reorient attention in a top-down fashion after the effect of the exogenous cue has dissipated, and suggests a putative role of the rMFG in switching between exogenous and endogenous modes of attention. Supported by the NIMH IRP

D9

THE NEURAL BASIS OF STIMULUS LOCALIZATION IN A COMPETITION-BASED CHANGE DETECTION PARADIGM Daniel Schneider[1], Edmund Wascher[1]; [1]Leibniz Research Centre for Working Environment and Human Factors — Previous studies on selective visual attention mainly concentrated on how the intention to search for certain features or at certain locations influences attentional selection. By means of event-related potentials (ERPs) of the electroencephalogram (EEG), the present study investigated modulations on attentional selection resulting from different action intentions. Participants were instructed to react on a luminance change in a fast sequence of two bilaterally arranged stimuli and ignore a randomly occurring orientation change of these stimuli. In one block, they had to localize the relevant luminance change, while in another block only the presence or absence of the luminance change had to be reported. Both in the localization and detection task, the lowest behavioral performance was shown when the relevant luminance change and the orientation distractor were presented contralateral to each other (spatial conflict condition). On ERP level, a stronger posterior N1 asymmetry towards the luminance target was shown in the localization compared to the detection task. This indicates that the action intention to localize a visual target enhances its spatial representation already at an early processing stage. In the N2 time window, a stronger posterior asymmetry towards the luminance change (N2pc) for the localization task was attributable to a higher positivity ipsilateral to the target compared with the detection task. Thus, the spatial selection of a feature change requires a further inhibition of the neural activity not associated with target information.

D10

SUSTAINING ATTENTION FOR A PROLONGED PERIOD OF TIME MAY DEPLETE RESOURCES OF TOP-DOWN CONTROL: EEG EVIDENCE Heleen A. Slagter[1], Leon Reteig[1], Sam Prinssen[1], Ruud L. Van den Brink[1], Mike X Cohen[1]; [1]Department of Psychology, University of Amsterdam — Mental fatigue is detrimental to our ability to remain attentive, though the exact nature of this effect is still unclear. Recent behavioral studies indicate that mental fatigue, as indexed by performance decrements after prolonged time-on-task, results at least in part from depletion of cognitive resources. This study examined what happens neurally during prolonged task performance to further insight into the mechanisms underlying the develop-

ment of mental fatigue in sustained attention conditions. We reasoned that, if mental fatigue is due to resource depletion, 1) performance decrements should be accompanied by changes in well-known neural measures of top-down attentional control, and 2) an unexpected monetary incentive introduced after prolonged performance, aimed at motivating subjects to do their utmost best, should not be able to revive performance and neural top-down control to initial levels. Participants performed a sustained attention task for 80 minutes without breaks, while their brain activity was recorded with EEG. 60 minutes into the task, they received the monetary incentive. Behavioral analyses showed a rapid decline in performance with time on task, a short-lived boost in performance after the monetary incentive, followed by a continuing decline in performance during the last part of the task, despite equal initial and post-incentive self-reported motivation levels. Notably, EEG analyses revealed a tight correlation between this behavioral pattern and neural measures of attentional control and stability. These findings indicate that mental fatigue is accompanied by a reduction in cognitive resources, and that high motivation can only briefly bring these resources back online.

D11

RIGHTWARD REPRESENTATIONAL BIASES INCREASE WITH LONGER INTERSTIMULUS INTERVAL Izabela Szelest[1], Nicole Mulenga-Woo[1], Stephanie Kennedy[1], Lorin Elias[1]; [1]University of Saskatchewan — Lateral biases while performing visuospatial tasks have been attributed to perceptual and attention mechanisms. Recently, evidence has been put forth indicating that asymmetries are also evident in memory processes, known as representational pseudoneglect. In our study we investigated whether inter-stimulus time interval and stimulus masking impacts the direction or magnitude of such bias. In a brightness judgment task, participants selected an array which they perceived to be overall darker despite that the two arrays were equiluminant. The results showed significant leftward biases dependent on the position and orientation of the array. These effects were increased with an increased inter-stimulus interval to 1 second. Our findings show asymmetries in later processing of information possibly utilizing working memory processes. Furthermore, although our findings indicate that these asymmetries are representational in nature, they show to differ from those found in representational pseudoneglect. The obtained results can be explained using the activation-orientation hypothesis indicating that this hypothesis may be also applicable in explaining biases occurring at later stages of visuo-spatial processing, such as memory.

D12

ELECTROPHYSIOLOGICAL CORRELATES OF ATTENTION-SPREADING BASED ON TASK-IRRELEVANT SHAPE SIMILARITY AND LUMINANCE SIMILARITY Ryuji Takeya[1], Tetsuko Kasai[1]; [1]Hokkaido university — It has recently been shown that attention spreads from a task-relevant object to others when they have common features. We previously found that attention spreads based on size similarity, independent of connectedness, in the results of P1, N1, and N2 spatial attention effects of event-related potentials (ERPs). The present study examined how attention spreads when bilateral stimuli are similar in two feature dimensions (luminance, shape). Bilateral two stimuli (white or black circles or squares) with a gap involved an orthogonal combination of luminance similarity and shape similarity (L+S+, L+S-, L-S+, L-S-). ERPs were recorded from 16 participants who were covertly attending to one hemifield and responded for infrequent stimuli with a shorter gap while ignoring the other during rapid stimulus presentations. ERP attention effects were defined as amplitude enhancement at electrodes contralateral to the attended visual fields. We observed attention-spreading effects (ASE) as reduction of attention effects in similar conditions, compared with those in dissimilar conditions. ASE based on luminance similarity was found in the N1 latency range (150-200 ms poststimulus) most prominently at parieto-occipital sites. In contrast, ASE based on shape similarity was most prominent at posterior tempo-ro-occipital sites, and the magnitude was greater for L- in the N1 latency, and for L+ in the N2 latency (200-240 ms). These results suggest that, due to task-irrelevant feature similarity, attention spreads over spatial neural representations that are specialized for luminance or shape, and attention-spreading based on shape similarity depends on luminance similarity.

D13

ATTENTIONAL STATE TRAINING IN TRAUMATIC BRAIN INJURY Alana Vernon[1,2], Christina Marini[1], Sawsan Dabit[1], Jose Gallegos[1], Ativ Zomet[1,3], Joseph DeGutis[4], Anthony Chen[2], Michael Merzenich[1,5], Thomas Van Vleet[1,2]; [1]Brain Plasticity Institute, [2]VA Medical Center, Martinez, [3]Tel-Aviv University, Israel, [4]VA Medical Center, Boston, [5]University of California, San Francisco — Patients with traumatic brain injury (TBI) often have difficulties regulating fundamental aspects of attention and may exhibit hypo or hyper states of alertness. Attention deficits may underlie or exacerbate higher order executive dysfunction. Recent studies indicate that computerized cognitive training, focused on attentional control and alertness, can ameliorate poor intrinsic regulation of alertness evident in patients with TBI or acquired brain injury. The current study examined effects of training in seven patients with a history of mild-to-moderate TBI. Patients engaged in several hours of Tonic and Phasic Alertness Training (TAPAT), a program previously shown to improve attention regulation in individuals with acquired brain injury. To evaluate potential consistencies in the training effect, individual's progress in training as well as performance on standard neuropsychological measures of attention, executive functions, and mood were evaluated pre and post training. On the computerized cognitive training program, patients demonstrated increased response inhibition, as well as decreased omission errors and overall variability in reaction time across sessions over time. Associated with improvements on TAPAT, improvements were also seen on neuropsychological outcome mesaures, including higher-order executive functions and overall emotion regulation. In particular, results suggested improvements in areas of attention, working memory, set-shifting, verbal fluency, and processing speed, as well as responses to emotinonal stressors. Patients' performances on TAPAT and neuropsychological outcome measures suggest that improvements in attention regulation facilitate improvements in higher-order executive functions. Results from the current study offer promising insight into the development of treatments for attentional deficits among patients with TBI.

D14

INCREASED VISUAL CORTICAL NOISE DECREASES CUED VISUAL ATTENTION DISTRIBUTION Zachery Greenberg[1], Navdeep Gill[1], Shai Porat[1], Jason Samaha[1], Tahim Kader[1], Bradley Voytek[1], Adam Gazzaley[1,2]; [1]Department of Neurology, Physiology and Psychiatry, University of California, San Francisco, [2]UCSF Center for Integrative Neuroscience, University of California, San Francisco — When driving we can focus on the car ahead or spread our attention broadly as we approach an intersection. Despite the commonality of this behavior we know relatively little about the limits of and neural mechanisms behind spatial attention distribution. Here we created a visual attention distribution task wherein participants are visually cued regarding the location of an ensuing target. A cue provides either 100%, 75%, 50%, or 0% information about the certainty of the location of the target that could appear in either the left or right hemifield. In the 100% conditions the target appeared directly to the left or right on the horizontal. For the 75% and 50% conditions the target appeared in the cued hemifield in a 90-degree or 180-degree arc around the horizontal, respectively. For the 0% condition the target appeared anywhere along a 360-degree circle spanning both hemifields. As uncertainty increased participant response times increased and accuracy decreased. We used lateralized transcranial direct current stimulation (tDCS) of the visual extrastriate to test the hypothesis that cued spatial attention emerges from focal top-down enhancement of visual cortical neurons encoding the region of space to be attended. Anodal tDCS to visual extrastriate parametrically increased response times for more focal conditions only when cued to the hemifield contralateral to the stimulation site. These results suggest that when faced with expected spatial uncertainty, top-down mechanisms prime visual cortical neurons representing the region of space to-be-attended and that stimulation of a broad cortical territory increases noise and decreases focal enhancement.

D15

BRAIN SYSTEMS MEDIATING TOP-DOWN AND BOTTOM-UP ATTENTIONAL CONTROL NETWORKS IN ACTION VIDEO GAME PLAYERS Julia Föcker[1,2], Daniel Cole[2], Daphne Bavelier[1,2]; [1]Department of Psychology and Educational Sciences, University of Geneva, [2]Brain and Cognitive Sciences, University of Rochester — Recent studies suggest enhanced

top-down attentional control in action video game players (VGPs). VGPs more efficiently suppress sources of distraction and better anticipate the pull of exogenous distractors. To characterize attentional control, a cross-modal cueing-paradigm was used concurrently with fMRI. On a trial-by-trial basis, a voice indicated the most likely location for a subsequent gabor-patch target. Participants had to decide on the orientation of the gabor-patch. Bottom-up attention was engaged on a small percentage of trials by presenting the target at unattended locations or with high-contrast distractors. A group of VGPs was compared to non-video-game-players (NVGPs). Overall, NVGPs and VGPs recruited typical attention-related areas. Interestingly, NVGPs revealed enhanced activation during cue processing and target preparation, whereas VGPs showed higher activation during target processing. NVGPs showed greater insula and anterior cingulate recruitment during the preparation period (Cue-SOA). By contrast, VGPs showed greater left temporal parietal junction (TPJ) recruitment during target processing as well as stronger activations of visual and reward-related areas (striatum). Furthermore, on rare no-go catch trials, VGPs showed less false alarms and enhanced recruitment of the middle frontal gyrus in contrast to NVGPs in which only visual areas showed stronger activation. VGPs are known to benefit from greater top-down attentional control. This work points to reduced activation of top-down networks during attention preparation but increased recruitment during target processing as a possible signature of greater attentional efficiency.

D16

THE NEURONAL MECHANISMS UNDERLYING BOTH INSTRUCTED AND SPONTANEOUS EMOTION REGULATION

Yanbo Hu[1], Ignazio Puzzo[1], Birthe Henne[1], Tom Johnstone[1]; [1]Centre for Integrative Neuroscience and Neurodynamics — This study aimed to measure the extent to which prefrontal brain regions involved in intentional, reappraisal-based emotion regulation overlap with those involved in spontaneous top-down regulation of emotion. 20 participants completed an instructed, reappraisal-based emotion regulation task and an N-back working memory task under threat of shock while undergoing BOLD imaging in a 3T MRI scanner. For the Instructed Regulation task, BOLD signal in response to aversive pictures was contrasted between a condition in which participants decreased their emotional responses using reappraisal and a control condition in which they maintained attention to the pictures. For the N-back task, BOLD signal was compared between the threat and no threat conditions as a measure of engagement of prefrontal cortex as participants spontaneously regulated threat-induced anxiety in order to perform the working memory task. Activation for intentional regulation but not for spontaneous regulation was seen in dorsal medial prefrontal cortex (DMPFC) and dorsal lateral prefrontal cortex (DLPFC). Activation was seen for spontaneous regulation but not for intentional regulation in rostral anterior cingulate cortex (rACC) extending to anterior medial prefrontal cortex. Two regions of activation common to both tasks were the left middle frontal gyrus (lMFG) and left ventral lateral prefrontal cortex (VLPFC). In summary, while medial prefrontal regions were differently involved in instructed and spontaneous top-down regulation of emotion, lateral prefrontal cortical regions seem to support processes common to both types of emotion regulation, a hypothesis that will be directly tested with FMRI-guided TMS.

D17

A FMRI STUDY OF BRAIN ACTIVATIONS IN VIEWING TAIWANESE AND CAUCASIAN EMOTIONAL FACES

Shih-Tseng T. Huang[1], Liwen Lee[1], Hsu-Huei Weng[2,3,4], Mei-Yu Yeh[2], Ho-Ling Liu[2,3], Sigmund Hsiao[1]; [1]National Chung-Cheng University, [2]Chang Gung Memorial Hospital at Chiayi, [3]Chang Gung University, [4]Chang Gung University of Science and Technology — The present study investigated the role of culture in mediating emotional processes through evaluation of the brain areas associated. Twenty Taiwanese participants (10 males and 10 females, age ranged from 19 to 29) with normal or corrected normal vision and reported no abnormal neurological history participated. Pictures of happy, angry, fearful, and neutral expressions of Taiwaneses and Caucasians and non-face pictures were presented in eight event-related functional runs, with 40 trials in each. The order of stimuli was randomized within and between functional runs. Participants were asked to view the pictures with attention while undergoing functional magnetic resonance imaging (fMRI) scanning. The contrast in blood-oxygen-level dependent (BOLD) signals when viewing Taiwanese and Caucasian pictures was calculated and analyzed with the SPM5 software to evaluate the brain activations. The results found higher responses in left post-central and inferior parietal cortex, right middle and superior temporal cortex, right middle frontal cortex, and left amygdala in viewing the Taiwanese faces than viewing the Caucasian faces, suggesting a cultural specificity effect. It was also found a culture and gender interaction with higher activations in the left post-central cortex, left middle occipital cortex, bilateral superior frontal cortex, right medial frontal cortex, and left fusiform. Results supported a cultural specificity hypothesis and suggested that higher activations were found not only in the primary areas related with emotions and faces but also in frontal, parietal, and occipital cortex when viewing emotional expressions of one's own culture than to faces from people of other cultural group.

D18

THE BRAIN ACTIVATIONS OF MEG IN PROCESSING EMOTION EXPRESSIONS AND IDENTITY OF FACES

Daisy L. Hung[1,2], Ovid J.-L. Tzeng[2,3], Shih-tseng T. Huang[4], Denise H. Wu[1,2], Pei-Shu Tsai[2], Ming-Chun Lee[4]; [1]National Central University, [2]National Yang-Ming University, [3]Academia Sinica, [4]National Chung-Cheng University — Facial identity and expressions were proposed to be processed in parallel pathways by the visual system and therefore with different brain activations. The present study attempted to test the hypothesis of independence by using MEG in measuring the brain activations in performing tasks of identity of person and emotional expression. The participants were 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. 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. There was also found a marginal significant interaction between task and the order of faces. The follow-up analysis found person identity task was significant higher than the activation of the emotion task in the processes of the first face, suggesting that the differentiation between the two tasks occurred early in processing of the first face. Furthermore, a marginal three-way interaction found when two faces in a trail were different, a higher activation in processing the second female faces. Results suggested task specificity and a possibility of gender effects in brain activations.

D19

NEURAL CORRELATES OF AROUSAL AND VALENCE-RELATED EFFECTS OF EMOTIONAL DISTRACTION ON WORKING MEMORY

Alexandru D. Iordan[1], Weiqi Zhao[1], Sanda Dolcos[1], Florin Dolcos[1]; [1]University of Illinois at Urbana-Champaign — Previous investigations have shown that the impact of task-irrelevant emotional distraction on working memory (WM) is linked to increased activity in regions of a ventral neural system, associated with "hot" emotion processing (HotEmo system), and concomitant decreased activity in regions of a dorsal system, associated with "cold" executive processing (ColdEx system). However, these previous investigations used high-arousing negative distracters and hence it is not known whether similar effects are also produced by positive distracters, or further dissociations linked to emotional arousal and valence exist. The present study investigated these issues using event-related fMRI in 18 young female participants, who performed a WM task with distraction that manipulated both the arousal (high vs. low) and valence (positive vs. negative) of emotional distracters. Overall, results identified brain regions showing overlapping effects of arousal and valence as well as regions showing specificity to arousal or to valence, linked to different levels of processing. Lower-level perceptual processing (fusiform gyrus) and basic HotEmo regions (amygdala) showed overlapping arousal and valence-driven effects. On the other hand, higher-level processing regions involved in emotion integration/regulation and executive control from both HotEmo and ColdEx systems showed either arousal-driven effects (ventrolateral and dorsolateral prefrontal cortex – PFC, respectively) or specificity to positive (anterior medial PFC) or negative valence (posterior medial PFC and anterior cingulate cortex). Collectively, these findings suggest that while "bottom-up"

responses to emotional distraction engage mechanisms jointly sensitive to arousal and valence, "top-down" responses are more specialized, with clearer dissociations between brain regions sensitive to arousal or valence.

D20

FACE-SPECIFIC N170 IS MODULATED BY EMOTION: EVIDENCE FROM ADULTS WITH CURRENT AND REMITTED DEPRESSION

Linda Isaac[1,2], Constance Vissers[3,4], Eni Becker[5], Anne Speckens[6]; [1]Stanford University, Department of Psychiatry and Behavioral Sciences, USA, [2]Palo Alto Veterans Affairs, USA, [3]Centre of Excellence for Neuropsychiatry, Vincent van Gogh Institute for Psychiatry, Venray, The Netherlands, [4]Donders Institute for Brain, Cognition and Behaviour, Centre for Cognition, Radboud University Nijmegen, The Netherlands, [5]Clinical Psychology and Behavioural Science Institute, Radboud University, The Netherlands, [6]Department of Psychiatry, Radboud University Nijmegen Medical Centre, The Netherlands — According to the two-stage model of face processing, the face-specific N170 event-related potential (ERP) maximal over occipital-temporal electrodes is linked to structural encoding of face stimuli, whereas later ERP components are thought to index processing of facial affect.We employed an event-related potential (ERP) methodology to examine neural activity associated with the pre-attentive and obligatory N170 response to emotional human faces in three groups: currently depressed (N = 10), remitted depressed (N = 16) and healthy controls (N= 17). Participants were instructed to view emotional faces. There were two main goals. First, to examine whether the N170 component is influenced by emotion even at this attention-independent stage of face processing. Second, to examine if currently depressed patients differed from both the remitted and never-depressed groups on early detection of negative emotional faces (angry faces) compared to both neutral and happy faces.We found a main effect of emotion (p = .01) for N170 to angry faces, only.A group x emotion interaction analysis did not reach significance(p = .22) suggesting that early vigilance for threatening faces is not linked to clinical status(current or remitted depression).Parallel encoding of faces sensitive to both structural and emotional content of faces appears to be characteristic of both clinical and healthy conditions.This finding suggests that N170 processes linked to structural analysis of faces do not necessarily precede analysis of emotional expression, and instead may reflect early top-down modulation from neural systems involved in rapid emotional processing, especially when confronted with threat in the environment such as angry faces.

D21

INDEPENDENT INFLUENCE OF VALENCE AND PREDICTABILITY ON TASK-DEPENDENT P3 MODULATION

Amishi Jha[1], Martin Paczynski[1], Shruti Baijal[1]; [1]University of Miami — Recent work by Shackman et al. (2011) demonstrated that threat can enhance perceptual processing, as indexed by the N1 ERP component and suppress the amplitude of the P3, an ERP component associated with decision making. Our study sought to determine whether this suppression generalizes to non-threatening aversive stimuli and the extent to which the suppression may be modulated by predictability of occurrence. One hundred and twenty soldiers viewed images which were either neutral or negative (war scenes). These images were followed by a simple, non-affective decision task. Each image was preceded by a cue which predicted affective valence of upcoming target with 75% validity. For the N1 Component, the amplitude of the N1 evoked by images was greater for negative compared to neutral targets. There was no main effect of cue validity nor did cue validity interact with image valence, suggesting that N1 modulations were driven by bottom-up processes. On the other hand, there significant main effects of both valence and cue validity on P3 amplitude. Both negative valence and unexpected affective content suppressed the P3. No significant interaction was found between valence and cue validity, implying that P3 suppression may be driven by two separable neural processes related to valence and expectancy. Our findings suggest that even non-threatening aversive stimuli may impair decision making and that this effect may be exacerbated when the aversive stimuli are unexpected. Indeed, our findings suggest that even stimuli devoid of strong emotional content may impair decision making when they are unexpected.

D22

ASYMMETRIES IN PREFRONTAL CONTROL OVER EMOTIONAL STIMULUS PROCESSING – EFFECTS OF TARGETED CORTICAL INHIBITION BY CONTINUOUS THETA BURST STIMULATION ON EVENT-RELATED POTENTIALS AND FIELDS

Kati Keuper[1,2], Christian Dobel[1,2], Torge Dellert[1], Annuschka Eden[1], Inga Laeger[3], Peter Zwanzger[3]; [1]Institute for Biomagnetism and Biosignalanalysis, University of Münster, [2]Otto Creutzfeldt Center for Cognitive and Behavioral Neuroscience, University of Münster, [3]Department for Psychiatry, University Hospital Münster — Basic research suggests that the dorsolatereal prefrontal cortext (DLPFC) contributes to emotional affect and emotional stimulus categorization. In order to investigate the causal influence of lateralized prefrontal structures on emotion-related neural networks and processes (Davidson, 1992), left vs. right DLPFC activity was selectively reduced by means of inhibitory continuous theta burst stimulation (cTBS, Huang et al., 2005). After the stimulation protocol, participants passively viewed low-arousing neutral and high-arousing positive and negative German nouns while EEG and MEG were recorded. We hypothesized the stimulation site to influence ERPs/ERFs and behavioral performance (valence rating, surprise free recall) in a valence-specific way. The data reveal the typical processing advantage for both positive and negative compared to neutral stimuli in ERPs/ERFs (200 and 600ms: Early Posterior Negativity (EPN/EPNm), Late Positive Complex (LPC/LPCm)) and in behavioral data. Importantly, ERPs (P1, EPN, LPC), ERFs (EPNm, LPCm) and behavioral data converge in the finding of a differential influence of the stimulation site on the processing of negative compared to positive words: In line with Davidson (1992), left frontal inhibition led to enhanced activity and better behavioral performance in response to negative stimuli whereas right frontal inhibition caused the reverse pattern. The MEG interaction effects were localized in the right occipital lobe (200-250ms) and the right temporoparietal junction (510-560ms). Based on these findings, we conclude that lateralized prefrontal structures control early stages of emotional stimulus processing by modulating neural networks related to perception and attention in a valence-specific manner.

D23

BRAIN ACTIVITIES ASSOCIATED WITH GAME IMAGES IN DIABLO III PLAYERS

Shin Ah Kim[1], Hyeon Min Ahn[1], Sang Hee Kim[1]; [1]Department of Brain and Cognitive Engineering, Korea University, Seoul, Korea — Excessive game players have shown increased neural activity while viewing game-related images in several brain regions including striatum, amygdala, orbitofrontal cortex and dorsolateral prefrontal regions. However, little is known as to whether neural activity to game-related images is modulated by individual differences in gaming experience. To address this issue, we conducted a functional neuroimaging study where 14 men (mean age 25.2, SD = 2.2) with differing degrees of experience in Diablo III viewed images taken from Diablo III inside an fMRI scanner. They also viewed control images taken from a fantasy drama (Drama) and from Korea University Affective Picture System (Neutral). Participants completed Young's Internet Addiction Test (IAT) outside the scanner. Brain images were analyzed in SPM 8. Statistical parametric maps of t values were created for (Game – Neutral) and (Game – Drama) contrasts and one-sample t test was conducted at the group level. Game images in contrast to neutral images activated brain regions including the left caudate, left hippocampus, right thalamus, right fusiform gyrus, left middle frontal gyrus (BA6), and superior frontal gyrus (BA8). Game images in contrast to Drama controls activated the left hippocampus, right parahippocampus, right thalamus, left superior gyrus (BA6), and middle frontal gyrus (BA9). Brain activity in the superior frontal gyrus for game images was negatively correlated with IAT scores. Our preliminary results suggest that game images elicit activations in a set of neural areas and the degrees of activation in part of the network are modulated by individual differences in online gaming experiences.

D24

SENSITIVITY TO REWARD AND PUNISHMENT MODULATE NEURAL PROCESSING OF REINFORCEMENT

Sang Hee Kim[1], Heung Sik Yoon[1], Hyeon Guk Kang[1], Hyeon Min Ahn[1], Hackjin Kim[1], Stephan Hamann[2]; [1]Korea University, [2]Emory University — Reinforcement learning is critical for our survival in the environment. A large volume of studies has identified dopaminergic brain structures such as the midbrain, striatum, amygdala, orbi-

tofrontal and medial prefrontal regions playing key roles in reinforcement learning. However little is known about how individual difference in reinforcement sensitivity is related to the neural processing of reinforcement. To address this question we recruited 17 healthy men and women to participate in a functional neuroimaging study. Inside the scanner, participants completed a monetary instrumental delay task where they viewed a series of pairs of fractals and were asked to choose one of them to win monetary reward or to avoid monetary loss. Participants also completed the Behavioral Inhibition/ Behavioral Activation Scales to indicate their sensitivity to reward and punishment. Brain imaging data were analyzed using SPM8. We found increased activation in the ventral striatum during anticipation of reward whereas the dorsal part was more dominantly involved in anticipation of loss avoidance. Both the dorsal and ventral striatum activated during reception of monetary feedback. Individuals with greater sensitivity to punishment showed reduced activation in the striatum and lateral prefrontal cortex while expecting avoidance of monetary loss. Whereas, individuals with greater sensitivity to reward showed increased activation in the right striatum while receiving monetary reward. These findings indicate that individual differences in reward or punishment sensitivity may play distinct roles in neural processing of reinforcement.

D25

THE EFFECT OF THE ETHNIC BACKGROUND ON THE NEURAL CORRELATES OF OBSERVING SOCIAL INTERACTIONS: A BRAIN IMAGING INVESTIGATION

Suhkyung Kim[1], Yuta Katsumi[2], Keen Sung[3], Florin Dolcos[1], Sanda Dolcos[1]; [1]University of Illinois at Urbana-Champaign, [2]Berea College, [3]University of Massachusetts — Social neuroscience studies identified a network of brain regions (social cognition network-SCN) involved in the evaluation of others' actions and intentions. However, little is known about the impact of the interaction partners' ethnicity on such evaluations, and the associated neural correlates. We investigated these issues using fMRI recording, while 15 Caucasian participants watched and rated movies displaying non-verbal guest-host interactions. The hosts displayed behaviors that either encouraged (Approach condition) or discouraged (Avoid condition) further social interactions. The ethnic background of the hosts was separated into 50% Caucasian (in-group) and 50% Non-Caucasian (out-group) trials. Analyses identified specific SCN regions showing common and dissociable responses to in-group and out-group hosts. The right amygdala (AMY), bilateral superior temporal sulcus and lateral prefrontal cortex were commonly engaged by in-group and out-group hosts, while the left AMY and inferior frontal gyrus (IFG) showed increased sensitivity to in-group hosts. Further investigation of these effects showed that activity in the AMY and IFG was driven by the response to Approach behaviors of in-group hosts. Interestingly, the same left AMY region showed an opposite pattern of response, with increased specificity to Avoidance behaviors displayed by the out-group hosts. A similar effect was also observed in the anterior cingulate cortex (ACC). These findings provide evidence that dissociable responses to Approach and Avoidance behaviors displayed by in-group and out-group interaction partners involve brain areas associated with basic emotion processing (AMY), emotion regulation (IFG), and conflict detection/resolution (ACC), and shed light on the role of ethnic background in evaluating non-verbal behaviors.

D26

MOTIVATIONAL CHARACTERISTICS OF YOUNG CHILDREN ARE ASSOCIATED WITH ERROR-RELATED BRAIN ACTIVITY

Matthew H Kim[1], Loren M Marulis[1], Jennie K Grammer[2], Melisa Carrasco[3], Frederick J Morrison[1], William J Gehring[1]; [1]University of Michigan, [2]Albert Einstein College of Medicine, [3]University of Rochester Medical Center — Recent research on cognitive control has focused on the neurological processes that occur when people make errors. The error-related negativity (ERN) is elicited when a subject makes an error on target discrimination tasks (Falkenstein et al., 1991). The error positivity (Pe) reflects an affective response to or conscious awareness of the error (Overbeek, Nieuwenhuis, & Ridderinkhof, 2005). While experimentally manipulating motivational contexts modulates the ERN, the association between motivation as a multidimensional individual-level characteristic and error-related brain activity (ERN and Pe) needs to be elucidated. The goal of the study was to explore this association in young children. Motivational characteristics of 36 children (12 females, M=5.4 years; N=23 for EEG data) were assessed through direct assessments and parent report. Children completed a Go/No-Go task during which EEG data were acquired. Most children were performance-oriented, exhibited high persistence, and had high competence and value beliefs. Parents rated their children low on avoidance motivation and moderate on approach motivation. A 3 (FCz/Cz/Pz) x 2 (Correct/Error) ANOVA yielded significant interactions for the ERN and Pe. Mastery orientation was associated with larger Pe, approach motivation was positively related to both the ERN and Pe, and the Pe was positively correlated with competence beliefs and negatively correlated with value beliefs. These results suggest that different aspects of motivation are related to different aspects of error-related brain activity. This is consistent with research suggesting that the motivational processes of young children are domain specific, and that the ERN and Pe represent different aspects/stages of error processing.

D27

DRD2 GENE ASSOCIATED WITH FASTER PROCESSING OF NEGATIVE SELF-REFERENTIAL INFORMATION

Alex Kline[1], Seth Disner[1], John E. McGeary[2], W. Todd Maddox[1], Christopher G. Beevers[1]; [1]University of Texas at Austin, [2]Providence VA Medical Center — The dopamine receptor D2 gene (DRD2) is a common target in gene-by-environment research due to its effects on dopaminergic activity in the brain. The A2 allele has been linked to vulnerability for disorders such as substance abuse, PTSD, and depression (Noble, 2000; Bhaskar, Thangaraj, Non, Singh, & Rao, 2010; Voisey, et al. 2008; Elovainio, et al., 2007). Depression in particular has been linked to maladaptive cognitive patterns such as faster processing of negative self-referential information, which is associated with activation of negative self-referential schemas (Alloy, Abramson, Murray, Whitehouse, & Hogan, 1997). The current study investigates the relationship between the A2 allele of the DRD2 gene and self-referential information processing. Seventy healthy participants provided saliva samples for genetic assay, and completed the Self-Referent Encoding Task (SRET; Derry & Kuiper, 1981). The SRET measures participants' reaction time as they make self-reference judgments about positive and negative adjectives. Although data collection is ongoing, mixed effect regression models identified a significant three way interaction between DRD2 genotype, self-reference, and emotional valence, $X2(2) = 6.91$, $p = 0.03$. Specifically, carriers of the A2 allele were significantly faster when identifying negative, self-referential adjectives compared to positive or non self-referential adjectives, even when controlling for current depression symptoms. These findings link the DRD2 gene with faster response time towards negative self-referential stimuli, which likely reflects facilitated activation of negative self-referential schemas. These vulnerability factors likely increase sensitivity to negative elements in the environment, increasing the risk of depression and anxiety.

D28

EXPECTATION OF PLACEBO ANALGESIA ENHANCES ELECTROPHYSIOLOGICAL MARKERS OF ERROR PROCESSING

Leonie Koban[1,2], Marcel Brass[3], Margaret Lynn[3], Gilles Pourtois[3]; [1]University of Geneva, [2]University of Colorado Boulder, [3]Ghent University — Placebo analgesia (PA) is usually accompanied by decreased activity in pain-related brain regions, but also by greater prefrontal cortex (PFC) activation. Previous studies have proposed that the PFC could play an important role in PA by implementing increases in top-down control and regulation of pain. Here we test whether PA is associated with altered prefrontal monitoring and control functions that could be necessary in order to adjust to a mismatch between expected and experienced pain. Using a within-subject cross-over design, we recorded event-related potentials (ERPs) for error commission in a speeded go/nogo task during placebo vs. a matched control condition. Error commission was associated with two well-described components, the error-related negativity (ERN) and the error positivity (Pe). Results show that only the Pe, but not the ERN, was selectivity amplified during PA compared to the control condition, with neural sources in the lateral and medial PFC. This Pe effect was driven by participants showing a placebo-induced change in pain tolerance, but was absent in the group of non-responders. Our results shed new light on the possible functional mechanisms underlying PA, suggesting a placebo-induced transient change in prefrontal error monitoring functions. More specifically, an altered processing of errors could be necessary to implement top-down changes in pain sensitivity in order to regulate a mismatch between expected pain and nociceptive input.

D29

ALTERATIONS IN EMOTION AND EXECUTIVE PROCESSING IN ADOLESCENTS WITH MENTAL HEALTH DISORDERS: AN FMRI INVESTIGATION. Marisa Kostiuk[1], Andrea T. Shafer[2], K. Jessica Van Vliet[3], Sunita Vohra[4], Lihong Wang[5], Florin Dolcos[2,6], Anthony Singhal[1,2]; [1]Department of Psychology, University of Alberta, [2]Centre for Neuroscience, University of Alberta, [3]Department of Educational Psychology, University of Alberta, [4]Department of Pediatrics, University of Alberta, [5]Department of Psychiatry, Duke University, [6]Department of Psychology, Neuroscience Program, and Beckman Institute, University of Illinois at Urbana-Champaign — Emotion processing (EP) and attentional control (AC) are sub-served by two separate, but integrated neural networks. EP is associated with more ventral structures (e.g. amygdala) and AC with more dorsal structures (e.g. dorsolateral prefrontal cortex, dlPFC; lateral parietal cortex, LPC). Notably, AC is active in both goal-relevant processing and inhibition of emotional distraction. For example, research examining emotion-attention interactions in adolescents suggests reduced emotional distraction inhibition due to late development of the AC network, and findings from adults with affective disorders suggest a heightened emotional response due to AC dysfunction. EP and AC have been investigated separately in healthy adolescents and clinical adults, but their interaction in adolescents with affective disorders is unclear. This was investigated with clinical adolescents (CAs) and controls using an emotional oddball task with infrequent task-irrelevant distracters (negative, neutral images) and task-relevant targets presented amongst frequent phase-scrambled images, while fMRI data were recorded. Results show altered EP in CAs with faster responses to distracters and greater and more generalized neural response when processing distracters. Controls exhibited response specificity to fear distracters in behavior and in EP regions including amygdala. Results also show AC dysfunction with decreased accuracy and activation in LPC to targets in CAs. Furthermore, behavioral differences to targets were modulated by the preceding distracter in CAs only: responses to targets-after-fear were faster than to targets-after-neutral, and dlPFC showed greater deactivation during fear processing. Findings extend the role of AC dysfunction to clinical adolescents, while showing elevated generalized response to pictures and attenuated emotional response.

D30

EVENT-RELATED POTENTIAL INVESTIGATION ON CONSCIOUS AND NON-CONSCIOUS EMOTION I-Chen Chou[1], Tsung-Han Yang[1], Po-Yu Wu[1], Bo-An Chuang[1], Wei-Ting Hsieh[1], Nai-Shing Yen[1,2,3]; [1]Department of Psychology, National Chengchi University, Taipei, Taiwan, [2]Research Center for Mind, Brain, and Learning, National Chengchi University, [3]Taiwan Mind & Brain Imaging Center, TMBIC — The current study directly compared emotion regulation effects between conscious and non-conscious awareness and its temporal dynamics to fill the gap of the current literature that focused mostly on conscious and deliberate control strategies such as cognitive reappraisal and suppression. Fifty six participants were randomly assigned to (1) conscious reappraisal, (2) conscious suppression, (3) non-conscious reappraisal, and (4) non-conscious suppression groups. In the first part of the study, we asked participants to passively viewing positive, neutral, and negative pictures. After a short break, we either asked participants to regulate their emotions (conscious group) or primed the regulated goals to them (non-conscious group) while viewing different set of emotional pictures. We investigated the role of consciousness on two emotion regulation strategies by comparing late positive potentials (LPP) and their subjective ratings on valence between first and second part of the studies across four groups. Our main findings included (1) Participants regulated positive emotions (300-1300 ms) better than neutral and negative ones (ps□.042).(2) Among two conscious groups, the regulation effect was stronger using reappraisal than suppression strategy between 1300-2300ms (ps□.064).(3) Participants in non-conscious regulation group had better outcome than conscious regulation group between 3700-4000 ms (ps□.005) disregard of strategies. Our results lined up with previous findings (Bargh et al., 2001; 2009; Mauss et al., 2007) and showed practicability and advantages of non-conscious emotion regulations.

D31

VICARIOUS EXTINCTION BLOCKS THE RETURN OF LEARNED FEAR Armita Golkar[1], Ida Selbing[1], Oskar Flygare[1], Andreas Olsson[1]; [1]Karolinska Institutet — Information about what is dangerous and safe in our environment is often transferred from other individuals through social forms of learning, such as observation. Past research has focused on the observational, or vicarious, acquisition of fears, but little is known about how learned fears can be attenuated vicariously. To address this, we studied the effects of vicarious extinction learning on the recovery of conditioned fear as measured by skin conductance responses. After a standard conditioning procedure, both a Direct extinction and a Vicarious extinction group watched a movie involving unreinforced presentations of the conditioned stimuli (CS). For the Vicarious extinction group, a learning model was depicted in the video as also watching the CS presentations. We showed that, as compared to direct extinction, vicarious extinction promoted better extinction and blocked the recovery of fear during a subsequent reinstatement test. We then confirmed that these effects could not be attributable to the presence of the learning model per se by comparing the Vicarious extinction group to a separate group of subjects; the Vicarious reinforcement group, which differed from the Vicarious extinction group only in that the learning model received shocks coupled to the presentations of the previously reinforced CS. Critically, vicarious extinction resulted in less reinstatement as compared to the Vicarious reinforcement group. Taken together, our results demonstrated that vicarious extinction efficiently blocked the expression of previously learned fear responses. These findings have implications for research on emotional learning, social affective processes, and clinical practice.

D32

INSULA AND POSTERIOR CINGULATE CORTEX RESPOND TO NEGATIVE AFFECT AFTER REWARD OMISSION Steven R. Green[1], Sharlene D. Newman[1], Joshua W. Brown[1]; [1]Indiana University — Recent imaging studies have implicated the dorsal anterior cingulate cortex and insula in processing negative affect after task performance failure. Based on these results, a possible role for the dACC and insula may be in processing negative affect. However, these studies have focused on the negative affect following task failure and have not evaluated their involvement in negative affect after reward omission. Reward omission is of interest for negative affect, as frustration theory has hypothesized that the omission of an expected reward can evoke the emotion of frustration. The current study developed an aversive task manipulating negative affect through the effort required to finish a trial and also the probability of omission while collecting self-reports of frustration after each trial. After performing a whole brain cluster-corrected analysis contrasting trials in which a reward was omitted relative to trials where reward was received, we found left insula and posterior cingulate cortex (PCC) activation. Furthermore, subjects reported greater levels of frustration after reward omission relative to reward. These results indicate that reward omission is frustrating and that the insula and the PCC activation may in part be mediating this negative affective response. Our conclusion is consistent with previous studies establishing a relationship between PCC and insula with negative affect. The results expand upon previous work by showing that reward omission is associated with frustration. Future analyses will focus on establishing a tighter association between PCC and insula with reports of frustration to confirm these roles in affective processing after a negative outcome.

D33

MODULATION OF ANTICIPATORY THREAT ACTIVITY BY TEMPORAL PREDICTABILITY IN COMBAT-EXPOSED VETERANS WITH AND WITHOUT PTSD Dan W Grupe[1], Emma Seppala[1], Richard J Davidson[1], Jack B Nitschke[1]; [1]University of Wisconsin-Madison — Research on the neurobiology of posttraumatic stress disorder (PTSD) emphasizes alterations to the medial prefrontal cortex, extended amygdala, and hippocampus. Although much attention has been paid to altered fear learning and extinction in PTSD, here we investigated involvement of this circuitry in an instructed threat anticipation task in combat-exposed Operation Iraqi Freedom/Operation Enduring Freedom veterans. During fMRI scanning, 7 veterans with PTSD and 8 veterans without PTSD viewed colored squares indicating either threat of shock or safety from shock. These squares were followed by

a variable-length anticipation period that terminated with a tone occurring either predictably or unpredictably. On 30% of the threat trials, aversive electric shock was delivered concurrently with the tone. Analyses focused on the modulation of anticipatory activity by the factors of threat condition and temporal predictability. Threat of shock resulted in robust anticipatory activity in the anterior mid-cingulate cortex (aMCC) and bilateral extended amygdala. In contrast, this condition resulted in deactivation in the ventromedial prefrontal cortex (vmPFC), basal amygdala, and anterior hippocampus. The temporal profile of aMCC activity showed qualitative differences for predictable and unpredictable threat trials, with the former showing increasing activity at the expected time of shock and the latter showing sustained activity throughout the anticipatory period. In the vmPFC and amygdala/hippocampus, greater deactivation was observed for unpredictable relative to predictable threat trials. While similar patterns of activity were observed across groups, further analysis with additional subjects is needed to better understand the integrity of this circuitry in combat-exposed veterans with and without PTSD.

D34

MINDFULNESS-BASED TRAINING ALTERS BRAIN ACTIVATION DURING AN EMOTION FACE PROCESSING TASK IN INFANTRY MARINES.

Lori Haase[1], Akanksha Shukla[1], Douglas C. Johnson[1,2], Nate J. Thom[2], Elizabeth A. Stanley[3], Alan N. Simmons[1,4], Martin P. Paulus[1,4]; [1]University of California, San Diego, [2]Warfighter Performance Department, Navel Health Research Center, San Diego, CA, [3]Mind Fitness Training Institute, Alexandria, VA, [4]VA San Diego Healthcare System — The neural basis of mindfulness training (MT) is poorly understood but both cognitive control and interoceptive neural systems have been implicated. Thus, not surprisingly, recruitment of anterior cingulate cortex (ACC) and insula has been consistently documented in tasks involving mindfulness meditation. Understanding the neural mechanisms underlying MT is a first step to develop more targeted interventions or to assess the degree to which MT alters cognitive and affective processing in individuals. This study aimed to investigate whether MT modulates the brains response to an emotion face matching task. Infantry Marines scheduled to undergo pre-deployment training and deployment, were examined in this experiment, and were divided into two groups: individuals who received a 20-hour Mindfulness-Based Mind Fitness Training (MMFT) and individuals who received training as usual (control). All subjects completed an emotion face matching task during functional magnetic resonance imaging at: 1) baseline, 2) post-MMFT training, and 3) post-deployment. MMFT group, relative to the control group, demonstrated significantly less activation in the amygdala, anterior cingulate cortex (ACC), and fusiform gyrus. Approximately 1-year following MMFT intervention, significant group differences in brain activation emerged, such that the MMFT group had attenuated brain activation in the anterior insula, ACC, and caudate, relative to the control group. The present findings indicate that MMFT intervention modulates the brains response during an emotion recognition task in regions involved in interoception, attention and emotion processing. There is also evidence to suggest differential time-course effects of MMFT modulation on brain activation during emotion processing.

D35

ENHANCING CULTURALLY CONGRUENT SELF-CONSTRUALS DECREASES EMPATHIC NEURAL RESPONSES

Shihui Han[1], Chao Jiang[1], Michael Varnum[1], Youyang Hou[1]; [1]Peking University — Behavioral research suggests differences in both self-construal and empathy for others between Westerners and East Asians. However, it remains unclear whether there is a causal relationship between self-construal and empathy. The present study examined whether and how making culturally congruent vs. incongruent self-construals salient affects empathic neural responses. We recorded event related brain potentials to perceived pain after Chinese and Westerners had been primed with independent or interdependent self-construals. Perception of painful vs. non-painful stimuli applied to hands of unknown others elicited a positive shift over the fronto-central area at 232-332 ms post-stimulus in a control condition. Such neural responses to perceived pain were decreased by interdependent self-construal priming among Chinese and by independent self-construal priming among Westerners. Our findings suggest that reinforcing culturally predominant self-construal decreases the sensitivity to perceived pain in unknown others possibly by highlighting the boundary between the culturally defined "self" and others.

D36

FUNCTIONAL ROLE OF AMYGDALA: A HIGH-RESOLUTION FUNCTIONAL MAGNETIC RESONANCE STUDY OF EMOTIONAL PROCESSING.

Stanislau Hrybouski[1], Andrea T. Shafer[1], Tyler Rolheiser[1], Christopher R. Madan[1], Corey A. Baron[1], Peter Seres[1], Fraser Olsen[1], Nikolai Malykhin[1]; [1]University of Alberta — The neuroanatomical substrate of emotional processing has been studied using functional magnetic resonance imaging (fMRI) for a number of years. While much of this research has focused on the amygdala, most studies have not had the spatial resolution required to isolate the amygdala proper from the surrounding structures in the medial temporal lobe. In addition, partial volume effects from the adjacent vasculature and white matter have also prevented accurate localization of the BOLD response within the amygdala itself. In the present study we developed a high-resolution fMRI scanning and analysis protocol aimed at elucidating the functional significance of the amygdala in emotional processing. Healthy volunteers rated images of varying levels of emotional arousal (high, medium, low, and neutral) in an event-related fMRI task. T2*-weighted EPI volumes were acquired on a Varian Inova 4.7T scanner (30 axial slices, TE = 19ms, TR = 2000ms, 74 volumes, resolution = 1.5mm × 1.5mm × 1.5mm). An ultra-high resolution structural T2-weighted 2D Fast Spin Echo (FSE) scan (90 coronal slices, TE = 39ms, TR = 11000ms, resolution = 0.52mm × 0.68mm × 1.0mm) was also acquired for high-precision manual anatomical tracing of the amygdala using a reliable volumetric protocol developed by our group. Results show that BOLD signal change co-varied with the emotional arousal level of the image in bilateral amygdala, with some individual variability based on the subjective ratings of emotional arousal. In conclusion, we report bilateral amygdalar modulation based on the emotional demands of a task using high-field imaging techniques.

D37

DIFFERENTIAL REWARD SYSTEM PROCESSING OF VIOLENT AND NON-VIOLENT SUCCESS IN A VIDEO GAME

Martin Klasen[1,2], Krystyna A. Mathiak[1,2], Mikhail Zvyagintsev[1,2], Michael Schwenzer[1,2], Pegah Sarkheil[1,2], René Weber[3], Klaus Mathiak[1,2]; [1]RWTH Aachen University, Aachen, Germany, [2]JARA Translational Brain Medicine, Aachen/Jülich, Germany, [3]University of California, Santa Barbara, CA, USA — Violent video games are popular and perceived as highly rewarding. Gaming has been shown to activate striatal reward system areas (Klasen et al., 2011), and recent research addressed the role of game success and failure on reward system responses (Mathiak et al., 2011). However, no study so far has separated effects of virtual violence from those of game success in general. In an fMRI study, eighteen healthy male subjects were measured during free playing of a violent video game where the player drives a vehicle and has the task of killing as many pedestrians as possible. As a comparison, we introduced a non-violent modification without pedestrians where the task of the player was to collect colorful icons. The game content was recorded and employed for fMRI data analysis according to different types of game events. Violent success activated bilateral putamen. Event-related time course analyses revealed an initial excitation phase for anticipated violent success, followed by a subsequent deactivation if the player failed. Nonviolent success events were characterized by bilateral nucleus accumbens activation. These results show for the first time a differential effect of violent and non-violent success on dorsal and ventral parts of the reward system. Activity in the nucleus accumbens is likely to reflect reward anticipation (Knutson et al., 2001), whereas the putamen pattern suggests reward-based learning (Haruno & Kawato, 2005). Our findings indicate that violent success in a game is not per se more rewarding than non-violent success, but may foster learning processes specifically associated with game violence.

D38

INDIVIDUAL DIFFERENCES IN THE USE OF SHAPE INFORMATION FOR FACE RECOGNITION

Juergen M. Kaufmann[1], Claudia Schulz[1,2], Stefan R. Schweinberger[1]; [1]Friedrich Schiller University of Jena, Germany, [2]University Hospital of Münster, Germany — Previous findings demonstrated that increasing facial distinctiveness by means of spatial caricaturing improves

face learning, and results in modulations of event-related-potential (ERP) components associated with the processing of typical shape information (P200) and with face learning and recognition (N250). The current study investigated individual differences in the effects of spatial caricaturing. A modified version of the Bielefelder Famous Faces Test (BFFT) was applied to subdivide a non-clinical group of 28 participants into good and poor face recognizers. Overall, a learning benefit was seen for caricatured compared to veridical faces. In addition, for learned faces we found larger caricaturing effects in response times, inverse efficiency scores and P200 and N250 amplitudes in poor face recognizers, indicating that these individuals profited disproportionately from exaggerated idiosyncratic face shape. During learning and for novel faces at test, good and poor recognizers showed similar caricaturing effects. We suggest that spatial caricaturing helps good and poor face recognizers accessing critical idiosyncratic shape information that supports identity processing and learning of unfamiliar faces. For familiarized faces, good face recognizers might depend less on exaggerated shape and make better use of texture information than poor recognizers. These results may be relevant for developing training-programmes for people with difficulties in face recognition.

D39

SITUATIONAL DISCOUNTING OF POSITIVE OUTGROUP BEHAVIORS

Jennifer Kubota[1], Tobias Brosch[2], Rachel Mojdehbakhsh[1], James Uleman[1], Elizabeth Phelps[1]; [1]New York University, [2]University of Geneva — Individuals have a propensity to ignore contextual (situational) information when explaining others' behavior; instead individuals default to personality (dispositional) explanations. This is known as the fundamental attribution error (FAE). It has been suggested that incorporating situational information into causal attributions requires an additional controlled correctional step. Consistent with this, recent neuroimaging results find that incorporating situational information into attributions is associated with increases in activity in DLPFC, a region known to play a role in cognitive control. In the current study, we extended these findings to intergroup attributions. The Ultimate Attribution Error (UAE) represents a systematic ethnocentric bias whereby positive outgroup and negative ingroup behaviors are attributed to situational causes, whereas positive ingroup and negative outgroup behaviors are attributed to dispositional causes. To assess this, participants provided attribution ratings for Black and White targets during fMRI. For each target, participants read a positive or a negative behavior, as well as qualifying situational information. Overall, we found mixed support for the UAE. For positive behaviors and consistent with the UAE, individuals made more situational attributions for outgroups than ingroups. However, for negative behaviors, dispositional attributions were similar for ingroups and outgroups. Our findings suggest that biased intergroup attributions were more common in positive than negative scenarios. For positive behaviors, when outgroup members behave in stereotype inconsistent ways, situational information is incorporated into judgments, and this most likely occurs through an additional controlled correctional step in the attribution process.

D40

PAST BEHAVIOR AFFECTS FUTURE INVESTMENT DECISIONS AND MODULATES ACTIVITY IN PERSON PERCEPTION AND DECISION-MAKING BRAIN REGIONS

Victoria K. Lee[1], Elizabeth H. Thompson[1], Rachel E. Kranton[1], Lasana T. Harris[1]; [1]Duke University — Social psychology demonstrates people infer traits about others from "thin slices" of behavior—brief single acts—as well as from faces and photographs (Ambady, 2010). These inferences activate a reliable person perception brain network and allow for generalizations about the person that may help guide behavior in future interactions (Brown & Brüne, 2012). Behavioral economics demonstrates brief descriptions of past behavior affect social decision-making and modulates brain activity in networks associated with decision-making processes including valuation and prediction error (Rilling & Sanfey, 2011). However, no study has examined the complete process of making inferences from behavior leading to generalization, then social decision-making across different domains. Here, we investigate the mechanisms underlying these generalizations for predicting behavior in person perception domains warmth and competence, and examine effects on future behavior in both domains. A database of participants completed a competence (time-estimation game) and a warmth task (charity donations). A separate group of participants then viewed accuracy and generosity information for database participants in the fMRI scanner before predicting and investing in the person's performance on an unrelated competence (guessing rocks in a jar) or warmth task (trust game). This allows us to test whether behavior in one game affects decision-making in a separate economic game, and whether this is mediated by the inferences made from the initial behavior. We show that inferences of trait warmth and competence are formed from prior behavior and affect investment decisions in both contexts, modulating activity in brain regions implicated in both decision-making and person perception.

D41

READING WHAT THE MIND THINKS FROM HOW THE EYE SEES

Daniel H. Lee[1], Reza Mirza[1], John G. Flanagan[1], Adam K. Anderson[1]; [1]University of Toronto — The eyes can convey a variety of complex social and emotional information. However, it remains unknown which specific features of the eyes convey such complex states, and how that came to be. Here we posit that this ability originates from simple optical principles related to how facial expressive eye-widening versus narrowing gathers and focuses light, optimizing visual sensitivity versus discrimination. We first grounded our investigation in basic expressions of fear, disgust, and neutral. Using standard tests of visual sensitivity and acuity, we show that fear eye-widening enhanced light gathering for greater sensitivity relative to neutral and disgust, while disgust eye-narrowing more sharply focused light to enhance discrimination relative to neutral and fear, in direct trade-off with one another as optics predict. Next, using multivariate analyses relating perceived mental states based on structural eye features, we show that these opposing optical effects also communicate opposing mental states denoting sensitivity versus discrimination (e.g., awe versus suspicion). These results show that emotional expressions are specifically shaped to serve opposing visual functions and that one organizing principle of the eyes' external reflection of internal mental states, and the human capacity to read them, arises from how the eye sees.

D42

THE IMPACT OF FAMILIARITY AND CHILDHOOD EXPOSURE ON THE NEURAL SUBSTRATES OF RACE PERCEPTION

Tianyi Li[1], Joshua Correll[2], Jasmin Cloutier[1]; [1]University of Chicago, [2]University of Colorado Boulder — The current study investigated the impact of familiarity on the perception of Black and White faces. Forty-seven Caucasian American participants took part in the study. Following familiarity training (requiring the individuation of Black and White male faces), participants took part in an event-related fMRI session during which they were presented with familiar and novel Black and White faces. Measures of childhood exposure to out-group members and of prejudice towards Black individuals were collected at the end of the study. Analyses focused on brain regions of interest believed to support person evaluation (amygdala and ventral medial prefrontal cortex). The results reveal an interaction between familiarity and race in the left amygdala, such that familiarity reduced left amygdala activity to greater extent for Black compared to White faces. Increased childhood exposure to Black individuals, when accounting for level of prejudice, was associated with greater differences in left amygdala activity when perceiving novel and familiar Black faces. Furthermore, greater childhood exposure, once again accounting for level of prejudice, was found to predict reduced differences in ventral medial prefrontal cortex (VMPFC) activity during the perception of familiar Black and familiar White faces. The implications of these results are discussed in the context of the factors believed to shape evaluative processes in person perception.

D43

IN RACE ERASED? KNOWLEDGE OF POLITICAL IDEOLOGY REDUCES INFLUENCE OF RACE ON NEURAL UNDERPINNINGS OF IMITATION

Elizabeth Reynolds Losin[1,2], Marco Iacoboni[1], Mirella Dapretto[1]; [1]University of California, Los Angeles, [2]University of Colorado, Boulder — People preferentially imitate those who are self-similar or high in social status, biases thought to increase the efficiency of cultural learning. Although race can suggest self-similarity and social status and it is also known to influence whom people imitate, other social categories are often better indicators of these characteristics. We previously found that race modulates the neural circuitry underlying imitation. Here we tested

whether these race effects would be diminished when a social category more diagnostic of belief similarity and orthogonal to race, political affiliation, was also present. Two matched groups of European American young adults performed identical fMRI tasks in which they imitated models from three racial groups performing meaningless hand gestures. Critically, one group of participants learned fictitious information about models' political affiliations prior to scanning and the other did not. When participants had knowledge of models' political affiliations, their ratings of models' self-similarity were based primarily on those affiliations, while the effects of the model's race were diminished. While the model's race always modulated neural activity in visual regions, race only significantly modulated activity within fronto-parietal regions associated with imitation when models' political affiliations were unknown. Furthermore, this fronto-parietal modulaton by the model's race was significantly greater than when models' affiliations were known, while no between-group differences were seen in visual regions. These data suggest that while race effects in visual areas are likely due to the model's physical appearance, race effects in imitation-related regions more likely reflects flexible processes of group identification important for cultural learning.

D44

DIAGNOSTIC VALUE UNDERLIES ASYMMETRIC UPDATING OF IMPRESSIONS IN THE MORALITY AND ABILITY DOMAINS

Peter Mende-Siedlecki[1], Sean Baron[1], Alex Todorov[1]; [1]Princeton University — While positive behavioral information is diagnostic when evaluating a person's abilities, negative information is diagnostic when evaluating morality. While this may suggest that different rules govern impression formation in the two domains, one parsimonious principle can potentially account for this asymmetry—the statistical value of a specific behavior. As highly competent and immoral actions occur less frequently in real life than their counterparts, they provide more diagnostic information for impression formation. We compared the neural dynamics of updating impressions based on ability and morality information, and tested whether the same principle guides impression updating on a neural level. If so, the diagnosticity of behavioral information, rather than its content (morality vs. ability) or valence, should drive neural responses associated with impression updating. While undergoing functional magnetic resonance imaging (fMRI), 23 participants encountered individuals varying on either the ability or morality domain, across five behaviors. These individuals behaved consistently during the first three trials (F3), but their behaviors switched valence during the last two trials (L2). A test of the diagnositicity hypothesis showed that activity in bilateral vlPFC, left IFG, and left anterior STS, increased during L2 trials only when information was diagnostically valuable: immoral and competent behaviors in the morality and ability domains, respectively. Additional analyses observed no content- or valence-specific increases in updating. Taken together, our results suggest that the same statistical principle underlies impression updating in both the ability and the morality domains—the informational value of behavior.

D45

DNA METHYLATION OF THE OXYTOCIN RECEPTOR GENE IS ASSOCIATED WITH CORTICAL AND SUBCORTICAL CONTRIBUTIONS TO EMOTIONAL FACE PERCEPTION

James Morris[1], Allison Jack[2], Jessica Connelly[1]; [1]University of Virginia, [2]Yale University — Social perception facilitates affiliative behavior, protects against social isolation and as a result, helps mitigate the impact of stressful life events. Oxytocin is a nonapeptide hormone with known anxiolytic effects that acts as a neurotransmitter in the mammalian brain. We are investigating how epigenetic variability of the oxytocin receptor (OXTR) may impact neural systems supporting social perception. DNA methylation is an epigenetic modification that can result in changes in gene function through changes in gene expression. Prior work from our group has established that DNA methylation of OXTR is associated with autism spectrum disorder and variability within neurotypical volunteers predicts neural response to socially meaningful stimuli. Here we test the hypothesis that OXTR methylation may influence the degree of 'fear-related' neural activity during emotional face expression. Forty-one neurologically normal volunteers submitted blood samples and were scanned while performing a common emotional face-matching task. DNA from peripheral blood mononuclear cells was isolated from each subject and assayed for percent DNA methylation at sites within OXTR that control gene expression in the brain. Higher degrees of methylation predicted greater response in cortical regions including posterior superior temporal sulcus, middle temporal gyrus and angular gyrus as well as subcortical regions including brain stem, thalamus and putamen. An ROI approach demonstrated a significant relationship between OXTR methylation and amygdala reactivity, whereby higher degrees of methylation were associated with greater reactivity to emotional facial expressions. Future work will continue to consider how molecular mechanisms shape social perception and impact our ability to regulate stress.

D46

NEURAL CORRELATES OF THE OTHER-RACE EFFECT IN ADULTHOOD: EFFECTS OF EXPOSURE

Margaret Moulson[1], Abdel Elshiekh[1], Nicole Sugden[1]; [1]Ryerson University — Adults are poorer at discriminating and remembering faces of other races compared to faces of their own race (Meissner & Brigham, 2001). This "other-race effect" (ORE) appears during the first year of life (Kelly et al., 2007; 2009), but there is some evidence that the ORE can be modified by experience received in childhood or adulthood (e.g., Sangrigoli et al., 2005; Hancock & Rhodes, 2008). However, the full extent of plasticity in the face processing system in adults is unknown. In the current study we are investigating the neural correlates of the ORE in Caucasian adults, and Chinese adults who have varying exposure to other-race faces because they have spent differing amounts of time in Canada. Participants view upright and inverted Caucasian and Chinese faces and perform an orientation judgment while their brain activity is recorded using high-density event-related potentials (ERPs). To date, we have analyzed data from 25 Caucasian participants. We found that the face-sensitive N170 component was larger in amplitude and longer in latency for inverted than upright faces. This inversion effect, a hallmark of face expertise, was found for both Caucasian and Chinese faces. However, the inversion effect was smaller for Chinese than Caucasian faces, indicating that Caucasians have less expertise with Chinese faces. We are currently testing Chinese adults to determine whether the size of their neural ORE differs depending on how long they have spent in Canada. These findings will have important implications for understanding the plasticity of the face processing system beyond infancy.

D47

ADAPTIVE CHANGE IN THE NEURAL DYNAMICS OF OLDER ADULTS IS RELATED TO PHYSICAL EXERCISE

Jennifer Heisz[1,2], Anthony R. McIntosh[1,2]; [1]Rotman Research Institute, Baycrest, [2]University of Toronto — The human brain undergoes marked structural changes with age. These changes compromise brain processes and can have detrimental effects on cognitive function. While the brain can functionally reorganize to compensate for some of this structural loss, there are interesting individual differences in cognitive outcome. The present study examined age-related changes in neural network dynamics as revealed by electroencephalogram while participants performed a working memory task. We observe an age-related shift in brain signal variability such that older adults displayed less distributed variability and more local variability than younger adults. Individual differences in task performance and lifestyle suggest that this age-related shift in variability is adaptive. High performing older adults had more local variability and less distributed variability than lower performing older adults. Moreover, a healthy lifestyle (with increased exercise behaviour) was related to more local variability and better task performance. In other words, physical exercise seems to facilitate the age-related shift in neural network dynamics, enhancing local variability for better cognitive function. In the face of structural changes, the neural flexibility that is promoted by a physically active lifestyle may help older adults maintain cognitive health longer into their lifespan.

D48

FUNCTIONAL MEASURES OF PREFRONTAL REGULATION IN ADOLESCENTS EXPERIENCING EARLY DEPRIVATION

Ruskin H. Hunt[1], Raquel A. Gabbitas-Cowell[1], Megan R. Gunnar[1], Kathleen M. Thomas[1]; [1]University of Minnesota — Background: Children reared in orphanages experience deprivation as a result of inadequate physical care, and/or lack of cognitive and socio-emotional stimulation. Some domains improve following adoption; however, cognitive and emotional problems often persist. Neuroimaging studies suggest altered structure and function of the amyg-

dala. Few studies have addressed development of prefrontal regulatory systems. The current study examined behavioral and neuroimaging measures of prefrontal function in post-institutionalized (PI) youth, emphasizing the effects of duration of deprivation. Methods: Forty-four PI youth (12-14 yrs.) and 22 non-adopted controls performed a cognitive conflict task involving motor relearning during functional MRI scanning. PI youth were either early-adopted (N=22) or later-adopted (N=22). Participants pressed buttons in response to visually presented numbers, with instruction screens periodically changing the mapping between fingers and numbers. Mappings ranged from low conflict (intuitive mapping) to high conflict (less intuitive mapping). Previous studies have shown that high conflict trials are more effortful and engage prefrontal regulatory systems in typical controls. Results: Later-adopted youth showed poorer performance (lower accuracy and longer reaction times) than early-adopted youth or controls. PI youth showed increased activation of bilateral dorsolateral prefrontal cortex relative to non-adopted controls for high conflict compared to low conflict trials. Early- but not late-adopted youth showed increased activation of medial prefrontal, cingulate, and insula regions during high conflict trials. Conclusions: Behavioral and functional imaging results support the hypothesis that early deprivation is associated with long-term alterations in the development of prefrontal circuitry, and that developmental outcomes vary with individual differences in early experience.

D49

AGE-RELATED CHANGES IN WHITE MATTER IN FRONTO-PARIETAL AND FRONTO-STRIATAL TRACTS ARE ASSOCIATED WITH DISTINCT MEASURES OF COGNITIVE FLEXIBILITY

Frini Karayanidis[1], Todd Jolly[1], Pat Michie[1], Christopher Levi[1], Mark Parsons[1], Andrew Heathcote[1]; [1]University of Newcastle, Australia — Distinct fronto-striatal networks have been shown to modulate response conservativeness on a trial-by-trial basis depending on the type of cue information (Mansfield et al., J Neurosci 2011). In young adults, individual variability in the structural integrity of these pathways is associated with the tendency to adopt a more risky or cautious strategy in a cued-trials switching paradigm (Mansfield et al., CNS abstract). Older adults show a preference for cautious responding and, in a perceptual decision-making task, this is associated with reduction of white matter (WM) integrity in fronto-striatal tracts (Forstmann et al., J Neurosci 2011). Age-related disruption of WM in fronto-parietal tracts has also been shown to relate to slowed decision rate (Madden et al., J Cogn Neuro, 2009). In this study, we examine whether aging-related variability in WM severity and multiple diffusion tensor imaging measures of WM integrity in fronto-striatal and fronto-parietal pathways is associated with performance and decision-related latent processes on a cued task-switching paradigm. Healthy elderly (n=33) and patients who recovered a mild cerebrovascular event (n=25) completed single-task and mixed-task blocks of 2-choice tasks under prepared and unprepared conditions. Participants showed mild to moderate radiological findings of hyperintense WM regions in T2-weighted MRI scans. Early analyses showed distinct associations between mixing cost (repeat trials in mixed-task vs. single-task block) and switch cost (switch vs. repeat trials in mixed-task block) performance and WM disruption in frontal-parietal, frontostriatal pathways as well as the cingulum bundle. These findings are interpreted within the framework of multiple process models of cognitive control.

D50

INDUCED POSITIVE AFFECT IMPROVES TASK-SWITCHING ABILITIES IN OLDER ADULTS

Julia Karbach[1], Kerstin Unger[1]; [1]Saarland University — Recent evidence indicated that induced positive affect improved executive control in healthy young adults and reward-based learning processes in patients suffering from Parkinson's disease. These effects have been attributed to transient boots in midbrain and striatal dopaminergic activity. However, so far there is no evidence for the effects of induced positive affect on executive control in healthy older adults. In the present study, we investigated 40 older adults (mean age = 72.4 years). In order to assess baseline cognitive abilities, participants first performed a battery of cognitive tasks, including measures for perceptual speed, sematic knowledge, working memory, and fluid intelligence. Afterwards, they watched a short video clip (about 7 minutes). Half of the subjects saw classic cartoons and the other half documentaries. Finally, all participants performed switching task without external task cues, allowing the assessment of two domains of executive control (goal maintenance and switching). Before and after the switching task, subjects completed a questionnaire assessing their affective states. Our analyses showed no differences in cognitive baseline performance between the participants reporting an increase in positive affect after seeing the video clips and those who did not. Importantly, data of the switching task showed no between-group differences in terms of goal maintenance, but participants with increased positive affect were more efficient in terms of task switching. The finding that induced positive affect modulates flexibility and but not maintenance is consistent with data from young adults and is likely to be caused by dopaminergic increases in the striatum.

D51

CORTICAL GREY-MATTER THINNING IS ASSOCIATED WITH AGE-RELATED IMPROVEMENTS ON EXECUTIVE FUNCTION TASKS

Maria Kharitonova[1], Rebecca E. Martin[2], John D.E. Gabrieli[3], Margaret A. Sheridan[1]; [1]Boston Children's Hospital, Harvard Medical School, Boston, MA, [2]Columbia University, New York, NY, [3]Massachusetts Institute of Technology, Cambridge, MA — Across development children show great improvement in their executive functions, including the ability to hold information in working memory and to deploy cognitive control, allowing them to ignore prepotent responses in favor of newly learned behaviors. How does the brain support these age-related improvements? Cortical grey-matter thinning, which is thought to be a correlate of increases in myelination and synaptic pruning, is one potential explanation for age-related improvements on measures of executive function. Here we used structural MRI to estimate cortical thickness using the morphometric procedures from the FreeSurfer image analysis suite. We investigated the association between cortical thickness in three a priori defined cortical regions and age-related changes in cognitive control and working memory tasks in 5-10 year old children (N = 32) and adults (N = 10). There were significant associations between reductions in cortical thickness and improvements in task performance across age for both tasks. Specifically, we observed a double-dissociation across thickness of neural regions that are related to changes in cognitive control (right Inferior Frontal gyrus and Anterior Cingulate cortex) and working memory span (Superior Parietal cortex), and performance on cognitive control and working memory tasks. These data add to our growing understanding of how the structural maturation of the brain supports vast behavioral changes in executive functions observed across childhood. In addition, our findings inform an ongoing debate regarding the functional role of the right Inferior Frontal Gyrus and suggest that its main role lies in attentional context monitoring, rather than in response inhibition.

D52

AN EIGHT MONTH EXERCISE INTERVENTION ALTERS BRAIN ACTIVATION DURING COGNITIVE CONTROL IN OVERWEIGHT CHILDREN

Cynthia Krafft[1], Abby Weinberger[1], Nicolette Schwarz[1], Lingxi Chi[1], David Schaeffer[1], Jordan Pierce[1], Amanda Rodrigue[1], Nathan Yanasak[2], Jerry Allison[2], Catherine Davis[2], Jennifer McDowell[1]; [1]University of Georgia, [2]Medical College of Georgia — Children who are more overweight or less fit tend to have worse performance on tests of cognitive control (CC). We have shown that regular exercise has cognitive benefits in overweight children and that it can alter brain activation as measured by functional magnetic resonance imaging (fMRI). The current study compared brain activation between an exercise intervention and attention control group. Forty sedentary, overweight (body mass index ≥ 85th percentile) children 8-11 years old were randomly divided into either an aerobic exercise (n=23) or attention control group (n=17). The exercise group underwent 40 min/day of instructor-led aerobic exercise, while the control group underwent 40 min/day of instructor-led sedentary activities. Programs were offered every school day for 8 months. At baseline and post-intervention, both groups completed a flanker task during fMRI. The flanker task requires response selection within the context of response-congruent and -incongruent information. fMRI data were analyzed using standard procedures and the group by time interaction was investigated using a whole-brain ANOVA. Results demonstrate significant alterations in several regions that are important for flanker performance. For instance, the incongruent versus congruent contrast showed a significant difference between the groups in the superior frontal gyrus, where the exercise group showed increased activation compared to the control group from baseline to post-test. This could reflect

more flexible modulation of neural resources, which may be related to the cognitive improvements that have been observed with exercise in previous studies.

D53

COGNITIVE BENEFITS OF MUSIC AND ART TRAINING IN HEALTHY OLDER ADULTS: BEHAVIOURAL AND ERP STUDIES

Sylvain Moreno[1], Yunjo Lee[1], Gavin Bidelman[2], Aline Moussard[1], Claude Alain[1]; [1]Rotman Research Institute, [2]University of Memphis — It is well documented that music training offers a variety of cognitive benefits. Emerging evidence suggests that musical activity late into life may preserve cognitive functioning in old age. Cognitive aging is associated with inhibitory deficits: older adults show difficulties attending to relevant information while ignoring irrelevant information. Considering the rapidly growing aging population, it is crucial to study the effects of music or other types of training as a way to intervene such cognitive decline. Here we explore whether short-term engagement with different forms of training (music and visual arts) can provide the aging brain with cognitive benefits. Specifically we assess whether or not training can improve attention and inhibitory control. Based on age, education and IQ, older adults (age range: 58-82 years) were pseudo-randomly assigned to either a music training group (n=18) or a visual art training group (n=19). Each group received either music or visual art lessons with a professional teacher for three months. Cognitive skills were assessed behaviorally with a neuropsychological test battery and a visual Go/NoGo task during electroencephalographic recording before and immediately after training. Following training, both groups improved in Digit Symbol, Stroop, and Cattell. Additionally, the visual art group was faster in color naming compare to pre-training (a subtest of Stroop). Evoked brain responses showed enhanced P3 amplitude in frontal channels of both groups but larger in the art group suggesting enhanced attention and inhibitory control. Results suggests the possibility that music and art training can be an effective intervention for cognitive aging.

D54

REAL-TIME STRATEGY VIDEO GAME TRAINING INCREASES FRONTO-PARIETAL CORTICAL THICKNESS, DEFAULT MODE NETWORK CONNECTIVITY, AND REASONING ABILITY IN HEALTHY OLDER ADULTS

William McGarry[1], Maren Strenziok[1], Dean Cisler[1], Ellen Clarke[1], Sophia Santa Cruz[1], James Thompson[1], Raja Parasuraman[1], Pamela Greenwood[1]; [1]George Mason University — Several studies found cognitive training in older people transfers to untrained tasks like reasoning, but the neural correlates of such effects are uncertain. Method of Loci training in older adults increased cortical thickness (CT) in fusiform and lateral orbitofrontal cortices, and improved source memory. Based on evidence that strategy videogame training increased functional connectivity in the default mode network (DMN), we hypothesized that real-time strategy training would induce an integrated change in gray and white matter - altered cortical thickness, increased DMN connectivity, and transfer to reasoning ability in older adults. Seven participants aged 60 to 85 underwent structural MRI (mprage: 160 slices; 1x1x.94 mm3; TR=2300ms; TE=3ms) and resting state scanning (BOLD: 42 slices; 3mm3; TE=30ms; TR=2500ms) before and after a six-week "no contact" period. Participants then learned and practiced a strategy videogame (8 weeks, 1 hour/day, 6 days/week). After training, they were scanned again. Reasoning ability for finding word patterns was assessed before and after training using the Word Series task. Whole-brain longitudinal analyses (FreeSurfer) indicated significantly greater thickening during the training versus control period in superior parietal, lateral inferior frontal, motor, and fusiform cortices ($p<.05$, cluster-corrected). Seed-based correlations revealed greater functional connectivity between the posterior parietal cortex and angular gyrus post-training compared to pre-training ($p=.07$). Accuracy on the Word Series task was also higher post-training ($p<.01$). Transfer of strategy training to reasoning may result from a combination of altered DMN connectivity, involved in self-referential cognition and consolidation processes, and a thicker cortex in fronto-parietal attention networks.

D55

FEEDBACK BLUNTING AS A MECHANISM OF SLEEP LOSS IMPACT

John Hinson[1], Paul Whitney[1], Melinda Jackson[2], Hans Van Dongen[1]; [1]Washington State University, [2]Victoria University, Melbourne, Australia — The adverse impact of sleep loss on critical decisions in the real world is well-documented. Nonetheless, laboratory studies of sleep deprivation often show small or inconsistent effects on decision making performance in controlled settings. Laboratory decision tasks typically involve a series of independent decisions on well-specified outcomes, but many of the real world contexts in which sleep deprivation produces errors in decision making require that critical information must be acquired over time and updated based on feedback. No sleep deprivation research to date has used decision making tasks that allow isolation of the ability to utilize feedback to guide decisions. The present study examined sleep deprivation effects on the utilization of feedback in a decision task involving both uncertainty and time pressure. In our study sleep deprivation eliminated the ability to use accuracy feedback from previous trials to improve performance on future trials. Skin conductance responses revealed that the ineffectiveness of feedback was associated with a blunted affective reaction to feedback. The feedback blunting observed in this study is not attributable to the most well established mechanism of sleep loss effects, that is, occasional lapsing or interruptions in the bottom up flow of sensory and perceptual information. Discovery of the novel mechanism of feedback blunting allows prediction about when and where sleep deprivation will produce catastrophic decision making outcomes in real world settings.

D56

BOTTLENECK-FUNCTION OF THE LEFT INFERIOR PARIETAL CORTEX IN DUAL-TASKING REVEALED BY REPETITIVE TRANSCRANIAL MAGNETIC STIMULATION

Houpand Horoufchin[1], Britta Worringer[1], Antonello Pellicano[1], Harshal Patel[1], Iring Koch[2], Ferdinand Binkofski[1]; [1]Division of Clinical and Cognitive Neurosciences, Medical Faculty, RWTH Aachen University, Germany, [2]Institute of Psychology, RWTH Aachen University, Germany — Previous dual-task studies found activation in the left inferior parietal-cortex that was associated with delayed processing of the second task in dual-tasking. Presumably, this reflects competition for neuronal resources (bottleneck; Sigman & Dehaene, 2008). We hypothesized that a "virtual lesion" induced in the left inferior parietal-cortex will result in decreased performance of the second task. The dual-task in the present study consisted of a colour- (yellow vs. blue) and a shape-discrimination task (triangle vs. circle). We used stimulus onset asynchronies (SOA) of 0ms (strong interference), 300ms (moderate interference), and 900ms (no interference). Two groups were tested. Both first performed a baseline measurement block (no stimulation) and then an experimental block with either transcranial magnetic stimulation (TMS group) or sham stimulation (sham group). We used a continuous theta-burst stimulation paradigm (Huang et al., 2005) to induce a "virtual lesion" of the left inferior parietal lobe. Preliminary results (12 participants) already show a significant 3-way interaction between SOA, TMS/sham and block ($p<0.05$). In the experimental block, the TMS group showed increased dual-task interference in the second task at short SOA relative to the sham group, whereas performance in both groups did not differ in the baseline block. These results reveal a causal relationship between the role of the left inferior parietal cortex and the performance of the second task in dual-tasking. They further corroborate our hypothesis that the inferior parietal region plays a crucial role in the serial processing of dual-tasks, most probably in form of a bottleneck.

D57

PAIN, CONGRUENCY, AND SURPRISE: PREDICTION VIOLATION ACROSS DOMAINS IN THE ANTERIOR CINGULATE CORTEX

Andrew Jahn[1], Will Alexander[1], Derek Nee[2], Joshua Brown[1]; [1]Indiana University, [2]University of California, Berkeley — Previous research has suggested that the Anterior Cingulate Cortex (ACC) is functionally segregated into a cognitive component associated with dorsal ACC (dACC) and an emotional component associated with medial prefrontal cortex (mPFC). However, recent reviews have shown that the ACC is less functionally distinct than originally thought (Etkin et al, 2011), and a recent meta-analysis has shown significant regions of overlap in the dACC in response to negative affect, pain, and cognitive control (Shackman et al, 2011). Here we use FMRI to

test whether the ACC shows a similar functional homogeneity in response to prediction violations for both pain and cognitive control. To test this, we used a factorial design consisting of cues signaling the probability of receiving either aversive or non-aversive levels of electrical stimulation, and cues signaling the probability of receiving a congruent or incongruent spatial stroop. Our results show overlapping activations in the dACC for violations of predicting upcoming levels of pain and upcoming levels of required cognitive control. Furthermore, post-hoc analyses revealed that the observed effects for both surprising pain and surprising spatial stroops were driven by outcomes that were worse than expected and outcomes that were better than expected, in contrast to predictions from Reinforcement Learning theory (Holroyd & Coles, 2002) and instead supporting predictions by the PRO model (Alexander & Brown, 2011).

D58

THE USEFULNESS OF DISTRIBUTIONAL ANALYSIS TO ASSESS COGNITIVE CONTROL EFFICIENCY AND SUSCEPTIBILITY TO IMPULSIVE REACTIONS

Jennifer Joyce[1], Karen Davranche[2]; [1]University of Limerick, Ireland, [2]Aix-Marseille Université et CNRS, France — The ability to resist interference and inhibit incorrect activation is an essential aspect of cognitive control which can be assessed using the Simon task. The classical version required participants to respond, as quickly and accurately as possible, according to the relevant feature of a stimulus (the color) and inhibit the irrelevant feature (the spatial location) of the same stimulus. Reaction time performances are usually reported to be worse when relevant and irrelevant information are mapped to different responses, than when corresponding to the same response. According to dual-route models, there is a conflict between an automatic response triggered by the spatial location, and a slower, controlled response related to the relevant information. The automatic activation is initially strong but gradually decreases over time with the strengthening of a slow and incremental inhibition. Then, a suppression mechanism counteracts the automatic activation and facilitates the occurrence of the correct response. The analyses of the percentage of correct responses (conditional accuracy functions, CAF) and the magnitude of the interference effect (delta curve) as a function of the latency of the response are powerful statistical methods. These analyses allow for the assessment of the initial phase related to an individual's susceptibility to making fast impulsive errors, and the later phase associated with the efficiency of the cognitive control. The usefulness of distributional analysis will be illustrated through experimental data showing an impairment of cognitive control with time on task, and the risky strategy of young adults compared to the elderly.

D59

MEG TIME-FREQUENCY ACTIVITY DURING STROOP CONFLICT IN TRAUMATIC BRAIN INJURY

Tracy L. Luks[1], Corby L. Dale[1], Leighton B. Hinkley[1], Phiroz E. Tarapore[1], Shelly R. Cooper[1], Sara C. LaHue[1], Anne M. Findlay[1], Hana A. Lee[1], Suzanne M. Honma[1], Danielle Mizuiri[1], Srikantan S. Nagarajan[1], Pratik Mukherjee[1]; [1]UCSF — Traumatic Brain Injury (TBI) patients often have persistent cognitive deficits, particularly in attention and executive function. We used Magnetoencephalography (MEG) to examine the timecourse of neural activity during a Color Naming Stroop Task with beamforming source localization. Data were acquired from 19 adult patients with chronic symptomatic mild or moderate TBI and 14 healthy controls using a 275-channel whole-head biomagnetometer (CTF Systems, Vancouver BC) and analyzed in the time-frequency domain using Nutmeg (bil.ucsf.edu/nutmeg). Activity was defined as power fluctuations in each voxel over time in theta (4-7 Hz), alpha (8-12 Hz), beta (12-30 Hz), low gamma (30-55 Hz), and high gamma (63-117 Hz) bands for Incongruent versus Congruent trials and submitted to within- and between-group analyses. Control subjects had significant conflict-related activity in prefrontal and temporal regions in all frequency bands, including Dorsolateral Prefrontal Cortex (DLPFC) and Anterior Cingulate Cortex (ACC), beginning at 50 msec post-stimulus and extending throughout a 700 msec window. In all regions exhibiting significant conflict-related activity in healthy controls, TBI patients had equivalent or reduced activity. However, TBI patients had extensive significantly increased activity in other frontal, temporal and occipital brain regions in each frequency band. High Gamma activity, in right prefrontal cortex from 350-450 msec and right ACC from 350-400 msec, was associated with conflict processing scores in TBI patients. This activity in right prefrontal cortex was correlated with the Extended Glasgow Outcome Scale, a measure of clinical status. These results suggest large scale compensatory reorganization due to TBI within the oscillatory networks subserving conflict.

D60

VOLUNTARY INHIBITION OF PAIN AVOIDANCE BEHAVIOR

Margaret Lynn[1], Jelle Demanet[1], Ruth Krebs[1], Marcel Brass[1]; [1]Ghent University — Behavioral inhibition has classically been considered to rely upon a neural network centered at the right inferior frontal cortex (rIFC; Aron et al., 2003). However, the vast majority of inhibition studies have entailed exogenous stop signals instructing participants to withhold responding. More recent work has begun to examine the neural underpinnings of endogenous inhibition, revealing a distinct cortical basis in the dorsal fronto-median cortext (dFMC; Brass & Haggard, 2007; Kühn, Brass, & Haggard, 2009). Yet, contrary to everyday experiences of voluntary behavioral suppression, the paradigms employed to investigate action inhibition have thus far been somewhat artificial, and involve little persuasive motivation to act. Accordingly, the present fMRI study seeks to compare and contrast intentional with instructed inhibition in a novel pain paradigm that recruits 'hot' incentive response systems. Participants (N=21) received increasing thermal stimulation to their inner wrists, and were required to occasionally withhold their natural impulse to withdraw from the visceral pain sensation at peak temperature, in both instructed and free-choice conditions. Consistent with previous research, we observed activation of the rIFC related to instructed inhibition. Intentional inhibition, on the other hand, yielded additional striatal activation centered on the caudate nucleus. These data extend previous research by demonstrating that under ecologically valid conditions with a strong motivation to act, brain regions in addition to the dFMC become relevant for voluntary inhibition. On a larger scale, these findings are concordant with recent models of inhibitory control suggesting discrete neural pathways for the suppression of behavior (Aron, 2011).

D61

RESOURCE-SHARING BETWEEN INTERNAL MAINTENANCE AND EXTERNAL SELECTION UNDERLIES THE CAPTURE OF ATTENTION BY WORKING MEMORY CONTENT

Anastasia Kiyonaga[1], Tobias Egner[1]; [1]Duke University — The precise relationship between working memory (WM) and attention is poorly understood. We examined the hypothesis that WM represents internally allocated attention. WM and visual attention should accordingly display a 'push-pull' relationship, due to their reliance on a single resource. We tested a strong prediction of this model, namely that WM content will (involuntarily) guide visual attention, but only when there is sufficient time for attention to internally refresh that WM content. If refreshing is prevented, WM content cannot be maintained and thus cannot guide external attention. We therefore examined whether the amount of unoccupied time during a WM delay could impact the magnitude of attentional capture by WM contents, as well as retention of that content. Participants were presented with a series of visual search trials while they maintained a WM cue for a delayed-recognition test. WM cues could coincide with the search target, a distracter, or neither. We varied both the number of searches to be performed, and the amount of available time to perform them. In support of the shared-resource hypothesis, the slowing of visual search by a WM matching distracter—and facilitation by a matching target—were curtailed when the delay was filled with fast-paced (refreshing-preventing) search trials. WM accuracy was also impaired by fast-paced search sequences, independent of the total duration of the delay. WM content may, thus, only capture visual attention during refreshing, demonstrating that internal (WM) and external (visual) attention demands mutually impact one another because they share a limited resource.

D62

TRACES OF EXPECTANCY BREACHES IN SEQUENTIAL EVENTS: DIFFERENCES BETWEEN DESTABILIZED AND ADAPTED PREDICTIONS

Anne B. Kühn[1], Ricarda I. Schubotz[1,2]; [1]Max Planck Institute for Neurological Research, Cologne, [2]Department of Psychology, Westfälische Wilhelms-Universität, Münster — The fMRI-study aimed to investigate how and by the help of which cortical areas the frontomedian cortex succeeds in prediction of events despite continually and rapidly changing events. A former study observed the frontomedian cortex to be activated if a sequen-

tial event could be predicted well, whereas a reduction of that activation was present when prediction was destabilized by a preceding change of that event. If this reduction of frontomedian activity is a neural signature of destabilization only or of adaptation to altered events as well should be clarified here. Furthermore, we hypothesized parietal or temporal areas to reflect adaptation to altered events. In a pre-fMRI session subjects (n = 21) learned a sequence of 24 digits. During the fMRI session this sequence was repeatedly presented digit by digit. Unexpectedly digits were omitted and subjects had to indicate these sequential changes by key presses. Half of all omissions were repeated (double omissions) and half were not (single omissions). If events can be predicted well, i.e. in non-destabilized events (NDE) the frontomedian cortex was activated. This activity was reduced in destabilized events after single omissions (DES) as known but almost reached the activity level as in NDE in destabilized events after double omissions (DED). Thus, the frontomedian activity reduction might only be a signature of destabilization. DED compared to DES revealed an activation increase in temporal and frontal areas. This might be a cortical signature of breaking through a beginning adaption and of "repairing the known event syntax" after repeated event-alterations.

D63

SEARCHING FOR TARGETS WITHIN VISUAL SHORT-TERM MEMORY VERSUS PERCEPTUAL REPRESENTATIONS: A MAGNETOENCEPHALOGRAHIC STUDY

Bo-Cheng Kuo[1,2], Duncan E. Astle[2,3], Gaia Scerif[2], Mark W. Woolrich[2], Anna Christina Nobre[2]; [1]National Chengchi University, Taipei, Taiwan, [2]University of Oxford, Oxford, United Kingdom, [3]Medical Research Council Cognition and Brain Sciences Unit, Cambridge, United Kingdom — Recent event-related potential (ERP) studies have revealed that searching for relevant items from within visual short-term memory (VSTM) representations involves spatiotopically specific top-down biasing of neural activity in a manner similar to that occurs during visual search for items within perceptual representations. However, the underlying neural substrates of VSTM and perceptual search were not fully investigated. Here our aim was to localise the neural source of brain activity associated with spatiotopic selection of targets in VSTM representations by using magnetoencephalograhy (MEG). Participants (N = 11) performed a visual and VSTM search task. Participants viewed a sample shape and a search array of different shapes. Their task was to respond whether the sample shape was present in the search array. In visual search trials, the sample shape appeared before the search array, and participants searched for the target item within the perceptual array. In VSTM trials, the sample shape appeared after the search array, and participants searched for the target item within representations held in VSTM. In accordance with previous ERP findings, we found the mN2pc for both VSTM and visual search from event-related magnetic field recording. MEG source localization using beamforming analysis revealed that the mN2pc was related to posterior visual areas for both search tasks. Moreover, the mN2pc for VSTM search also reflected neural activity in the frontal cortex. Taken together, these findings bolster the notion that top-down biasing in VSTM may share properties with spatially specific attentional mechanisms that bias perceptual processing in favour of the relevant information.

D64

WITHIN-CATEGORY DECODING OF ATTENDED VS. UNATTENDED ITEMS IN SHORT-TERM MEMORY

Joshua J. LaRocque[1], Adam C. Riggall[1], Stephen M. Emrich[1], Bradley R. Postle[1]; [1]University of Wisconsin-Madison — It has long been believed that short-term memory (STM) is accomplished by sustained, elevated neural activity, termed the "active trace." Recently, several studies (Lewis-Peacock et al., 2012; LaRocque et al., in press) have suggested that this active trace corresponds to attention, not STM, per se. In these studies, participants were retroactively cued to attend to one of two items in STM. Using multivariate pattern analysis (MVPA) applied to delay-period neural activity, the category of the cued memory items was decoded successfully. However, uncued memory items could not be decoded, suggesting that items in STM are accompanied by an active neural trace only when they are in the focus of attention. A caveat about this interpretation stems from the fact that these two studies decoded memory items at the level of stimulus category (i.e., visually, semantically, or phonologically encoded stimuli). This leaves open the possibility that a category-agnostic but item-specific active trace supports the retention of information outside the focus of attention. To test this alternative, we collected fMRI data while subjects performed the retrocuing STM task with items drawn from the same category: coherent motion. With MVPA we could decode STM for cued items. Decoding was unsuccessful, however, for uncued items, despite the fact that they could be recognized on a subsequent memory probe. These results add to the mounting evidence that an active neural trace reflects the focus of attention, not the contents of STM.

D65

HIGHER OMEGA-3 FATTY ACID EXPOSURE MITIGATES EFFECTS OF LOW PHYSICAL ACTIVITY ON COGNITIVE PERFORMANCE

Regina Leckie[1], Neha Bhattacharjee[1], Stephen Manuck[1], Matthew Muldoon[1,2], Kirk Erickson[1]; [1]Univerisity of Pittsburgh, [2]University of Pittsburgh Medical Center — Lower levels of physical activity are associated with poorer working memory and executive function. However, there is significant variation in the extent to which any individual benefits from participation in physical activity, raising the possibility that its effects might be attenuated or augmented by other moderating factors. One potential moderator of physical activity on cognition is long-chain omega-3 fatty acid intake. The balance between the omega-3 fatty acid, docosahexaenoic acid (DHA), and the omega-6 fatty acid, arachidonic acid (AA), has been associated with multiple domains of executive function and shares several molecular pathways with physical activity. The present study examined whether the AA:DHA ratio in serum phospholipids moderated the effects of physical activity on the Trail Making Task, Logical Memory Task, and a Spatial and Letter N-Back task. Participants were 358 healthy adults, 30-55 y/o not taking fish oil supplements. Physical activity was measured by the Paffenbarger questionnaire. Multiple regression analyses covarying age, sex, and education revealed a significant interaction between Physical Activity and AA:DHA for scores on both the Trail Making and N-Back tasks. Specifically, higher proportions of DHA offset the negative effects of lower amounts of physical activity on cognitive performance, whereas low levels of both physical activity and DHA was associated with the worst cognitive performance. Our results suggest that a high proportion of omega-3 fatty acids mitigates the negative effects of sedentary lifestyle on cognitive performance.

D66

MEMORY UPDATING OPERATION IS HIGHLY CORRELATED WITH MULTIPLICATION PERFORMANCE

Chia-Yuan Lin[1,2], Cheng-Ching Han[2,3], Daniele Didino[4], Brian Butterworth[4], Nai⊠Shing Yen[1,2,3]; [1]Department of Psychology, National Chengchi University, Taiwan, [2]Research Center for Mind, Brain, and Learning, Taiwan, [3]Taiwan Mind & Brain Imaging Center, TMBIC, [4]Institute of Cognitive Neuroscience, University College London, UK — Although approximate number system (ANS) has widely seen as the key factor to predict math ability, we had recently found memory updating (continual adding and subtracting numbers) capacity to be a stronger predictor to multiplication performance. However, one could argue that these results were due to the similarity across two tasks as both memory updating and multiplication tasks required participants to be engaged in mathematic calculation. To examine this potential confound, we added three control conditions including (1) numerical memory updating task (remembering the larger number shown on screen, no addition and subtraction required), (2) word memory updating task (remembering the animal name that is smaller in size), (3) spatial memory updating task (remembering the spatial location after dot movements) in addition to (4) the original memory updating task, (5) an ANS task (select the panel with more dots) and (6) a multiplication task. Thirty-four college students were recruited to participate in all six tasks. Our preliminary results were consistent with previous findings that showed no correlations between ANS and multiplication task performance. Correlation between numerical memory updating and multiplication performance was relatively low, but performance in all the three other memory updating tasks was significantly correlated with performance in multiplication task (rs > 0.6), suggesting high correlations in performances we had found between memory updating and multiplication tasks was not due to the presence of numbers in both tasks. We therefore concluded that operation in memory updating was the key component to explain multiplication performance, not numbers per se.

D67

FRACTIONATING THE NEURAL CORRELATES OF INDIVIDUAL WORKING MEMORY COMPONENTS UNDERLYING PROBLEM SOLVING SKILLS IN YOUNG CHILDREN

Arron W. S. Metcalfe[1], Miriam Rosenberg-Lee[1], Sarit Ashkenazi[2], Vinod Menon[1]; [1]Stanford University, [2]The Hebrew University of Jerusalem- Mt. Scopus — Baddeley and Hitch's multi-component working memory (WM) model has played an enduring and influential role in our understanding of cognitive abilities in adults. Little is known, however, about how WM components impact behavior and brain response underlying cognitive abilities in children. We investigate the role of the model's core central executive, phonological and visuo-spatial abilities during a demanding mental arithmetic task in 7-9 year olds (n=74). Using a combination of neuropsychological assessments of math ability and working memory, and functional neuroimaging during arithmetic problem-solving, we test the hypothesis that behavior and brain responses are independently predicted by the multi-component model. Individual differences in visuo-spatial ability were the only significant predictor of math ability and were associated with increased task-related brain responses in right ventrolateral and dorsolateral prefrontal cortex, and bilateral intra-parietal sulcus and supramarginal gyrus. Individual differences in visuo-spatial, phonological and central executive components correlated with brain response in largely distinct brain areas. Overlap between visuo-spatial and central executive correlations was observed in left supramarginal gyrus. Left dorsolateral prefrontal cortex correlations with visuo-spatial ability were mediated by central executive and phonological ability; no overlap resulted for visuo-spatial and phonological abilities. These results point to distinct patterns of brain response underlying the central role of visuo-spatial WM for arithmetic problem-solving in young children. Our findings reveal a striking concordance between cognitively derived fractionation of working memory and task-related functional brain activity and suggest that complex problem-solving tasks are fertile ground for bridging cognitive constructs with developmental cognitive neuroscience findings.

D68

STRUCTURAL PLASTICITY RESULTING FROM PHONETIC CATEGORY TRAINING

Stephanie Del Tufo[1,2], Laura Mesite[3], Emily Myers[1,2,3]; [1]University of Connecticut, [2]Haskins Laboratories, [3]Brown University — Changes in both gray and white matter have been shown to occur as a result of learning, even in adulthood. When learning a new language, functional recruitment of new brain areas for the new language may over time be accompanied by structural changes in the brain. Previous findings have shown that brain structure differences in the left auditory cortex, bilaterally in the parietal cortices and in the left inferior frontal cortex predict individual differences in the perception of foreign speech sounds (Golestani et al., 2002; 2007). Moreover, years of experience as a phonetician correlates with the size of the left pars opercularis (Golestani et al., 2011), and recent work suggests that structural changes may be seen following several months of learning a second language (Stein et al., 2012). Taken together, these studies suggest that extensive language experience results in structural plasticity. What is less clear is whether these changes can be observed after shorter-term training, that is, over two weeks. In the current study, participants were trained for ten days to categorize non-native phonemes taken from a dental-retroflex continuum. Structural data was analyzed with FSL using voxel-based morphometry (Douaud et al., 2007). Preliminary whole brain analyses show anatomical differences in the right parietal cortex. Isolation of this region using a post-training functional activation mask, between- vs. within-category contrasts on the dental-retroflex continuum, confirmed greater white matter density in the right parietal cortex after training. This provides initial evidence of training-induced structural plasticity for the perception of non-native speech sounds.

D69

ARE THERE DIFFERENT BRAIN MECHANISMS FOR LETTER, SYMBOL AND DIGIT POSITION CODING? FMRI EVIDENCE FOR ORTHOGRAPHIC SPECIFICITY

Jon Andoni Duñabeitia[1], Ileana Quiñones[1], Manuel Carreiras[1,2,3]; [1]Basque Center on Cognition, Brain and Language (BCBL), [2]Ikerbasque, Basque Foundation for Science, [3]University of the Basque Country — Do within-string character position coding processes differ for different types of characters? Recent behavioral and electrophysiological data from transposed-character manipulations in the perceptual matching task show that this is the case. Deciding that two strings containing transposed-letters are different from each other (e.g., CVSN-CSVN) is much harder than taking a similar decision for strings containing transposed-digits or transposed-symbols. Besides, these effects follow a different time course, with letters showing stronger and earlier effects than digits and symbols. It remains unclear whether or not these differences are due to qualitative or quantitative differences in position coding (different brain sources vs. different time courses). Here we present an event-related fMRI study using the same transposed-character manipulation within letter, symbol and digit strings and a perceptual matching task. Results showed different brain networks associated with the processing of the different types of characters (e.g., activation in the reading network only for letter strings). The discrimination cost between transposed-character references and targets was associated with an increase of activation in a bilateral fronto-parietal network (attentional monitoring system). Critically, these results also showed that position-coding differences for letters, symbols and digits were associated with clearly different neural regions. While symbol-position coding effects led to activation differences in areas associated with semantic processing (e.g., posterior middle temporal cortex), digit-position coding cost effects were found in the angular gyrus and the inferior parietal cortex, and the cost in letter-position coding was associated with activation differences in the fusiform gyrus, the pars opercularis and the supramarginal cortex.

D70

THE ROLE OF MORPHOLOGICAL STRUCTURE IN PHONEME PREDICTION: EVIDENCE FROM MEG

Allyson Ettinger[1], Tal Linzen[1], Alec Marantz[1]; [1]New York University — Reaction times in auditory word recognition show effects not only of the point at which a morphologically complex word becomes uniquely distinguishable from all other words in the language, whether morphologically related or unrelated ("kindly" from "kite" and "kindness"), but also of the point at which its stem ("kind-") becomes distinguishable from other stems ("kindly" from "kite"). These results weigh against full-form models of word processing in favor of models assuming a role for obligatory morphological decomposition. Furthermore, it has been suggested that this effect of morphological structure is mediated by its involvement in prediction of upcoming phonemes. The present study leverages the temporal resolution of magnetoencephalography (MEG) to probe the role of morphology in phoneme prediction. Subjects performed a lexical decision task on stimuli consisting of a) bimorphemic words paired according to initial morpheme ("clockwise", "clockwork"), and b) monomorphemic words paired according to shared phonological material starting at onset ("bourbon", "burble"). Phoneme predictability was quantified using the information theoretic concept of surprisal. Correlational analysis of activation in the left transverse temporal gyrus revealed that less predictable phonemes were associated with higher processing cost both in simple and in complex words. Importantly, morphological complexity enhanced the effect of phoneme surprisal over and above the local informativity of the phonemes, consistent with the hypothesis that morphological decomposition plays a role in predicting upcoming phonemes. The significant effect of phoneme surprisal furthermore supports the viability of millisecond-by-millisecond analysis of information theoretic stimulus variables in MEG data.

D71

DIFFERENTIAL PROCESSING OF LITERAL AND FIGURATIVE MEANING IN THE LEFT AND RIGHT CEREBRAL HEMISPHERES

Smolka Eva[1]; [1]Department of Linguistics, University of Konstanz — This study investigated whether literal and figurative language is processed differently in the left and right cerebral hemispheres. For this purpose, we combined a visual sentence-priming experiment with visual half-field presentation of target associations. Sentences were either ambiguous idiomatic sentences, that is, sentences featuring both literal and figurative meaning, or literal control sentences. Seventy right-handed participants made lexical decisions about nouns that were associated with either the literal or figurative meaning of the ambiguous idiomatic sentences. Sentences were presented word-by-word in the central visual field (CVF), followed by the target presentation in either the left (LVF) or right visual field (RVF). Our results showed a strong interaction between visual field and association type. Relative to the literal control sentences, in the RVF, only associations

with the literal meaning of the sentence were activated, whereas in the LVF associations with the figurative meaning of the sentence were activated. These results indicate differential processing strategies in the left and right hemispheres with respect to literal and non-literal language: The left hemisphere processes salient (literal) meanings of phrases while the right hemisphere is required to process figurative (non-salient) meanings.

D72

EFFECTS OF SLEEP AND NUMBER OF REPETITIONS ON NOVEL SPOKEN WORD LEARNING: FMRI EVIDENCE

Max Garagnani[12], Yury Shtyrov[1], Matt Davis[1]; [1]MRC Cognition and Brain Sciences Unit, Cambridge (UK), [2]University of Plymouth, Plymouth (UK) — The brain mechanisms underlying our ability to learn words are still not well understood. Previous evidence indicates that the newly learnt items acquire lexical status only after a period of sleep, during which cortical consolidation processes are believed to occur. Recent findings, however, indicate that many exposures to a novel word during a short time may lead to a faster formation of cortical memory traces. To investigate the effects of sleep and number of exposures on word acquisition, we presented our volunteers with spoken familiar words and novel pseudowords during two behavioural training sessions taking place on two consecutive days (day1, day2). The number of times each item was repeated (20 vs 150) varied orthogonally to the day-of-training. After the training (on day 2), we used fMRI to measure brain responses to these trained and, as a further control, to previously unheard (untrained) items. We found that brain responses to words and pseudowords in the left STG were differentially modulated by day/training. While word responses were generally smaller and mostly unaffected by training, we found that untrained, day2-trained, and day1-trained pseudowords exhibited increasingly smaller responses (i.e., gradually becoming more and more like real word ones). This is line with previous results, indicating that sleep leads to consolidation of newly acquired representations. When pulling apart data for 20- and 150-times-repeated pseudowords, however, the effects of sleep appeared limited mostly to the latter items, suggesting a critical role for the number of repetitions required to set off consolidation and word learning processes.

D73

PERCEPTION OF AMERICAN ENGLISH VOWELS BY ADULT BILINGUAL SPANISH SPEAKERS: AN EEG STUDY

Paula Garcia[1], Karen Froud[1]; [1]Teachers College Columbia Unicersity — Adult cross-language studies demonstrate that learning of a second language (L2) is influenced by the native language (L1) phonological system, with L2 learners assimilating non-native sounds to native phonemes (Best, 1995; Flege, 1995). Adult sequential bilingual Spanish-English speakers face perceptual challenges in acquiring American English (AE) vowel contrasts, because these are often signaled by multiple acoustic cues that may not be present in their L1. Research on English vowel perception in L1-Spanish adults has focused on the English vowel contrast /i/, /I/ (as in sheep, ship) because discrimination errors between these two vowels are common (Flege, Bohn & Jang, 1997; Fox, Flege & Munro, 1995). However, other vowel contrasts such as /ɑ/-/ʌ/ and /a/-/æ/ are also known to present perceptual challenges for Spanish listeners (Flege, Munro & MacKay, 1994; Escudero & Chládková, 2010). This 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 /ɑ/-/ʌ, /a/-/æ/ under two listening conditions: (1) natural vowel duration and (2) neutral vowel duration. MMN / P300 responses were observed for all participants, indicating that Spanish and English listeners were able to discriminate these vowels. However, Spanish speakers did not show behavioral indices of discrimination between AE vowels, since accuracy and reaction time differed significantly between Spanish and English groups. Directional asymmetries were observed only for the L1-Spanish listeners. These findings provide more evidence on the neural correlates of Spanish-speaking adults' perceptual organizational abilities for identification of L2 vowel contrasts.

D74

THE FUNCTIONAL NEUROANATOMY OF ADULT SECOND LANGUAGE: AN ACTIVATION LIKELIHOOD ESTIMATION META-ANALYSIS

Sarah Grey[1], Kaitlyn M. Tagarelli[1], Peter E. Turkeltaub[1], Michael T. Ullman[1]; [1]Georgetown University — Numerous fMRI and PET studies have investigated the neuroanatomical bases of second language (L2) learning and processing. Although a number of review papers have examined this literature, the lack of quantitative statistics precludes determining the actual patterns of L2 neural activity and how they compare to first language (L1) processing. For example, it is difficult for qualitative reviews to take into account study-specific features such as sample size. In this study we conducted a comprehensive quantitative meta-analysis of the functional neuroanatomy of L2 processing, focusing on lexical/semantics and grammar. We used Activation Likelihood Estimation (ALE), a probabilistic method for quantifying spatial reproducibility in neuroimaging studies. One hundred and thirty five fMRI and PET studies of L2 were identified, 34 of which focused on lexical/semantics and/or grammatical processing, and qualified for ALE analysis (based on several criteria, including examination of the whole brain and reporting of stereotactic coordinates). Preliminary ALE analyses revealed the following. L2 showed more activation than L1 both for lexical/semantics and for grammar. L2 and L1 showed both shared and distinct brain areas for both lexical/semantics and for grammar. However, L2 grammar overlapped more with L1 lexical/semantics than with L1 grammar. These and other results provide a quantitative fine-grained analysis of the functional neuroanatomy of L2 and its relation with L1, and constrain the theoretical landscape of the brain bases of L2.

D75

NATIVE LANGUAGE EXPERIENCE INFLUENCES THE NEURAL SYNCHRONIZATION OF AUDITORY SPEECH PROCESSING: A CROSS-LANGUAGE MMN STUDY USING TIME-FREQUENCY ANALYSIS

Chang Gu[1], Yuliya Yoncheva[1], Reyna Gordon[1], Hua Shu[2], Bruce McCandliss[1]; [1]Vanderbilt University, [2]Beijing Normal University — Processing speech in one's native language might rely on enhanced neural sensitivity with high temporal precision, which can be complimentarily measured in EEG by power change and phase alignment to the speech onset. Here we investigated how one's language experience may tune the oscillatory synchronization of neural activity to achieve superior processing of native relative to non-native speech. In a cross-language experiment, we presented the same sets of Mandarin and English syllable stimuli to Mandarin-speaking and English-speaking adults and measured their mismatch negativity (MMN) response. We found that both the inter-trial coherence (ITC), which indexes the EEG phase-locking to deviant stimuli, and the event-related spectral perturbation (ERSP), which indexes the overall power change of EEG, varied as a function of the native language of the subject. In line with previous cross-linguistic MMN studies, we first applied conventional event-related potential (ERP) analysis and found that, in both language groups, the native contrasts elicited significantly larger MMN (160-220ms) and P3a (280-320ms) ERP amplitudes than the non-native contrasts. Furthermore, time-frequency analysis revealed that this enhanced ERP to native speech stems from a significant increase of ITC ($P<0.01$) and ERSP ($P<0.05$) for the single-trial EEG in theta (4-7 Hz) and low-frequency alpha (8-10 Hz) bands from 150 to 300ms. These results indicate that an individual's heightened brain processing of native relative to non-native speech, as evidenced by enhanced neural sensitivity and temporal precision, might be driven by language experience tuning auditory neural synchronization over the course of development.

D76

USING FTCD TO EXAMINE LANGUAGE LATERALISATION DURING PHONOLOGICAL AND SEMANTIC FLUENCY TASKS

Eva Gutierrez[1], Heather Payne[1], Anna Safar[2], Mairead MacSweeney[1]; [1]Deafness, Cognition & Language Research Centre & Institute of Cognitive Neuroscience, University College London, [2]Radboud University Nijmegen — Functional transcranial Doppler sonography (fTCD) is a non-invasive, fast and safe way of establishing hemispheric dominance during cognitive tasks (see Deppe et al., 2004; Bishop et al., 2009).The gold standard task for demonstrating lateralisation during speech production is phonological fluency (PF). Due to concerns about artefacts induced during overt production, previous stud-

ies have required covert production. In this study we tested this assumption by contrasting lateralisation during both covert and overt production. We also tested semantic fluency (SF) to assess consistency of hemispheric dominance across different language tasks. Nineteen right-handed English speakers were tested in four conditions: PF–overt; PF-covert; SF-overt; SF-covert. Laterality indices (LIs) for 12 participants who had sufficient remaining trials following artefact rejection were calculated for each task. Those with LIs significantly different from zero were classed as left or right lateralised, as appropriate. The remainder were classed as 'bilateral'. Our data showed an increase of rejected epochs for the overt conditions. In covert tasks, the strength of lateralisation correlated with the number of words produced. Additionally, we observed a larger percentage of participants and stronger lateralization for PF than SF. Our results demonstrate that lateralization can be assessed with fTCD during overt tasks, allowing a more naturalistic experimental situation and concurrent measure of production, although more trials should be included to compensate for artefacts. More research is needed to fully understand the nature of within individual variation in language lateralisation during language tasks with different demands.

D77

COMPLEMENTARITY OF LINGUSITIC AND EMOTIONAL PROCESSING

Victoria Harms[1], Lorin Elias[1]; [1]University of Saskatchewan — Clear evidence suggests a division of functional processing between the left and right hemispheres; the left hemisphere is known to be dominant for linguistic processing whereas the right hemisphere is found to be dominant in emotional processing. These population-level biases in linguistic and emotional processing suggest a complementary organization of these two functions. It is commonly assumed that this complementary pattern reflects a causal relationship in lateralization where the asymmetrical lateralization of language processing to the left hemisphere drives emotional processing to be lateralized the right hemisphere. However, little research has tested this assumption by assessing whether this pattern of hemispheric asymmetry still holds when both functions are measured within subjects. Using 52 healthy, right-handed participants we examined whether the degree of lateralization on the Fused Words task is correlated with the degree of lateralization on an emotional sounds task at the level of the individual using the dichotic listening method. When laterality scores for the two tasks were compared within individuals, only 59% of participants showed a complementary pattern of lateralization. The remaining 41% showed same-side lateralization for both tasks. An overall complementary pattern of lateralization was observed at the population level, but no significant relationship was found for degree of lateralization of linguistic and emotional processing within individuals. These results provide evidence against the assumption of a causal relationship between left- and right-lateralized functions; rather, the observed pattern provides support for the view that functions in the left and right hemispheres are independently lateralized.

D78

THE FUNCTIONAL ROLE OF THE UNCINATE FASCICULUS IN SEMANTIC CONTROL: CONVERGING EVIDENCE FROM STRUCTURAL AND FUNCTIONAL CONNECTIVITY MEASURES

Denise Y. Harvey[1], Tao Wei[1], Timothy M. Ellmore[2], A. Cris Hamilton[1], Tatiana T. Schnur[1]; [1]Rice University, [2]The City College of New York — Language comprehension impairments following stroke result potentially from a loss of cognitive control during access to semantic knowledge. An increasingly popular hypothesis proposes that the left inferior frontal gyrus supports this form of control, directing activation of semantic knowledge underpinned by the anterior temporal lobes. Further, a white matter tract, the uncinate fasciculus (UF), connects these regions. This study aimed to examine whether the connectivity profiles of areas hypothesized to be important for semantic processing predicts aphasic speakers' comprehension impairments. Diffusion tensor imaging (DTI) and resting-state functional magnetic resonance imaging (rs-fMRI) data were collected from patients to assess the functional role of three ventral tracts: the UF, inferior longitudinal fasciculus (ILF), and inferior fronto-occipital fasciculus (IFOF). Functional connectivity analyses were conducted on regions located in close proximity to the ventral tracts. Based on its projections, we hypothesized that UF structural integrity relates to semantic control performance. We assessed pathway functional significance by correlating performance on word comprehension tasks requiring semantic control with indices of pathway structural integrity and the functional connectivity strengths of regions they connect. Both the structural integrity of the UF and the functional connectivity strength of regions it connects predicted patients' performance, while the connectivity profiles of other subcortical and cortical structures did not. We conclude that the UF mediates semantic control during comprehension by connecting regions important for cognitive control with those storing meaning. These findings also support a relationship between structural and functional connectivity measures, as the DTI and rs-fMRI results provide converging evidence.

D79

NEURAL SUBSTRATES UNDERLYING IMAGERY-BASED FOREIGN WORD LEARNING

Arturo Hernandez[1], Kailyn Bradley[1]; [1]University of Houston — The purpose of this study was to investigate whether an interactive imagery-based learning paradigm would facilitate foreign word learning beyond picture association. Functional magnetic resonance imaging (fMRI) was used to examine the cognitive constructs underlying these pedagogies. English monolinguals were trained on novel German vocabulary using two different imagery-based learning techniques for four consecutive days. Picture imagery training required participants to visualize the picture of an object presented with a novel word, whereas interactive training required visualization of a first-person interaction with the object. After training, participants were scanned during a preattentive listening task where all 60 learned and 30 novel words were presented. Two weeks post-scan, vocabulary retention was assessed. Behavioral results revealed that participants learned more words through picture imagery. Additionally, imaging results revealed distinct neural patterns related to the different learning techniques. Words learned through picture imagery strongly activated basic visual processing regions, whereas activity for words learned through interactive imagery was greatly reduced and present in the anterior cingulate and SMA. The lack of activity for words learned through interactive imagery suggests greater individual variability in the neural mechanisms recruited in this paradigm. The simpler picture association learning technique was less taxing, and resulted in more homogeneous activation of areas associated with visual processing, whereas individual differences contributed to the wider range of learning outcomes in interactive imagery training. Taken together, these findings support the conclusion that it is more difficult for adults to adapt to using interactive imagery to learn vocabulary.

D80

THE DYNAMICS OF BRAIN ACTIVATION IN SEMANTIC PRIMING: A STUDY COMBINING ERP AND EVENT-RELATED OPTICAL SIGNALS

Jian Huang[1], Suiping Wang[1], Shiwei Jia[2], Deyuan Mo[2], Hsuan-Chih Chen[2]; [1]South China Normal University, Guangzhou, China, [2]Chinese University of Hong Kong, Hong Kong S.A.R., China — Previous studies have revealed three different processes in semantic priming: automatic spread activation, strategic retrieval and inhibition. However, the neural dynamics of these processes remain unclear. In this study, we used the Event-Related Optical Signal (EROS) technique that has both high temporal and spatial resolution to examine the dynamics of brain activation in semantic priming. Fourteen participants read pairs of words and made a lexical decision to the second word in each pair. Words were presented sequentially with short(250ms) and long(1000ms) SOAs in separated blocks. EROS responses were recorded simultaneously with ERPs time-locked to the second words. ERP results showed the N400 amplitude was modulated by the priming effect in both short and long SOA conditions. And EROS results revealed activation in left superior/middle temporal gyrus(LS/MTG) in the early time window(192 to 256 ms)for the short SOA condition, and in LS/MTG and left anterior inferior frontal gyrus(LaIFG) in the N400 time windows. For the long SOA condition, activation in LpIFG in the early time window(160 to 192 ms), and activation in the LMTG, LaIFG and left inferior temporal gyrus/fusiform gyrus in the N400 time window. More interestingly, the primed condition has larger activation in the LMTG from 384 to 448ms. These results suggest that spread activation and strategic inhibition occur very early and strategic retrieval exists in the N400 time window. Moreover, in the long SOA primed condition there is more rely on semantic information while in unprimed condition the orthographic information is more important to the lexical decision task.

D81

FROM IMPLICIT TO EXPLICIT: THE CONVENTIONALIZATION OF NOVEL METAPHORS Jie Yang[1], Manali Khadilkar[1], Steven L Small[1]; [1]Brain Circuits Laboratory, Department of Neurology, University of California Irvine, USA — Metaphors provide a poetic flourish to communicate ideas. In conventional metaphors the figurative meaning supersedes the literal meaning while in novel metaphors the opposite is true. Despite known differences in the biological basis of conventional and novel metaphor comprehension, the process of conventionalization of a novel metaphor has not been investigated. In this fMRI study, six participants passively listened to 28 novel metaphors (e.g., to brush one's belly), each repeated 5 times in different sentential contexts, leading the figurative meaning to become more dominant than the literal meaning (i.e., conventionalization). As a control condition, participants heard identically configured repetitions of literal phrases (e.g., to beat octagonal drums). After each of five runs, participants completed a short comprehension test to ensure attention to the stimuli. Bilateral superior temporal gyrus was activated in both metaphor and literal conditions. Compared with literal phrases, novel metaphors showed increased bilateral activation in the anterior temporal lobes, possibly suggesting a stronger need for context integration in the metaphor condition. Repetition of novel metaphors led to decreased activation in the right inferior frontal, right inferior temporal, bilateral middle frontal, and bilateral anterior and middle cingulate gyri. Repetition of literal phrases led to decreased activation in the angular gyri, precentral gyri, insulae, and medial frontal cortices bilaterally. Although conventionalization and familiarization elicited decreased activation, they have different neural substrates: the right frontal and temporal regions are more involved when the metaphor is novel, and this possibly indicates that the right hemisphere is important for coarse semantic coding.

D82

LOCALIZATION OF NEURAL NETWORKS FOR SEMANTIC AND SYNTACTIC PROCESSING USING MEG Aneta Kielar[1,2,3], Lily Panamsky[1,2], Jed A. Meltzer[1,2,3]; [1]Rotman Research Institute, [2]Baycrest Center, [3]University of Toronto — Introduction: Language processing depends on the interactions between frontal and temporal brain regions. These interactions are mediated by a ventral temporal-frontal route processing semantic information, and a dorsal parietal-frontal pathway subserving syntax and phonology. In the present study, we mapped the neural networks that generate electrophysiological responses to semantic and syntactic anomalies using Magnetoencephalography (MEG). Methods: Experimental items consisted of 400 sentences selected from a set of normed materials. The semantic anomalies were created by substituting the final word of the sentence with an unexpected completion (e.g., She will go to the bakery for a loaf of books). The syntactic anomalies were elicited by introducing a grammatical error in the verb tense or agreement earlier in the sentence (e.g., She will going to the bakery for a loaf of bread). Participants performed a sentence acceptability judgement task. Results: Oscillatory changes in MEG event related synchronization/desynchronization (ERS/ERD) in alpha and beta frequency bands (8-30 Hz) were localized using beamforming and synthetic aperture magnetometry (SAM) in both time and frequency domains. The results indicated that ERD in the 8 to 30 Hz frequency band was observed in the temporal-frontal regions for both semantic and syntactic anomalies. In addition, syntactic anomalies engaged bilateral parietal and precentral areas more strongly. Conclusions: The neural generators of responses to violations were mapped using MEG beamforming of 8-30 Hz ERD. As predicted, semantic and syntactic responses were localized to the brain regions within ventral and dorsal language networks.

D83

EVENTS ALONG THE GARDEN PATH: NO N400 EFFECT AND A P600 EFFECT TO SEMANTICALLY REVERSIBLE EVENTS IN DISCOURSE Gina Kuperberg[1,2], Kristina Fanucci[1,2]; [1]Tufts University, [2]Mass. General Hospital — During language comprehension, we can draw upon semantic knowledge, stored at multiple levels/grains of representation, to generate 'best guesses' (predictions) about the message being conveyed, even before incremental combinatorial analysis is complete (Paczynski & Kuperberg, 2012). Predictions can facilitate semantic access, reflected by an attenuation of the N400 event-related potential (ERP), but if they mismatch the message that is output by full combinatorial analysis, the resulting prediction error triggers additional analysis, reflected by a semantic P600 effect (Kuperberg, 2007). Here we asked whether we predict on the basis of simple schema-based associations, or more structured event representations? We measured ERPs as participants viewed four types of two-clause sentences, linked by the causal connector, 'because': (1) Coherent (e.g. Katrina took her temperature because she was feverish…); (2) Unassociated incoherent (...because she was re-elected…); (3) Schema-associated incoherent (… because she was healthy...), and (4) Event-associated incoherent (Katrina was feverish because she took her temperature...). Unassociated critical words produced N400 effects, but no P600 effects. Schema-associated critical words generated both N400 and P600 effects. Event-associated critical words failed to evoke an N400 effect, but produced a robust P600 effect. These data suggest that comprehenders predicted whole event sequences (\), ahead of encountering the critical word, and independently of its combinatorial integration. We suggest that the activation of these stored event sequences was further boosted by the Event-associated and the Schema-associated, but not the Unassociated, critical words, and that these coherent event-sequence representations conflicted with the combinatorially-determined representation to trigger a P600.

D84

PREDICTIVE SEMANTIC FACILITATION IN SCHIZOPHRENIA: A MULTIMODAL IMAGING INVESTIGATION Ellen Lau[1,2,3], Kirsten Weber[2,3], Nate Delaney-Busch[2,3], Candida Ustine[2,3], Kristina Fanucci[2,3], Matti Hamalainen[3], Gina Kuperberg[2,3]; [1]University of Maryland, [2]Tufts University, [3]Massachusetts General Hospital — Language deficits in schizophrenia are often characterized as impairments in the use of semantic context. It is unclear, however, whether these abnormalities result from problems in using context to predict and facilitate the processing of upcoming words on the basis of stored semantic information, or from problems in combinatorially integrating incoming words into their context. Here, we aimed to isolate the effects of predictive semantic facilitation in schizophrenia using a semantic priming paradigm. We varied predictive validity by manipulating the proportion of related pairs, but kept the context simple and constant across conditions. A multimodal MEG/EEG/fMRI approach allowed us isolate neural activity between 300-500ms following target onset. Our prior work in young healthy controls showed maximal attenuation of the N400 component (ERP) and of activity within anterior temporal cortex (MEG and fMRI) in the high proportion predictive condition. Our initial findings in schizophrenia (n=14) and demographically matched controls (n=15) suggest that, in the predictive condition, patients show just as much reduced semantic activity as controls between 300-500ms. These findings suggest that, when the context is simple and combinatorial integration demands are minimal, schizophrenia patients have the capacity to use top-down strategies to predict and facilitate the processing of upcoming words. We hypothesize that abnormalities in using context to process language in schizophrenia do not arise from impairments in using semantic information to predict and facilitate the processing of expected words, but rather from a failure to engage in prolonged combinatorial processing when incoming words mismatch these predictions.

D85

NEUROMAGNETIC TIME COURSE OF SEMANTIC ACCESS AND INTEGRATION OF SPOKEN LANGUAGE: ULTRA-RAPID AUTOMATIC ACCESS PRECEDES A CASCADE OF ATTENTION-MODULATED PROCESSES Lucy J MacGregor[1], Yury Shtyrov[1]; [1]MRC Cognition and Brain Sciences Unit — What are the neural dynamics of the access and integration of semantic information during spoken language processing, and how are they affected by attention and the nature of language-oriented task? To address these questions we measured listeners' neuromagnetic brain responses to auditorily presented prime-target word pairs that were either semantically related or unrelated. Listeners performed three tasks designed to manipulate attentional focus on the stimuli (counterbalanced across participants): (1) passive listening where volunteers were engaged in a non-linguistic visual distracter task, (2) a semantic task where volunteers judged whether word pairs were related or unrelated, and (3) a phonological task where they listened for an unnaturally extended closure time in one of the words. MEG was recorded and event-related fields were calculated relative to the onset of the target word uniqueness point, which coincided

with the onset of the stimulus-final unvoiced plosive. Amplitude differences between brain responses to the target words (related>unrelated) were first observed in a very early transient peak at approximately 60 ms. Notably, the effect was seen even in the passive listening condition, indicating its resilience to attention withdrawal. Effects in a second short-lived response (unrelated>related), at approximately 130 ms, were largest in the phonological task. A longer-lasting N400-like effect (unrelated>related), emerging around 220 ms, was observed in all conditions. Results support a cascade of neuro-cognitive processes underpinning the access and integration of semantic information. We suggest that context drives very rapid (<100 ms) automatic activation of related semantic information, which is followed by attention-modulated integration processes.

D86

OLDER ADULTS WITH EPILEPSY EXHIBIT SIGNIFICANTLY GREATER EXECUTIVE DYSFUNCTION THAN THEIR MATCHED PEERS WITH CORTICALLY-BASED NEURODEGENERATIVE DISEASE

H. Allison Bender[1], Martin Goldstein[1], Stephanie Towns[1], Marta Krajniak[1], Agnieszka Mlodnicka[1], Lara Marcuse[1], Madeline Fields[1], Amy Aloysi[1], Sonja Schuetz[1], Laili Soleimani[1], Samuel Gandy[1], Anna Miley-Akerstedt[1]; [1]Mt. Sinai School of Medicine — Neurocognitive profiles of reduced confrontation naming and diminished memory are frequently present in older adults with epilepsy and those with cortical neurodegenerative disorders (e.g., Alzheimer's disease (AD)). Yet, neuropathogenesis of these deficits differ. Research is needed to identify cognitive characteristics of each group to improve diagnosis. We matched 11 patients with confirmed diagnoses of epilepsy and 11 with either amnestic mild cognitive impairment (MCI) or AD, aged 55-84 (M=70.3; SD=10.5), by age, education and gender. Neuropsychological testing evaluating attention, executive function, language, motor speed, learning and memory was administered. Frequency of scores falling in "Impaired" range was calculated for each test based on age-matched standardization samples. Relationship among cognitive function, neuroimaging, and EEG data was also explored. Performance on tasks of new learning, delayed recall, and fine motor coordination were areas of greatest weakness in the studied sample. Significant differences between groups emerged on tasks of sustained and divided attention (Trails A&B, p=.042 and p=.037, respectively), as well as fine motor coordination of the non-dominant hand (p=.023). Older adults with epilepsy exhibited greater impairment than those with primary neurodegenerative disorders. White matter disease was also more common in the MCI/AD group than the epilepsy group. No EEG variable (e.g., localization, lateralization) correlated with neurocognitive test data. Findings suggest that executive dysfunction is a prominent deficit in older adults with epilepsy as compared to those with cortical neurodegenerative disorders (MCI/AD). Impairment in this population are not limited to temporal lobe functions, such as memory, but may extend to extratemporally-mediated cognitive domains.

D87

MAGNITUDE OF PRACTICE EFFECTS IN ASSOCIATIVE MEMORY IS RELATED TO THE VOLUME OF CA3-4/DENTATE GYRUS IN HEALTHY MIDDLE-AGED AND OLDER ADULTS

Andrew R. Bender[1], Ana M. Daugherty[1], Naftali Raz[1]; [1]Wayne State University — Repeated administration of cognitive tasks usually results in improved performance over time. Practice effects that may obscure age-related change may provide a useful method for investigating the anatomical correlates of long-term memory. Functional and volumetric imaging points at the hippocampal subregion CA3-4/dentate gyrus (DG) as an anatomical substrate of associative memory. We hypothesized that individual differences in CA3-4/DG volume would predict the magnitude of practice effects on an associative memory task over repetitions separated by considerable delays. We tested associative memory in 49 healthy adults, (age 52 to 82 years, mean = 60.84, SD = 9.59 years) on three occasions separated by mean delays of 24.76 and 31.31 months. At the third testing, participants underwent high-resolution (.4×.4 mm in plane) MRI for manual delineation of hippocampal subfields: CA1-2, subiculum, and CA3-4/DG. Latent growth models (LGM) included Age, associative memory performance at each occasion, and CA1-2 and CA3-4/DG subfield volumes; subiculum volume was unrelated to other variables and was omitted from the final model. LGM analyses showed that the magnitude of practice effects was related to individual differences in CA3-4/DG volume: participants with larger CA3-4/DG volumes at the third occasion experienced greater benefit from repeated test administrations. In contrast, baseline performance was associated with age, but not subfield volume. The effects were unchanged after controlling for history of hypertension. Thus, the volume of the CA3-4/DG subfields, presumably indicating its structural integrity, may serve as an important indicator of long-term memory for associations.

D88

OVERLEARNING IMPROVES LONG-TERM RECALL IN OLDER ADULTS

Katherine E. Bercovitz[1], Stephanie Traulsen[1], Bonnie Given[1], Matthew C. Bell[1], Patricia M. Simone[1]; [1]Santa Clara University — With older adults constituting the most rapidly growing age demographic, recent efforts have been directed at better understanding the optimal conditions of encoding and retrieval for this population. The purpose of this study is to determine if overlearning combined with spacing can improve long-term recall in older adults. Since older adults have demonstrated slowed processing and decreased attentional abilities (Salthouse, 1991), it is possible that improving encoding could significantly improve long-term recall in this demographic. Alternatively, overlearning (high encoding) may impair recall since it could make the task too easy and discourage participants from deeper processing. In a within-subjects study, 20 older adults (Mage= 71.4 years, SDage=6.61) learned English/English word pairs. Word pairs were randomly assigned to two conditions: massed/spaced and high/low encoding. Words in the massed condition were practiced immediately after initial encoding and tested again 10 days later, whereas those in the spaced condition were practiced 24 hours after encoding. Words in the low encoding condition required the participants to correctly recall twice during encoding, while those in the high encoding condition required the participants to correctly recall the pairs 10 times. Participants were significantly more likely to remember the high encoding words and more likely to remember words practiced 24 hrs later (Mmassed/overlearned = .41, Mspaced/overlearned = .52, Mmassed/control = .21 Mspaced/control = .20). Our results suggest that, as demonstrated in younger adults, overlearning can enhance learning in older adults and that further research should focus on improving encoding to further benefit the effect of spacing.

D89

INFLUENCE OF HIPPOCAMPAL VOLUME AND CONNECTIVITY WITH THE PREFRONTAL CORTEX ON MEMORY ABILITY IN EARLY CHILDHOOD

Sarah Blankenship[1], Elizabeth Redcay[1], Tracy Riggins[1]; [1]University of Maryland, College Park — Recent magnetic resonance imaging (MRI) studies have revealed the importance of medial temporal lobe (MTL) structures, such as the hippocampus, and dorsolateral prefrontal cortex (DLPFC) for memory ability. These regions make independent contributions to memory, and increased functional connectivity between them has been associated with better memory performance during late childhood and adolescence. Little is known about the neural correlates of memory during early childhood. We investigated the influence of MTL and PFC structure and function on memory development in 4- and 6-year-old children and adults. We examined the volume and connectivity of memory-related regions using anatomical and resting-state functional MRIs. To date, we have collected MRI data from 10 4-year-old and 23 6-year-old children and 23 adults. As a measure of memory ability, participants completed a picture recall task which required them to view multiple lists of pictures and subsequently recall as many pictures as possible. Structural analyses revealed that, in children, left and right hippocampal volume was positively correlated with performance on the picture recall task ($r(31)=.397$, $p < .02$ and $r(31) = .481$, $p < .005$, respectively). In adults, whole-brain functional connectivity analyses revealed positive correlations between memory performance and left and right hippocampal connectivity with DLPFC. In children, correlations were observed between the hippocampus bilaterally and the Medial Frontal Gyrus, a different, more ventral and medial, region of PFC. These results suggest that, although the hippocampus and PFC are involved in memory during early childhood, the cortical network engaged may differ from that in adults.

D90

THE NEURAL CORRELATES MEDIATING AGE DEFICITS IN NOVELTY DETECTION

Caitlin R. Bowman[1], Nancy A. Dennis[1]; [1]The Pennsylvania State University — Past research finds age-related increases in false recognitions, indicative of a general deficit in novelty detection. This deficit increases when novel items are semantically or perceptually related to items from study. However, little work has examined the neural mechanisms older adults (OAs) engage to avoid false recognitions and identify new information as novel. The present study scanned young adults (YAs) and OAs during a retrieval task in which new items were exemplars from studied categories (related novelty) or exemplars of unstudied categories (unrelated novelty) in order to detect age-related differences in the neural correlates mediating novelty detection of related and unrelated items. Results from related novelty detection indicated that YAs engaged a network of regions including bilateral visual, parietal, and prefrontal cortex more so than OAs. Instead, OAs showed increases only in left occipitoparietal cortex compared to YAs for related novelty detection. This suggests that OAs engage visuospatial attention to support related novelty detection but show a reduced sensory signal and less cognitive control, diminishing their ability to make subtle distinctions between related items. Regarding unrelated novelty detection, YAs showed engagement of lateral temporal regions and inferior parietal cortex while OAs showed increased activity in early visual regions and fusiform gyrus. These results suggest that while YAs can identify novel unrelated items based on categorical information alone, OAs engage sensory processing and object recognition. Therefore, age-related deficits in related novelty detection may be due to both deficits in cognitive control processes as well as a reduced specificity of sensory processing.

D91

AGE-GRADED DIFFERENCES IN NEURAL CORRELATES OF MNEMONIC TRAINING

Yvonne Brehmer[1,3], Lars Bäckman[3], Hauke Heekeren[2], Ulman Lindenberger[1], Yee Lee Shing[1]; [1]Max Planck Institute for Human Development, [2]Freie Universität Berlin, [3]Karolinska Institute — Episodic memory (EM) performance increases during childhood, and decreases in adulthood, with accelerated decline in old age. Older adults generally profit less from mnemonic training than children and younger adults. We recently proposed a two-component framework of lifespan changes in EM functioning, distinguishing between two evolving and interacting components, one strategic and the other associative (Shing et al., 2008). The associative component relies primarily on the medial temporal lobes (MTL), whereas the strategic component depends primarily on the prefrontal cortex (PFC). Initial evidence suggests that the relative contributions of MTL and PFC to EM performance differ by age. However, this hypothesis has not been investigated in mnemonic training thus far. Here, we examine training-induced changes in neural correlates of EM among children aged 10-12, younger adults aged 20-25, and older adults aged 63-68 years. We used a multi-session training procedure with fMRI assessments (Siemens T3) at pretest and posttest while participants were memorizing word pairs. Trained participants showed greater performance gains from pretest to posttest than controls, regardless of age. Preliminary analyses of younger adults (N = 34) revealed activation increases in MTL and PFC with training, which correlated with performance gains. Based on the two-component framework, we expect that older adults will show fewer activation increases than children and younger adults, reflecting senescent changes in MTL and PFC regions. Furthermore, younger adults and children are expected to show greater training-induced increases in functional connectivity between PFC and MTL than older adults, allowing for more effective memory encoding after training.

D92

EXPLORING THE NEURAL CORRELATES OF ITEM FAMILIARIZATION IN NOVELTY DETECTION OF ASSOCIATIVE INFORMATION

Christina E. Johnson[1], Kristina M. Peterson[1], Nancy A. Dennis[1]; [1]The Pennsylvania State University — Novelty detection is critical to everyday cognition. It is not currently evident, however, what role familiarization plays in the process of novelty detection. The goal of this study was to elucidate the neural correlates of novelty detection across different degrees of familiarity. During training, participants became highly familiarized with individual faces and scenes. They then completed an associative encoding task including face-scene pairings composed of familiar items from the training phase, as well as pairs of new, unfamiliar items not included in training. Finally, participants completed an associative recognition test involving novel pairs created by recombining previous familiar (trained on) or unfamiliar (not trained on) pairs. Analyses centered on participants' ability to correctly detect novel recombinations, examining associative novelty detection based on levels of familiarization with the component items within recombined pairs. Behavioral results indicated that memory was facilitated by the familiarization process, in which one's ability to correctly reject novel recombinations was enhanced when individual items of novel pairs were previously familiarized with. Functional MRI analysis showed greater activity in posterior parahippocampal gyrus (PHG), a region associated with familiarity, for familiar versus unfamiliar recombinations. In contrast, novelty detection of recombined pairs composed of unfamiliar items was associated with greater activity in anterior PHG, a region associated with detecting novel, unfamiliar information. Our results suggest that, although all recombined pairs of items in the current analysis were indeed novel, novelty detection may be mediated by discrete regions within the medial temporal lobe when processing information within different levels of familiarity.

D93

TRUE MEMORY AND FALSE MEMORY FOR MOTION DIFFERENTIALLY ACTIVATE THE HIPPOCAMPUS AND THE PARAHIPPOCAMPAL CORTEX

Jessica M. Karanian[1], Scott D. Slotnick[1]; [1]Boston College — The hippocampus has been associated with both true memory and false memory. While the parahippocampal cortex has also been associated with true memory and false memory, there is some evidence that this region is preferentially associated with true memory (which is thought to reflect greater sensory contextual processing). However, relatively few studies have investigated the role(s) of medial temporal lobe sub-regions during true memory and false memory. In the present study, we used functional magnetic resonance imaging to measure activity in these sub-regions during true memory and false memory for motion. At encoding, participants viewed moving or stationary abstract shapes. At retrieval, participants classified shapes from encoding as previously in motion or previously stationary. A random effect general linear model analysis was conducted. Consistent with previous findings, the contrast of true memory ("moving"/moving) versus false memory ("moving"/stationary) and the reverse contrast produced distinct activations in the hippocampus; however, the number of activations was greater for the true memory versus false memory contrast. In direct opposition to previous work, the contrast of false memory versus true memory produced bilateral activity in the parahippocampal cortex, while the reverse contrast produced no activity in this region. Considered with previous evidence, our results suggest that the role of the parahippocampal cortex during true memory and false memory is task dependent. More broadly, the present findings suggest that the parahippocampal cortex mediates higher-level contextual processing rather than lower-level sensory processing during all forms of memory.

D94

COMBINED GENE EFFECTS ON HIPPOCAMPAL MNEMONIC PROCESSING: A LARGE-SCALE IMAGING-GENETICS STUDY OF APOE, BDNF, KIBRA, AND CLSTN2

Karolina Kauppi[1], Lars-Göran Nilsson[2], Rolf Adolfsson[1], Lars Nyberg[1]; [1]Umeå University, Sweden, [2]Stockholm University, Sweden — Twin studies have revealed that memory and related brain functions are highly heritable traits, but putative candidate genes have shown small and inconsistent effects –referred to as "the missing heritability". Little is known about the combined effect of several genes on brain function: whether the presence of one "risk" variant hides the effect of another, interacts with it, or increases the risk in an additive -or even multiplicative –way. In a large fMRI sample we explored the combined effect of polymorphisms with documented impact on brain activation in the medial temporal lobe (MTL) during episodic memory encoding or retrieval. Analyses of the effects of individual genes revealed decreased MTL activation for ApoE ε4 and BDNF Met alleles during encoding, and for Kibra CC and the CLSTN2 T allele during retrieval. Analyses of combined effects revealed that, during encoding, carriers of both the ApoE ε4 and the BDNF Met allele had lowest MTL activation, whereas non-carriers of both alleles had the highest activation in several MTL clusters. For most clusters, step-

wise regression analyses revealed that the addition of a second polymorphism increased the percentage of explained variance in BOLD signal. Similar clusters were seen for the combination of Kibra and CLSTN2 genotypes during retrieval, but here the difference in BOLD activation was mainly driven by one of the polymorphisms. In conclusion, our results highlight the importance of simultaneously considering several genetic variants.

D95

CLASSIFICATION AIDED ANALYSIS OF OSCILLATORY SIGNATURES IN CONTROLLED RETRIEVAL Nicholas Ketz[1], Tim Curran[1], Randall O'Reilly[1]; [1]University Colorado, Boulder — Control over memory retrieval is a ubiquitous process within humans, yet this process and its implications are not yet well understood. The current work, inspired by a similar fMRI design (Detre, Natarajan, Gershman, & Norman, in press), uses a modified Think/No-Think(TNT) paradigm to investigate the neural signatures of volition over enhancing and suppressing memory retrieval. Previous studies in this domain have shown a memory enhancement when well learned stimulus-pairs are restudied in cued recall ('Think of studied pair item'), and a degradation in memory performance when restudied with cued suppression ('Don't think of studied pair item'). As is the case in the current study, this memory effect has been somewhat difficult to replicate (Bulevich, Roediger, Balota, & Butler, 2006). We address these issues by using category based (faces vs. scenes) multivariate classification of Electroencephalography within a modified TNT paradigm to determine if individuals were successfully able to retrieve or suppress retrieval of the target pair image. A logistic regression using classifier determined retrieval success as a predictor for subsequent memory reveals the classic TNT pattern of enhanced memory for successful cued-retrieval and degraded memory for unsuccessful cued-retrieval. Further, this classification process allowed for a parametric investigation into the time-frequency signatures of cognitive control over retrieval. Current results, using a cluster based analysis, show Theta oscillations (3 to 8 Hz) as more prominent in controlled retrieval, and Alpha/Beta oscillations (8 to 20 Hz) as more prominent in controlled suppression. These results suggest contrasting roles for these frequency bands in episodic retrieval.

D96

SUCCESSFUL RETRIEVAL EFFECTS IN LATERAL POSTERIOR PARIETAL CORTEX DURING RECOGNITION OF PERCEIVED AND IMAGINED EVENTS UNDER HIGH AND LOW TARGET PROBABILITY CONDITIONS Danielle King[1], Misty Schubert[1], Jeanne Li[1], Michael Miller[1]; [1]University of California, Santa Barbara — The lateral posterior parietal cortex (PPC) has been shown to be associated with successful retrieval, although the precise functional contributions of this region to recognition memory remain uncertain. In two previous studies, we found that lateral PPC is sensitive to source, exhibiting significantly greater activity during retrieval of perceived compared to imagined events. This region has also been shown to be sensitive to target probability manipulations. Successful retrieval effects were more robust under low target probability conditions, when subjects tended to adopt a conservative response criterion, responding "old" only when they were fairly certain that items were studied, compared to high target probability conditions, when subjects tended to adopt a more liberal response criterion. Because individuals typically adopt a more conservative response criterion when making judgments about perceived compared to imagined events, we examined whether this difference in criterion placement could account for source-based differences in activity in lateral PPC. Subjects were scanned while making old/new recognition memory judgments about previously perceived and imagined events under conditions of low (30%) and high (70%) target probability conditions. The results revealed that lateral PPC is sensitive to both source as well as target probability. However, differences in criterion placement alone could not account for source-based differences in parietal activity. Supported by the Institute for Collaborative Biotechnologies through grant W911NF-09-0001 from the U.S. Army Research Office. The content of the information does not necessarily reflect the position or the policy of the Government, and no official endorsement should be inferred.

D97

EXPECTATIONS MODULATE ERP INDICES OF FAMILIARITY AND RECOLLECTION Emily Knight[1], Ian Dobbins[2], Logan Trujillo[1], Antonio Jaeger[2], David Schnyer[1]; [1]University of Texas at Austin, [2]Washington University in St Louis — Multiple event-related potential components have been identified that differentiate items previously experienced from novel items. fMRI findings by O'Connor, et al (2010) suggest that some old/new effects could be explained by subject expectations about an item's status in memory. This experiment examines the effects of cued expectations on ERP indices of memory. 64 channels of EEG were recorded from 24 participants while they engaged in a cued recognition memory task. Participants studied 50 words, followed by a test phase with old/new judgments to 100 words (50 old/ 50 new). Prior to memory probes, participants saw cues for 1500ms indicating if the upcoming word was "likely new" (LN), "likely old" (LO) or "unknown" (UN). Participants were explicitly informed that 75% of cues were valid. Mean amplitudes following the presentation of probe words were tested for two windows: 300-400ms and 500-700ms. Old probes elicited more positive waveforms than new probes in each range for all cue conditions at all scalp sites tested (left/right x anterior/posterior). Left posterior sites showed a significant interaction of probe type and cue type from 300-400ms, and a main effect of probe type from 500-700ms. This suggests that a component in an interval previously associated with familiarity is sensitive to expectations about memory. However, the later component (similar to ones previously associated with recollection) responds primarily on the basis of episodic content, indicating that at least one old/new effect is not driven exclusively by the successful retrieval of episodic content, but by congruence between expectations and retrieval outcomes.

D98

HUMAN HIPPOCAMPAL INTRACRANIAL RECORDINGS DURING SPATIAL NAVIGATION SUGGEST ALPHA OSCILLATIONS MAY BE AN INDICATOR OF BEING LOST Branden Kolarik[1,3], Andrew Watrous[2,3], Itzhak Fried[4], Arne Ekstrom[1,3]; [1]Department of Psychology, University of California, Davis, [2]Neuroscience Graduate Group, University of California, Davis, [3]Center for Neuroscience, University of California, Davis, [4]Department of Neurosurgery, David Geffen School of Medicine and Semel Institute for Neuroscience and Human Behavior, UCLA — Previous findings have demonstrated the importance of hippocampal delta and theta activity (humans: 1-8Hz) in memory and navigation. Less is understood about the possible role of alpha oscillations (8-12 Hz) in the human hippocampus during navigation. Recordings in human cortical areas suggests alpha plays a role in idling or inhibitory states, although this idea has not been tested or addressed directly in the human hippocampus. We recorded local field potentials from 198 hippocampal electrodes in 8 patients undergoing seizure monitoring while they played a virtual taxicab game requiring them to deliver passengers to designated targets in the environment. Learning was assessed based on excess path, which was calculated from the deviation from the most direct path from the passenger to the target location. These values were then used to categorize trials as either high or low excess path and served as a proxy for being lost. Analyses were conducted on times when the patient was moving in the virtual environment, ensuring engagement in the task. A bootstrapped t-distribution of mean power values at frequencies below 12Hz was used to calculate the number of electrodes with increased power for high>low excess path trials. We found significantly greater numbers of electrodes showing increases in alpha band power for high compared to low-excess path trials (63 and 23 electrodes respectively, $\chi 2(1,N=86)=18.60$ $p< .0001$). Our results suggest that alpha activity in the human hippocampus during navigation may serve as an indictor of being lost, possibly due to inhibition or disruption of the current representation.

D99

NEURAL CORRELATES OF MNEMONIC EXPERTISE Boris Nikolai Konrad[1], Martin Dresler[1,2], Kristina Hennig-Fast[3], Victor Spoormaker[1], Axel Steiger[1], Michael Czisch[1]; [1]Max Planck Institute of Psychiatry, Munich, [2]Stanford University, [3]Ludwig-Maximilians University, Munich — Memory athletes try to maximize the amount of data (f.e. digits or words) stored in given time periods using mnemonic techniques. These techniques make use of meaningful encoding by applying visual imagery that is associated with prelearned retrieval structures, usually spatial locations. 25 athletes ranked at

least Top 50 in the memory sports World Rankings took part in our study. All of them trained mnemonics for years and credited their memory performance solely on them. In contrast to Maguire et al. (2003) we found high intelligence (IQ 131 ± 12) in the athletes. The performance in a mental speed task was even more supreme compared to matched control subjects. We investigated the effect of intense learning on sleep and found that the sleep of memory athletes does not differ in any typical sleep EEG measure including spindle activity from the controls and remains unaffected by intense learning. We discuss that memory athletes have a deeper processing of information on top of the increased capacity based on cognitive test results and fMRI findings, which suggest that this is due to direct storage in long-term memory structures: Memory athletes learned 120 binary digits days before the fMRI scan, 120 binaries while being scanned and sets of only six binaries while being scanned. The fMRI results show that the last condition without mnemonics is distinct in brain activation to the two other conditions. Congruently, athletes only had superior recall, when they applied mnemonics in a direct forgetting paradigm.

D100

SELECTIVE AND CHRONIC CONFABULATION IN PERSONAL TEMPORALITY: A FOUR YEAR FOLLOW-UP STUDY

Valentina La Corte[1,2,3], Pascale Pradat-Diehl[1,2,3,4], Nathalie George[1,2,3], Gianfranco Dalla Barba[1,2,3,5,6]; [1]Université Pierre et Marie Curie-Paris6, Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, UMR-S975, Paris, France, [2]Inserm, [3]Cnrs, UMR 7225, Paris,, [4]AP-HP, Hôpital de La Pitié-La Salpêtrière, Service de médecine physique et de réadaptation, Paris, France, [5]AP-HP, Hôpital Henri Mondor, Service de Neurologie, Créteil, France,, [6]Dipartimento di Psicologia, Università degli Studi di Trieste, Italy — Clinical evidences show that confabulating patients retrieve personal habits or repeated events and mistake them for actually unique events (Habit Confabulations La Corte, 2010). According to the Memory, Consciousness and Temporality Theory (MCTT, Dalla Barba, 2002), this pathological condition does not reflect a pure memory disorder, but a disorder involving temporal consciousness (TC). TC means to become aware of something as part of a personal past, present or future. Confabulation is usually a transient phenomenon whereas amnesia often persists. In this study we report a patient, TA, who developed a chronic amnesic-confabulatory syndrome four years ago, following rupture of the right internal carotid siphon aneurysm. Our principal aim was to study the evolution of the amnesic-confabulatory syndrome. Confabulations were collected with the Confabulation Battery (Dalla Barba, 1993), which comprises 169 questions tapping various aspects of semantic and episodic memory. TA's confabulations were selective to the personal temporality (i.e questions concerning the personal past, present and future) over different evaluations; in contrast he never confabulated in questions tapping impersonal semantic knowledge. At qualitative level most confabulations consisted of Habits Confabulations. TA's brain MRI showed lesions involving right hippocampus, thalamus, fornix, mammillary bodies and parahippocampus. Moreover TA showed sub-cortical lesions in bilateral caudate nucleus, which has been rarely described in amnesic-confabulatory syndrome. In conclusion TA's confabulation reflects a chronic and selective pathological awareness of personal temporality. These findings are discussed within the framework of the different theories proposed to explain mechanisms underling confabulation and in particular within the MCTT.

D101

VISUAL IMAGERY ABILITY AND THE NEURAL CORRELATES OF RECOLLECTION

Emily Leiker[1], Jeffrey D. Johnson[1]; [1]University of Missouri — One aspect of episodic memory research that remains largely unexplored is whether general cognitive abilities that differ across individuals might be indicative of episodic retrieval ('recollection') performance. Here, we investigated the relationship between recollection-related brain activity and the ability to form vivid mental images, which is likely a pre-requisite for recollection. In particular, we focus on activity in left lateral parietal cortex that has been consistently linked to recollection as well to the amount of information retrieved. Subjects encoded words in the context of three tasks and two presentation durations, with the latter manipulation providing a means to encode different amounts (or presumably, vividness) of episodic information. On a later memory retrieval test, words were segregated according to whether or not they were accompanied by the recollection of any specific details. fMRI data acquired during both of these phases allowed for analysis of the task-related encoding information that was reactivated during retrieval. In a final experimental phase, subjects completed a questionnaire about visual imagery that has been previously shown to correlate with visual cortical activity. As expected, analysis of the fMRI data confirmed that left parietal activity was sensitive to recollection and, furthermore, to the amount/vividness of information encoded. Composite scores on the imagery questionnaire correlated with both of these effects as well as with the magnitude of reactivation present at retrieval. These findings provide initial support for a relationship between individuals' imagery abilities and the potential neural mechanism by which these abilities might aid episodic memory retrieval.

D102

HIPPOCAMPAL VOLUME CORRELATES WITH CHINESE VERBAL LEARNING TEST

Josiah K. Leong[1], Allen K. Lee[1], Jennifer S. Yokoyama[1], Joel H. Kramer[1], Bruce L. Miller[1], Howard J. Rosen[1]; [1]University of California, San Francisco — Previously developed tests for assessing memory impairment in mild cognitive impairment (MCI) and Alzheimer's disease (AD) were predominantly written in English and administered to English speaking subjects. These tests were validated by converging evidence from other neuropsychological measures and brain imaging data. Out of this framework the Chinese Verbal Learning Test (ChVLT) was developed to examine memory consolidation in Chinese speakers. The goal of this analysis was to demonstrate the relationship between ChVLT scores and hippocampal volume. The ChVLT consists of nine two-character nouns presented orally over four learning trials, with immediate recall after each learning trial. Recall is then assessed after a 30-second delay and a 10-minute delay. We administered the ChVLT to 12 MCI and 6 AD patients and obtained cortical volumes of regions of interest using the FreeSurfer processing stream on T1-weighted MRI images. A linear regression model including immediate recall performance after the last learning trial, overall level of cognitive impairment, years of education, age, volumes of cortical regions implicated in AD, and left hippocampal volume was predictive of list recall performance after a 10 minute delay ($R2 = 0.82$, $p < 0.01$), with hippocampal volume explaining 9.4% of the variance in delayed list recall performance. These results suggest that the ChVLT is sensitive to hippocampal function. Moreover, the ChVLT provides a new measure for detecting involvement of the hippocampus in degenerative disease and monitoring hippocampal function over time.

D103

THE TIME COURSE OF EPISODIC ASSOCIATIVE RETRIEVAL: ELECTROPHYSIOLOGICAL CORRELATES OF CUED RECALL OF UNIMODAL AND CROSSMODAL PAIR ASSOCIATE LEARNING

Daniel A. Levy[1], Roni Tibon[1]; [1]Interdisciplinary Center Herzliya — We recorded event-related scalp potentials during episodic cued recall following pair associate learning of unimodal object-picture pairs and crossmodal object-picture and sound pairs. In this paradigm, designed to minimize recognition process confounds, successful recall was characterized by scalp potential differences over pre-frontal areas as early as 150 ms post-cue presentation, as well as later differences recorded over frontal and parietal areas. Notably, cued recall success divergences over frontal areas were apparent in a time window generally assumed to reflect familiarity but not recollection, challenging that assumption. Furthermore, parietal scalp recall success differences did not distinguish between cross-modal and unimodal conditions, a convergence that may support attention-capture or buffer accounts of posterior parietal mnemonic function but not focal attention or representational accounts.

D104

AN ERP STUDY OF EPISODIC RETRIEVAL IN AMNESTIC MILD COGNITIVE IMPAIRMENT AND NORMAL ELDERLY WITH MATCHED PERFORMANCE

Juan Li[1], Xin Li[1]; [1]Institute of Psychology☒Chinese Academy of Sciences — Introduction: Impairments in episodic memory have been found to be the core features of amnestic Mild Cognitive Impairment (aMCI) patients. The current study aimed to explore the underlying neutral correlates for their deficits in episodic retrieval Methods: A source memory task was conducted on 15 normal controls (NC) and 16 aMCIs. ERPs were recorded during test phases. Difficulty was manipulated by varying the number of items presented for each study-test run. Results: Memory per-

formances were matched under easy condition between the two groups. Consistent with previous studies (e.g., Li etal, 2004), in NC group a mainly right parietal distributed, positive going old-new effect was observed around 400-800ms, while a reversed old-new effect (old items more negative going than new items) was discerned starting from 800ms till the end of epoch, which was left laterally distributed and proposed to reflect a perceptual-based retrieval strategy. In contrast, for aMCI group, the earlier parietal old-new effects parietal diminished, while the later left-lateralized negative effect was greatly enhanced, and even extended to the right hemisphere. Conclusions: These results indicated that aMCI patients, compared with normal older adults, used more perceptual details as retrieval cues, suggesting that their encoding may not deep enough so that their retrieval could not be carried out at a conceptual level. In addition, given that the ERP effects were different between the two groups despite of their comparable behavioral performances, these ERP effects may serve as neuromarkers which are more sensitive than behavioral measures for the early detection of AD.

D105

TOP-DOWN VS. BOTTOMS-UP? INTERMEDIATE PHENOTYPES FOR COGNITIVE CONTROL AND PERSONALITY MEDIATE THE EXPRESSION OF DOPAMINE GENES IN ADDICTION

Travis Baker[1], Tim Stockwell[1], Gordon Barnes[1], Roderick Haesevoets[1], Clay Holroyd[1]; [1]University of Victoria — Introduction: The development and expression of the midbrain dopamine system is determined in part by genetic factors that vary across individuals such that dopamine-related genes are partly responsible for addiction vulnerability. However, a complete account of how dopamine-related genes predispose individuals to drug addiction remains to be developed. Adopting an intermediate phenotype (IP) approach, we investigated whether behavioral and electrophysiological measures of reinforcement learning and cognitive control as well as personality risk factors for substance dependence mediate the influence of multiple dopamine-related genetic polymorphisms over substance use. Methods: We explored whether six candidate IPs —an electrophysiological measure of a cortical mechanism for reward processing and cognitive control, a behavioral index of a subcortical mechanism for reinforcement learning, and four personality risk factors associated with drug addiction (impulsivity, novelty seeking, depression proneness and anxiety sensitivity)—mediate the effect of nine dopamine-related genetic polymorphisms on substance dependence. Substance dependence data, together with data associated with personality risk factors, were collected from 812 undergraduate students. 196 returned on a subsequent day to participate in an electrophysiological and behavioral experiment and to provide saliva samples for DNA analysis. Results: Several dopamine-related neural pathways underlying individual differences in substance dependence were identified and statistically modeled, including its biological, cognitive, and personality manifestations. Conclusion: This study presents a theoretical framework for bridging the gap between genes and behavior in substance dependence and illustrates how future interventions might be individually tailored for specific genetic, cognitive and personality profiles.

D106

MISMATCHED NEGATIVITY AND BINGE DRINKING

Barbara Banz[1], Alana Campbell[1,2], Deana Davalos[1]; [1]Colorado State University, [2]UNC - School of Medicine — Alcohol intoxication influences how the brain responds to stimuli and is able to gate out stimuli. Research assessing early occurring measures of brain physiology, specifically the mismatch negativity (MMN), suggests that acute alcohol intoxication in non-alcoholics is associated with significant suppression of the MMN. In contrast, chronic alcohol use has been associated with increased MMN amplitude. The question remains as to how binge drinking, a behavior which is characterized by episodes of intoxication, but not necessarily associated with later alcohol abuse, is characterized neurophysiologically. Specifically, do binge drinkers have a neurocognitive profile more similar to chronic alcohol abusers and does this profile suggest differences in orienting and attention from their non drinking peers. In the current study, college aged participants had their brain waves recorded in response to an auditory MMN task in order to investigate these possible differences. Participants were categorized based on the frequency and patterns of binge drinking. Participants who reported greater binge drinking tendencies showed a difference in MMN compared to their peers that did not report such habits.

D107

NOVEL EPIDERMAL ELECTRONICS (EES) METHODOLOGY TO CAPTURE EVENT-RELATED BRAIN POTENTIALS (ERP)

Todd Coleman[1], Rui Ma[1], Raynard Fung[2], Michael Bajema[1], Thomas Albright[2], John Rogers[3], Ricardo Gil da Costa[2]; [1]University of California, San Diego, [2]Salk Institute, [3]University of Illinois, Urbana-Champaign — Recently, we reported the development and potential applications of an epidermal electronics system (EES) that uses ultrathin silicon islands interconnected by serpentine-like wires resting on a biologically inert flexible polymer. The EES is no thicker than a human hair, is flexible and stretchable, and is mechanically matched to the skin. It can measure and transmit information of activity produced by the heart, skeletal muscles and the brain. As such, there is great potential for a wide range of applications across clinical and scientific domains. Here, we further investigated the use of the EES, testing its ability to detect event-related brain potentials (ERPs). Specifically, the detection of: i) a sensory visual evoked potential (VEP) as elicited by a flickering checkerboard and ii) a P300 ERP in an attention modulation task, using natural images. The P300 ERP amplitude is inversely correlated with an item's subjective probability of occurrence, and has been widely used in visual target detection tasks. We recorded brain activity using either a conventional electroencephalography system (rigid electrodes) or an epidermal electronics system (EES) coupled to an external amplifier. Our results show that while the EES failed to adequately detect the sensory VEPs elicited by the flickering checkerboard, it was able to accurately detect the modulation of the P300 ERP responses to "target" vs. "distractor" images. This is the first report of the use of epidermal electronics for detection of ERPs, presenting EES as a viable and appealing alternative to conventional EEG systems for brain-machine interfaces related to cognitive processing.

D108

THE AUDITORY CONTRALATERAL ADVANTAGE AS A MODEL SYSTEM FOR STUDYING CONNECTIVITY

Doug Davidson[1], Phil Monahan[1], Ainhoa Bastarrika[1]; [1]Basque Center on Cognition, Brain, and Language — Previous M/EEG studies have successfully used dynamic causal modelling (DCM) for evoked responses to model connectivity networks, but there are few models of already-established connectivity differences in the auditory system. We studied whether DCM for M/EEG can effectively model the well-established asymmetrical response to left/right auditory stimulation. Participants (n=3) heard monaural pure tones on either the right or the left ear, and responses were recorded using MEG. To analyze these data, DCM models were constructed with single equivalent current dipole (ECD) sources in left and right auditory cortex, using a single-shell sphere model. We compared models with separate input to each source, versus models with a unitary input to both sources, and also models with and without lateral connections between the sources. Model comparison showed that the DCM without lateral connections, but with separate inputs to left and right cortex was the best account. This was true in both the planar gradiometer data, as well as the magnetometer data. These preliminary results suggest that DCM for M/EEG is an effective model for connectivity for the auditory evoked field.

D109

A MATLAB TOOL FOR SIMULTANEOUS EYE TRACKING AND EEG

Olaf Dimigen[1], Ulrich Reinacher[1]; [1]Humboldt University at Berlin, Germany — Although natural vision involves several eye movements per second, EEG data is usually recorded during steady fixation. An alternative approach to signal analysis, used in several recent studies (for review see Dimigen et al, 2011, JEP:General, 140, 552-72), is to time-lock the EEG to the onsets of saccades or fixations in unconstrained viewing situations. However, recording high-resolution eye movements with the EEG is also useful for other purposes: controlling fixation, detecting signal distortions from microsaccades, measuring saccadic reaction times, improving ocular artifact correction, gaze-contingent stimulus presentation (c.f., Dimigen, Kliegl & Sommer, 2012, Neuroimage, 62, 381-93), or coregistration of pupil diameter. To facilitate joint analyses of oculomotor and electrophysiological data, we wrote a plugin to the popular open source MATLAB toolbox EEGLAB, which imports and synchronizes eye tracking data and adds it as additional channels to the EEG. Saccades and fixations are either detected with an extended version of the velocity-based algorithm by Engbert & Mergenthaler (2006) or imported from the raw EDF file and then added to the existing EEGLAB

event structure. Additionally, ocular ICA components can be objectively rejected based on their covariance with the electrically independent eye track. Currently, eye trackers from SR Research (EyeLink) and SMI (e.g., IView X) are supported. Usage of the plugin is exemplified for an experiment investigating the relative contributions of visual, extraretinal, and oculomotor signals to fixation-related brain potentials (FRPs) during picture viewing.

D110

EXPECTATIONS ABOUT ACTION OUTCOME MODULATE ERP RESPONSES TO OBSERVED ACTIONS Ashley R. Drew[1], Lorna C. Quandt[1], Peter J. Marshall[1]; [1]Temple University — There is increasing interest in the determinants of anticipatory components in event-related potentials (ERPs) elicited to the observation of others' actions. In previous work we found differential changes in sensorimotor EEG rhythms during observation of reaches to similar different-colored objects that participants expected to be either heavy or light. In the current analysis, we examined whether effects of expected weight were also present in ERPs elicited to the onset of observed reaches. Prior work has not generally examined whether anticipatory ERPs to observed actions might vary with the expected outcome of the actions. In the current study, undergraduate participants (N=25) were given experience grasping and lifting a pair of cylindrical objects varying in weight (80g vs 1200g) and color (yellow/blue). EEG was recorded during the viewing of videos showing a hand reaching towards, grasping, and lifting the expected-heavy or expected-light objects. ERPs were computed for frontal and central sites for the 500 ms following the onset of reaching, relative to a pretrial baseline. The grand means showed a negative-going peak which may be a form of readiness potential or part of the contingent negative variation. While no differences were found at central sites, there was a significant main effect of expected weight for mean amplitude at frontal sites (F3/F4) with more positive mean amplitudes for the expected-light object. This effect of expected weight may indicate an anticipatory response related to the expected motor consequences of an observed action, which constitutes a potentially novel finding that suggests directions for future work.

D111

REMOVING INDEPENDENT EFFECTS OF THE PRIME ON TARGET ERPS IN MASKED PRIMING PARADIGMS Marianna Eddy[1,3], Jonathan Grainger[2], Phillip Holcomb[3]; [1]U.S. Army NSRDEC, [2]CNRS and Aix-Marseille University, [3]Tufts University — A concern in neuro-cognitive paradigms is how to untangle overlapping effects resulting from the presentation of multiple stimuli. By design, the masked priming technique compounds this problem by rapidly and consecutively presenting primes and masks immediately before the target. In ERP paradigms this close temporal proximity results in overlapping waveforms generated to consecutive events. Because temporal jittering of the prime-target presentation is not possible (an exact SOA is an important variable), little can be done to lessen the prime/mask impact on the target ERPs. We explored an alternative approach for removing activity from prime/mask events on target word ERPs. In this study we employed a masked priming paradigm with a forward mask (300 ms), word prime (50 ms), backward mask (20 ms), and word target (300ms) presented consecutively. Additional trials with the same primes as in the priming trials were presented using the same parameters; however no target stimulus was presented. This allowed us to create ERP waveforms reflecting processing of the prime + mask and then use this waveform to "subtract" the effect of the prime + mask from the priming trials which had prime + mask + targets. While the shape of the ERP components changed when subtracting out the effects of the prime + mask, the overall priming effects did not change, suggesting that this is a viable method for removing the independent influence of prime stimuli on target ERPs in experiments where primes necessarily differ across conditions.

D112

WORKING MEMORY IN TODDLERS WITH A HISTORY OF PVL: AN EEG POWER SPECTRUM ANALYSIS Maria Luisa Garcia Gomar[1], Efrain Santiago Rodriguez[2], Thalia Harmony[1]; [1]Unidad de Investigación en Neurodesarrollo "Dr. Augusto Fernández Guardiola", Departamento de Neurobiología Conductual y Cognitiva, [2]Neuroclin — Periventricular leukomalacia (PVL) is defined as white matter damage although it has also been described grey matter affection to structures like mediodorsal nucleus related to working memory (WM). WM is the active retention of information for a prospective action. It has been found that toddlers present more theta-alpha activity during WM tasks. The aim was to study WM in toddlers with a history of PVL and compare them with controls. 10 toddlers with a history of PVL and 10 controls between 24 and 27 months old were included in the study. Toddlers were assessed with a visuospatial delayed response task with synchronic EEG record. There were not significant differences in correct answers between controls (67.5%) and toddlers with a history of PVL (57.1%). To evaluate differences in the narrow band power spectrum between groups and during baseline, attention and memory a two way ANOVA was used. In the healthy group, it was recorded increased power on memory in comparison to attention on 2.34 Hz over bilateral frontal and right temporooccipital regions, on 15.23 Hz over right parieto-occipital regions ($p \square 0.05$). In PVL group it was recorded increased power on memory in comparison to attention on 1.56 Hz over bilateral frontal regions, and from 9.37 to 11.33 Hz over bilateral frontal and left centro-temporal regions ($p \square 0.05$). Although no behavioral differences were found in WM task, significant differences were found in brain electrical oscillations. Toddlers with PVL have a different electric pattern secondary to anatomic damage characteristic of PVL.

D113

THE SITUATED MEANING OF MATHEMATICAL SYMBOLS: ERPS TO MATHEMATICAL EQUATIONS ARE MODULATED BY THE RELATION BETWEEN ACCOMPANYING SPEECH AND GESTURE Seana Coulson[1], Tyler Marghetis[1], Susan Cook[2], Susan Goldin-Meadow[3]; [1]UC San Diego, [2]University of Iowa, [3]University of Chicago — When children explain their mathematical reasoning, they combine speech and gesture to communicate their problem-solving strategies, often pointing to co-situated equations. Children sometimes convey different strategies in gesture than in speech; these speech-gesture "mismatches" are known to predict when a child is ready-to-learn. Here we used event-related potentials to study whether the relation between speech and gesture affects the processing of associated equations. In Experiment 1, participants viewed naturalistic video-recordings of children explaining their solutions to mathematical equivalence problems, followed by a still image of the correct solution (e.g., "8+2+3=8+5"). The children in the videos either solved the problems correctly or incorrectly, and the strategies expressed in speech and gesture either matched or mismatched, producing a 2 (Correctness) x 2 (Match) within-participants design. The correct solution was followed by a list of strategies; participants' task was to indicate which strategies the child used to solve the problem. ERPs were time-locked to the onset of the still of the correct equation. The relation between speech and gesture affected the semantic processing of the equation: Equations following Mismatch videos elicited a larger N400 component than Match videos. Experiment 2 was identical to Experiment 1 except participants had to indicate whether the child had solved the problem correctly. Unlike Experiment 1, ERPs revealed no effect of gesture-speech Match. Thus, processing of mathematical equations was modulated by the relation between speech and gesture—but only when participants attended to the reasoning process (the child's strategy) rather than the outcome (whether the child was correct).

D114

SENSORIMOTOR DEFICIT IN UNILATERAL NEGLECT AS REVEALED IN A MENTAL ROTATION TASK Luca De Simone[1], Stefania Riggi[1], Tomasino Barbara[2], Passarini Laura[3], Aiello Marilena[1], Eleopra Roberto[4], Vallar Giuseppe[5], Rumiati Raffaella[1]; [1]SISSA - International School for Advanced Studies — Unilateral neglect (UN) patients may fail to report sensory events occurring in the contralesional side of space or to explore through motor acts that portion of the space. In the present study we tested 20 patients with right-brain damage, 10 of whom with and 10 without UN. Patients performed two mental rotation tasks by either applying an effector- based (sensorimotor) transformation or an object-based (visuo-spatial) transformation. In the effector-based transformation, patients were asked to decide whether a rotated hand was left or right, while in the object-based transformation, they were asked to decide if a red dot was on the left or right side of a hand. Stimuli could be either left or right hands presented in a palm or back perspective, and could appear either on the left, on the right or on the center of a computer screen. The key result shows that patients

with UN were impaired when they performed mental rotation using the effector-based transformation on left hands. The present finding suggests that UN is associated with a deficit in coupling visual information with proprioceptive signals arising from the left side of the body which, being affected, selectively reduces the patients' ability to apply sensorimotor transformations.

D115

MULTISENSORY INTEGRATION OF VISUAL AND MOTION CUES IN A MOTION SIMULATOR: AN ANALYSIS OF THE P3 EVENT-RELATED POTENTIAL COMPONENT

John G. Grundy[1], Martin v. Mohrenschildt[1], Stefan A. Nazar[1], Judith M. Shedden[1]; [1]McMaster University — We used event-related potentials (ERP) to examine brain responses to visual and motion cues in a motion simulator. The P3 is an ERP component associated with higher-order cognitive processing in the detection of important or novel events. This component is a reliable index for the integrity of sensory systems and can be informative in revealing processes involved in multi-sensory integration. A robust P3 component has recently been observed in response to self-motion cues as experienced in a motion simulator. Here, we examine the integration of visual and motion cues and show a P3 component that is distinct in both amplitude and topography from the P3 elicited by visual or motion cues alone. Multisensory integration and practical implications for training operations in a motion simulator are discussed.

D116

SENSORY ATTENUATION FOR JOINTLY-PRODUCED ACTION EFFECTS

Janeen Loehr[1]; [1]University of Saskatchewan — Successful interpersonal coordination often requires people to distinguish between their own and others' contributions to a shared task. One mechanism that is thought to underlie a self-other distinction is sensory attenuation, whereby the sensory consequences of one's own actions are reduced compared to other sensory events. Previous research has shown that the auditory N1 event-related potential (ERP) is reduced for self-initiated compared to externally-generated tones. The current study examined whether attenuation also occurs for jointly-initiated tones, which require two people to coordinate their actions to produce a single tone. ERP responses were measured when participants generated tones alone (tone onset immediately followed the participant's button press) or with a partner (tone onset immediately followed the participant's or the partner's near-simultaneous button press, whichever occurred last). N1 attenuation was smaller for jointly-initiated tones compared to self-initiated tones. Furthermore, for jointly-initiated tones, smaller delays between the participant's button press and tone onset were associated with greater attenuation. These findings indicate that sensory attenuation differentiates between one's own and others' contributions to sensory events, even when two people act together to produce a single shared effect.

D117

THE MOTOR SYSTEM DOES NOT PLAY A ROLE IN AV INTEGRATION: EVIDENCE FROM THE MCGURK EFFECT UNDER ARTICULATORY SUPPRESSION AND FMRI

William Matchin[1], Greg Hickok[1]; [1]University of California, Irvine — Visual speech influences the perception of heard speech. A classic example of this is the McGurk effect, whereby an auditory /pa/ overlaid onto a visual /ka/ induces the fusion percept of /ta/. Recent behavioral and neuroimaging research has highlighted the importance of both articulatory representations and motor speech regions of the brain, particularly Broca's area, in processing visual speech. We assessed the claims regarding the involvement of the motor system in visual speech in two experiments: (i) examining the effect of articulatory suppression on the McGurk effect, and (ii) comparing the activation in frontal-motor brain regions for auditory, visual, audiovisual and McGurk speech to articulatory rehearsal using functional magnetic resonance imaging (fMRI). The hypothesis regarding experiment (i) is that if the motor system plays a substantial role in McGurk fusion, distracting the motor system through articulatory suppression should result in a reduction of McGurk fusion. The results of experiment (i) showed no such reduction. The hypothesis of experiment (ii) is that if motor speech regions are responsible for the McGurk effect, they should show a response profile consistent with AV integration: activation for both auditory and visual speech, with enhanced activation for AV speech. The results of experiment (ii) demonstrate an activation profile inconsistent with multisensory integration: activation in motor speech regions (regions showing response to subvocal articulation) was strongest for visual speech with almost no activation for auditory speech. The combined results suggest that the processing of visual speech does not rely on the speech production system.

D118

TWO PLUS BLUE EQUALS GREEN: THE MINIMAL COST OF DOING MATH WITH COLORS IN GRAPHEME-COLOR SYNESTHESIA

J. Daniel McCarthy[1], Lianne N. Barnes[1], Gideon Paul Caplovitz[1]; [1]University of Nevada, Reno — In grapheme-color synesthesia, graphemes (e.g., numbers or letters) evoke color experiences. Synesthesia is generally considered to be a unidirectional phenomenon: graphemes can activate experiences of color, but colors will not generate experiences of graphemes or the symbolic information they represent. However, recent research using implicit measures has provided some evidence that colors can elicit symbolic representations of the associated grapheme. Here, we examine the degree to which such elicited representations can be cognitively accessed. Using a mathematical verification task (e.g., 2 + 3 = 5, true/false?) replacing one or more of graphemes with color patches, we find that synesthetes can verify such problems with colors as fast and accurately as with graphemes. Moreover, we find no measurable cost for switching between equations formed with graphemes and colors. This demonstrates that given specific task demands, synesthetes can cognitively access symbolic information elicited by physical colors as effectively and efficiently as with specific graphemes.

D119

MANIPULATING ACTION IN THE MIRROR BOX ILLUSION

Jared Medina[1], Priya Khurana[2], H. Branch Coslett[3]; [1]University of Delaware, [2]Haverford College, [3]University of Pennsylvania — We examined the role of vision and action in representing limb position by manipulating body position and movement using a novel mirror tapping illusion. We placed participants in a modified mirror box, in which they viewed their left hand and a reflection of their left hand (which looked like their right hand) in the mirror. Participants placed their index fingers against the mirror, and were instructed to tap on the mirror with both hands either synchronously or asynchronously. Between blocks, we manipulated the distance of the hidden right hand from the mirror (0, 6, and 12 inches). After one minute of tapping or no movement, participants reported the perceived location of their right hand, relative to the mirror. In all conditions, visual feedback created the illusion that the right hand was touching the mirror. In the 6 and 12 inch conditions, participants consistently felt that their right hand was closer to the mirror compared to its actual position. This illusory displacement was significantly greater after synchronous tapping compared to asynchronous tapping and no movement. Participants also filled out a questionnaire on the illusion, including perceived location, ownership of the mirrored hand, deafference, and affect. High ratings of limb ownership were correlated with greater displacement towards the mirror in the synchronous tapping condition. However, in the asynchronous condition, high ratings of limb deafference were correlated with greater illusory displacement. These results provide evidence regarding how action information is integrated with higher-order body representations to provide estimates of limb position.

D120

MORPHOLOGICAL CONSTRAINTS MODULATE THE EFFECTS OF TOOL USE ON BODY REPRESENTATIONS

Luke E. Miller[1,2], Matthew R. Longo[3], Ayse P. Saygin[1,2]; [1]University of California, San Diego, [2]Kavli Institute for Brain and Mind, [3]Birkbeck College, University of London — Research over the past decade has established that tools can become incorporated into representations of the user's body. Using a long grabber lead to a systematic mislocalization of touch distally along the user's arm (Cardinali et al., 2009, CB), suggesting that tool use elongates the user's arm representation. However, no change in the length of the hand representation was found. One possible explanation for the lack of modulation comes from the body model hypothesis (Tsakiris, 2010 EBR), which states that visual similarity between an object and body part is a necessary condition for plasticity to occur. According to this hypothesis, the lack of visual similarity between the grabber and the hand might have been the reason plasticity did not

occur on the hand. To test this hypothesis, we administered a tactile distance judgment task before and after tool use in two experiments. Wooden points at variable distances were used to touch an experimental (dorsum of hand) and a control (forehead) site. Subjects made judgments about which stimulus had the greatest distance between the two points. In the first experiment, subjects used a dynamic hand-shaped tool to pick up objects. Use of the hand-shaped tool significantly modulated the shape of the hand representation as measured by anisotropy of tactile size perception. In contrast, no change was found in the second experiment, when subjects used a long grabber. These findings demonstrate that the visual form of the tool plays a mediating role in whether tool use leads to plasticity to body representations.

D121

WHAT DETERMINES WHEN: THE VISUAL AREAS THAT ARE CRITICAL BOTTLENECKS FOR RAPID, FINE DISCRIMINATION OF SHAPE IN TWO AND THREE DIMENSIONS.

Justin Ales[1], Benoit R. Cottereau[2], Anthony M. Norcia[1]; [1]Stanford University, [2]Centre de Recherche Cerveau et Cognition (CerCo) — The ability to discriminate between different shapes underlies our ability to recognize an enormous range of objects across many environments. Information about the shape of an object is carried both by the object's 2D boundary, defined by texture discontinuities, as well as its 3D boundary specified by disparity. Here we used fMRI-informed EEG source-imaging to localize the cortical areas responsible for two fine perceptual discriminations, one involving 2-D shape discrimination and the other 3-D disparity discrimination. For both tasks, contrasting stimulus-locked responses from trials containing changes that were correctly detected (hits) with trials in which no change occurred (correct-rejects) revealed stimulus-locked, target-selective activity in several occipital visual areas. During the 3-D disparity discrimination task, activity first appeared in the V4 and V3A regions of interest (ROI) and subsequently in the lateral occipital complex (LOC) ROIs. During the 2-D boundary discrimination however, activity first appeared in the LOC ROI and subsequently in the V4 and V3A ROIs. The V1 ROI did not show target-selective responses in either task. We next used response-locked analysis to analyze the timing and source distribution of evoked responses that predicted the timing of the behavioral response. In the 3-D task, activity appeared first in the V4 ROI, while for the 2-D task activity first appeared in the LOC ROI, consistent with the stimulus-locked results. Our results indicate that although the same network of three visual areas is activated for both 2-D and 3-D discriminations, the task determines which visual area acts as the critical bottleneck.

D122

FURTHER EVIDENCE OF WHORFIAN EFFECTS TO THE RIGHT VISUAL FIELD IN PRESENT-ABSENT AND POP OUT TASKS

Abdulrahman Al-rasheed[1], Drivonikou Vicky[2], Ian Davies[2]; [1]Department of Psychology. University of King Saud. Riyadh, KSU., [2]Department of Psychology. University of Surrey. Guildford. UK. — Abdulrahman S. Al-Rasheed1,Drivonikou2, V, and Ian R. L. Davies2. 1Department of Psychology. University of King Saud. Riyadh, KSU. 2Department of Psychology. University of Surrey. Guildford. UK. The Left Hemisphere (LH) bias in colour Categorical Perception (CP) has been related to the linguistic nature of the LH and converging evidence to support this hypothesis has been presented (e.g., Gilbert et al. 2006; Drivonikou et al. 2007 a & b; Roberson et al. 2008; Tan, Chan, Kay, Khong, Yip & Luke, 2008; Liu et al. 2009). However, So far, all studies that tested the lateralised CP effect have used either the visual search task of Gilbert et al (2006) or the target detection task of Drivonikou et al (2007) with most of these tasks involving a spatial decision about whether the target is on the left or the right, and it is important to establish that the effect is independent of the detailed methods used. Here, we extended the investigation to include two other types of tasks: First, varying the number of distractors affects lateralised CP (Experiment 1) and then whether removing the spatial decision (left or right of fixation) affects lateralised CP (Experiment 2). Forty native English-speaking undergraduates recruited from the student population of the University of Surrey the UK were participated in this study. The results showed that the pattern of lateralisation was independent of the number of distractors, confirming that, detecting a target colour amongst differently coloured distractors is a 'pop-out' task, and confirming that the LH bias is invariant across basic changes in the nature of the task.

D123

PREDICTING MULTIPLE STIMULUS FEATURES IS ASSOCIATED WITH PROCESSING COSTS

Magda Altman[1], David Melcher[1,2], Uri Hasson[1,2]; [1]University of Trento, [2]Center for Mind/Brain Sciences (CIMeC), University of Trento — The brain's ability to encode environmental regularities licenses predictions regarding upcoming events and enables appropriate anticipatory behaviors. A core question is whether prediction-related processes are mediated by systems specialized for predictions about specific stimulus dimensions, or via a general system that mediates predictions about different dimensions. To address this issue, we examined whether being able to predict both the category of a forthcoming image and its location (i.e., 'what' and 'where') results in decreased performance as compared to conditions where either the location or category could be predicted, but not both. We constructed 4 types of stochastic series where participants could predict the location of the next image, the image category, both location and category, or neither feature. Series were presented while participants performed an incidental task. Eye tracking investigated how regularities influence the temporal and spatial coordinates of eye movements. Location regularities improved various performance metrics including predictive positioning prior to stimulus onset, earlier saccade latencies to targets, more efficient saccade dynamics, earlier fixation onsets and better performance in both detection and memory. Several benefits were also found for series with category regularities. Crucially, the condition in which both category and location were predictable incurred costs relative to the condition where only location was predictable: it interfered with predictive positioning, increased target dwell times, and reduced performance in the incidental task. We conclude that parallel encoding of independent location and category regularities is possible, but incurs costs in terms of prediction as well as online and offline processing/information consolidation.

D124

DIFFERENTIAL CONNECTIVITY WITHIN THE PARAHIPPOCAMPAL PLACE AREA

Christopher Baldassano[1], Diane M. Beck[2], Li Fei-Fei[1]; [1]Stanford University, [2]University of Illinois at Urbana-Champaign — The Parahippocampal Place Area (PPA) has traditionally been considered a homogeneous region of interest, but recent evidence from both human studies and animal models has suggested that PPA may be composed of functionally distinct subunits. Macaque parahippocampal cortex exhibits distinctive changes in connectivity along the anterior-posterior axis, suggesting that anterior and posterior segments of human PPA might also have differential connectivity properties. To investigate this hypothesis, we utilize a functional connectivity measure for fMRI that can estimate connectivity differences at the voxel level. Applying this method to whole-brain data from two experiments, we provide the first direct evidence that anterior and posterior PPA exhibit distinct connectivity patterns. Anterior PPA is more strongly connected to regions in the default mode network, including the parieto-medial temporal pathway consisting of the caudal Inferior Parietal Lobule (cIPL) and Retrosplenial Cortex (RSC). Posterior PPA is more strongly connected to occipital visual regions, including the Lateral Occipital Complex (LOC) and the Transverse Occipital Sulcus (TOS). We further show that object sensitivity in PPA also has an anterior-posterior gradient, with stronger responses to images of abstract sculptures in posterior PPA than in anterior PPA. Our findings not only reinforce the link between PPA and macaque parahippocampal regions, but also demonstrate that PPA is actually composed of at least two regions operating on different types of visual information, shedding new light on the controversy over its functional properties.

D125

FUNCTIONAL AND EFFECTIVE CONNECTIVITY DYNAMICS OF SEMANTIC PROCESSING DURING WORD READING

Nicolas Bedo[1], Lawrence Ward[1,2]; [1]University of British Columbia, Department of Psychology, [2]UBC Brain Research Centre — Many neural processes underlying word reading remain obscure. Importantly, the flow of information within and between language networks during word reading has not been adequately explored. One such network involves semantic processing. Semantic network ROIs have been identified in reading, but how this network engages with other reading networks remains unclear. We investigated differences in functional and effective connectivity when reading letter strings with semantic content (words), as opposed to letter strings absent of seman-

tic content (consonant strings). EEG was recorded from healthy volunteers with no reported learning or reading disabilities, during a reading task. Participants viewed sequences of three letters, each followed by either a three-letter word or a consonant string. Participants responded as to whether or not the string matched the letter sequence. Independent component analysis of the EEG data followed by dipole fitting of single dipole topographic maps identified many sources of neural activation previously associated with word reading, including the visual word form area (VWFA), left STG, angular gyrus (Wernicke's area), and left IFG (Broca's area). As expected, strings with semantic content produced a more extended pattern of theta-band phase synchronization over time and brain regions compared with consonant strings. Analyses of directed information transfer indicated extensive information transfer beyond the VWFA into semantic processing areas for words, whereas consonant strings produced little information flow to to these regions. These results begin to extend our knowledge of reading in the brain beyond the functional anatomy into the dynamics of information transfer among brain networks.

D126

SYNESTHETIC GRAPHEME-COLOR PERCEPTS EXIST FOR NEWLY ENCOUNTERED HEBREW, DEVANEGARI, ARMENIAN AND CYRILLIC GRAPHEMES

Christopher Blair[1], Marian Berryhill[1]; [1]University of Nevada, Reno — Those with grapheme-color synesthesia experience specific color percepts when viewing symbols. For most synesthetes, these experiences have been present for as long as they can remember. Are such associations formed in the brain during a critical period early in development, or can new associations be formed and/or changed with appropriate exposure? Grapheme-color synesthete MC2 studied abroad in India where she was exposed to the Devanegari alphabet for the first time. During her six months abroad, her color associations for Devanegari, Latin, and Hebrew (with which she had no prior experience and no exposure) alphabets were regularly tested. We later longitudinally tested MC2, another synesthete, DN, and two non-synesthetic controls on Cyrillic and Armenian graphemes. When presented with Cyrillic letters, participants heard the letter name to test for the effect of phonemic information on the development of grapheme-color associations. These studies showed the following: synesthetes can form synesthetic color percepts for graphemes first encountered during adulthood, these percepts are present from the first exposure, and synesthetic percepts stabilize over time but this is not facilitated by phonemic information. Control participants never matched the synesthetes' performance. These findings confirm that synesthetic color-grapheme associations are not dependent on a critical period of early childhood development. They also suggest the existence of a general grapheme-color association mechanism in color-grapheme synesthetes.

D127

HEMISPHERE-SPECIFIC CONTRIBUTIONS OF RHYTHMIC FRONTAL ACTIVITY TO HUMAN VISUAL PERFORMANCE: A TMS STUDY

Lorena Chanes[1], Romain Quentin[1], Antoni Valero-Cabre[1,2,3]; [1]Université Pierre et Marie Curie, CNRS UMR 7225-INSERM UMRS S975-ICM, Paris, France, [2]Laboratory for Cerebral Dynamics Plasticity & Rehabilitation, Boston University School of Medicine, Boston, USA, [3]Cognitive Neuroscience and Information Technology Research Program, Open University of Catalonia (UOC), Barcelona, Spain — Despites growing evidence of the fundamental role played by cerebral oscillations in neural signaling and processing, the region- and hemisphere-specific contributions of brain oscillatory activity to human visual cognition remains to be causally explored. In two groups of participants, we applied 4-pulse real or sham TMS bursts either to the left or the right Frontal Eye Field (FEF) to induce rhythmic activity patterns and study the impact on the visual detection and categorization of low-contrast near-threshold targets. In separate experimental blocks, and in order to assess the effects of frequency, frequency-specific (rhythmic) TMS bursts at a high-beta (30 Hz) frequency were compared to non-frequency-specific (arrhythmic) patterns, matched in duration and number of pulses. Our interventions revealed hemisphere-specific modulations of frontal oscillatory activity on the visual detection task. More specifically, the right FEF frequency-specific high-beta TMS bursts enhanced perceptual sensitivity (d') as compared to sham, whereas no visual performance effects derived from the use of non-frequency-specific patterns. In contrast, on the left FEF, only the non-frequency-specific TMS pattern yielded significant perceptual sensitivity (d') improvements, whereas no visual performance effects emerged from the use of frequency-specific high-beta bursts. No significant modulations were observed for the categorization task for any of the TMS patterns used. Our results provide causal evidence in favor of hemisphere-specific frontal contributions to the modulation of visual performance and suggest different oscillation-based mechanisms for the right and the left FEF in such phenomena.

D128

LATERALIZATION OF THE N170 FOR ACTIONS THAT ENGAGE THE VENTRAL VISUAL STREAM

Leanna Cruikshank[1], Jeremy Caplan[1], Anthony Singhal[1]; [1]University of Alberta — The N170 event-related potential (ERP) component is elicited in response to visual stimuli, and is thought to signify early perceptual processing and classification of visual objects. Recently, it was suggested that the N170 may reflect more general ventral stream processes, and evidence has linked this component to motor planning and perception for action (Cruikshank et al., 2012). Specifically, the N170 was more negative in amplitude when participants reached towards targets that were occluded, compared to directly visually available. These types of actions rely on previously stored perceptual representations and are often referred to as memory-guided actions. The enhancement of the N170 over the contralateral hemisphere for memory-guided actions supports a theory that the N170 may be a marker of neural activity within the ventral stream. However, in the aforementioned study, only right-handed actions were examined. If the N170 does indeed reflect ventral stream activity, it should also be more negative in amplitude over the right hemisphere for left-handed memory-guided actions. To test this hypothesis, participants were auditorily cued to touch target dots on a touchscreen. Two viewing conditions varied with respect to the contribution of the ventral stream during response initiation. In condition 1, the target disappeared with movement initiation. In condition 2, it disappeared with the cue to respond. The N170 was larger in amplitude for condition 2 over both hemispheres; however, a laterality effect was found only for condition 2. These results further support the theory that the N170 is an electrophysiological marker of ventral stream activity.

D129

TO CROSS OR NOT TO CROSS: MONITORING DECISIONS BASED ON EVERYDAY LIFE EXPERIENCE IN A SIMULATED TRAFFIC TASK

Evelien Kostermans[12], Renske Spijkerman[12], Rutger C.M.S Engels[2], Harold Bekkering[1], Ellen R.A de Bruijn[3]; [1]Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behavior, Nijmegen, the Netherlands, [2]2Radboud University Nijmegen, Behavioral Science Institute, Nijmegen, the Netherlands, [3]Leiden University, Institute of Psychology, Unit of Clinical Psychology and Leiden Institute for Brain and Cognition, Leiden, the Netherlands — ERP studies have identified the feedback-related negativity (FRN) component in relation to processing feedback which indicates that a particular outcome was worse than expected. In addition, according to the conflict-monitoring theory the stimulus-locked N2 reflects pre-response conflict. Although formulated around different principles, these theories share the notion that both conflict and error-signals function as a warning signal to improve behavior. Assumptions of these theories have been made on the basis of relatively simple response-mapping tasks, rather than more complex decision-making processes associated with everyday situations. The question remains whether expectancies and conflicts induced by everyday knowledge similarly affect decision-making processes. To answer this question, participants in the current study had to engage in a simulated traffic task that varied high and low ambiguous situations at an intersection by presenting multiple varying traffic light combinations. The tendency to cross was more pronounced for traffic light combinations that in real-life are associated with proceeding, as opposed to more ambiguous traffic light combinations not uniquely associated with a specific response. On a neurophysiological level, the stimulus-locked N2 was enhanced on trials that induced experience-based conflict. Although the FRN was more pronounced for negative as compared to positive feedback, this component did not differ as a function of everyday expectancies in relation to traffic rules. The current study shows that well-learned everyday rules may influence decision-making processes in situations that are associated with the application of these rules, even if responding accordingly does not lead to the intended outcomes.

D130

NEURAL CORRELATES OF ABSTRACTION AND EXEMPLAR BASED CATEGORY LEARNING

Robert Lech[1,2], Onur Güntürkün[1,2], Boris Suchan[1,2]; [1]Institute of Cognitive Neuroscience, Ruhr University Bochum, [2]International Graduate School of Neuroscience, Ruhr University Bochum — Categorical learning in humans can be based on abstraction or exemplar based learning of stimuli. The aim of this study was to examine the contributions of different brain structures to these two processes using functional magnetic resonance imaging (fMRI). Twenty healthy right-handed subjects were scanned in a 3T magnetic resonance scanner while performing a categorization task. Fourteen circular stimuli with six color dimensions were divided into two families, each family consisting of a prototype, five typical stimuli differing in only one dimension, and one exception that shared more dimensions with the other family. The participants had to decide if a stimulus belongs to family one or two, receiving feedback after every trial. Behavioral data shows a replication of previous findings, with a faster learning of prototypes and typical stimuli, and a switch from an abstraction based to an exemplar based categorization for exceptions in the later learning phases. Imaging data reveals activation in the PFC, striatum, cingulate cortex, medial temporal lobe and parietal lobe for the categorization of exceptions. Moreover, an interaction of stimulus type and learning phase (learned vs. unlearned stimuli) yields activation in the prefrontal cortex, showing its involvement in category learning and strategy switching. These results suggest differing neural substrates for abstraction and exemplar based category learning and an involvement of widespread cortical and subcortical networks, especially the PFC.

D131

DISTORTION OF PROPORTION ESTIMATION IN SENSORY JUDGMENT

Ya Hsuan Liu[1], Shih Wei Wu[1,2], Chun I Yeh[3]; [1]Institute of Neuroscience, National Yang-Ming University, [2]Brain Research Center,National Yang-Ming University, [3]Department of Psychology, National Taiwan University — In many situations, in order to make a decision, the organisms have to go through a two-step process. First, they need to analyze information coming from the environment and second, they need to use the result of their analysis to guide decision computations. While it has been well documented that humans distort information during decision making (step 2), less is known how and to what extent information is distorted in the analysis of sensory information (step 1). In a sensory judgment task, the subjects were presented with a rectangular patch filled with black and white squares on a gray background and were asked to estimate the proportion of either the black or white squares in the stimulus. There were 7 different proportions (40 trials each). On half of the trials, subjects were asked to estimate the proportion of black squares and to estimate the proportion of white on the other half of trials. The subjects were not given feedback on the actual proportion during the experiment. We found that the subjects (n=10) on average showed patterned deviation in their proportion judgment. When the actual proportion of black was below 0.3, the subjects overestimated the proportion, with the peak of deviation at around 0.1. On other hand, the subjects tended to underestimate proportion of black when the actual proportion was greater than 0.3 with the maximum underestimation taking place at around 0.7. This suggested that distortion of information could take place during sensory judgment prior to decision making.

D132

GENDER DIFFERENCES IN OXYTOCIN-ASSOCIATED DISRUPTION OF DECISION BIAS DURING EMOTION PERCEPTION

Spencer Lynn[1], Elizabeth Hoge[2], Laura Fischer[2], Lisa Feldman Barrett[1,2], Naomi Simon[2]; [1]Northeastern University, [2]Massachusetts General Hospital — Oxytocin is associated with differences in the perception of and response to socially mediated information, such as facial expressions. Across studies, however, oxytocin's effect on emotion perception has been inconsistent. Outside the laboratory, emotion perception involves interpretation of perceptual uncertainty and assessment of behavioral risk. An account of these factors is largely missing from studies of oxytocin's effect on emotion perception and might explain some inconsistency of results. Of relevance, studies of oxytocin's effect on learning and decision-making indicate that oxytocin attenuates risk aversion. We used the probability of encountering angry faces and the cost of misidentifying them as not angry to create a risky environment wherein a bias to categorize faces as angry would maximize point earnings. Forty participants (45% women) received 30 IU intranasal oxytocin or placebo before testing. Oxytocin was hypothesized to be associated with insufficient bias, due to an underestimation of the factors creating risk, the encounter rate and cost. Men given oxytocin were less influenced by cost and base rate, exhibiting a less liberal (i.e., worse) response bias, than men given placebo ($p<0.037$). Oxytocin did not influence women's performance. These results suggest that oxytocin may impair men's ability to adapt to changes in risk and uncertainty when introduced to novel or changing social environments. Oxytocin pharmacotherapy may only be helpful when patients exhibit an overly-liberal threat detection bias. Because oxytocin also influences behavior in non-social realms, oxytocin pharmacotherapy could have unintended consequences (i.e., risk-prone decision-making) while nonetheless normalizing pathological social interaction.

D133

PERSONALITY INFLUENCES INTERTEMPORAL CHOICE: BEHAVIORAL AND BRAIN EVIDENCE

Joshua Manning[1], Trey Hedden[2], Drazen Prelec[1], John Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Massachusetts General Hospital — We investigated how personality is associated with individual differences in temporal discounting and neural activity. Participants completed a Big-Five personality inventory. In a functional magnetic resonance imaging scanner, participants then completed a discounting task where they chose between a series of two options of monetary rewards, a smaller monetary reward with a shorter delay and a larger monetary reward with a longer delay. Discount functions were estimated for each individual using a hyperbolic discount function. We correlated each participant's personality scores with the discount parameter. Higher discount parameters represent a relative preference for shorter delays and lower discount parameters represent a relative preference for longer delays. Conscientiousness was significantly correlated with lower discount parameters and neuroticism with higher discount parameters. Next we correlated each individual's subjective value (SV) of the reward and personality to neural activity. When choosing the shorter delay, SV and conscientiousness were correlated with greater activations in the bilateral dorsolateral prefrontal cortex (DLPFC), bilateral frontal BA10, left insula, and bilateral parietal cortex. There were no correlations with neuroticism. When choosing the longer delay, SV and neuroticism were correlated with greater activations in the bilateral DLPFC, left frontal BA10, bilateral insula, bilateral parietal cortex, and ventral striatum. There were no correlations with conscientiousness. Overlapping areas of these two contrasts reveal areas that are associated with cognition and executive control. These areas are engaged when choosing the option that is relatively less preferred for each personality type (i.e. high conscientiousness with short delays and high neuroticism with long delays).

D134

AMBIGUITY DEMANDS INCREASED COGNITIVE CONTROL: ENGAGEMENT OF THE LATERAL PREFRONTAL CORTEX UNDERLIES DECISIONS OF MAXIMAL UNCERTAINTY

Elizabeth M Martin[1], Anastasia Christakou[1], Judi A Ellis[1], Carien M van Reekum[1]; [1]Centre for Integrative Neuroscience and Neurodynamics, School of Psychology and Clinical Language Sciences, University of Reading. — Everyday decisions are invariably made with imperfect information about the potential consequences of an action. The brain mechanisms that deal with conditions of ambiguity and levels of uncertainty critically involve the prefrontal cortex (PFC), but are incompletely understood. In this study we collected echo-planar magnetic resonance imaging from 20 participants whilst they performed a simple decision-making task, an adaptation of the Cambridge Gambling Task. We examined decisions under risk (varying explicit probabilities of success) and ambiguity (50% probability of success), with temporal separation between the decision and a confidence rating. The confidence rating for each trial was incorporated into the model as a modulator of the decision-making regressor. Bilateral activation in anterior cingulate (BA24/32) and ventromedial prefrontal cortex (vmPFC, BA10) scaled with the level of risk during decisions. The increased uncertainty of the ambiguous condition additionally recruited left ventrolateral (BA10), right anterolateral (BA9/10) and right dorsolateral PFC (BA8). We suggest that recruitment of the vmPFC when the probability of success was explicit reflects reliance on affective inputs when making such decisions. However, at maximal uncer-

tainty, the information demands of the decision appears to modulate the prefrontal cortical networks recruited, with the engagement of both medial and more lateral prefrontal cortical regions, presumably reflecting integration of affective and cognitive inputs. These findings provide evidence that additional, rather than alternate, cortical regions are recruited when information is lacking and confidence in the decision itself is low.

D135

FACEBOOK USE POSITIVELY CORRELATES WITH NUCLEUS ACCUMBENS RESPONSE TO POSITIVE SOCIAL FEEDBACK

Dar Meshi[1], Carmen Morawetz[1], Hauke R. Heekeren[1]; [1]Freie Universität Berlin, Germany — People use Facebook, an online social networking platform, to maintain and sometimes increase their "social capital" (i.e. reputation) (Ellison et al., 2007). The neural processing of gains in one's reputation occurs in the ventral striatum (Izuma et al., 2008). Thus, we hypothesized that there is a relation between one's degree of Facebook use and the neural processing of one's reputation. The study consisted of an on-camera interview on Day 1, and an fMRI (Siemens, 3T) session on Day 2. Participants (n = 31) believed that 10 anonymous "reviewers" watched their interview and used 10-15 words to describe the participant. In the scanner, participants discovered the words that the reviewers used to describe them (only pre-determined positive words), as well as played a card-game to obtain monetary reward. Our results demonstrate an overlap of BOLD signal change in the ventral striatum due to monetary reward and positive social feedback regarding participants' reputation ($Z>2.3$, $p<0.05$, cluster corrected). Importantly, activity due to positive social feedback in the left nucleus accumbens positively correlated with Facebook use across individuals ($r=0.450$, $p=0.011$). Conversely, activity due to monetary reward in the same region of interest did not correlate with Facebook use ($r=-0.249$, $p=0.176$). These correlations were significantly different from each other (William's $T2(28)=3.06$, $p<0.005$). Furthermore, a control step-wise regression analysis showed that Facebook use primarily explains our results when considered with other personality traits (Adjusted $R2=0.378$, $F(2,28)=10.104$, $p<0.001$, beta=0.561). To note, we have not addressed causality, therefore these results should be interpreted with this consideration.

D136

BENEFITS OF COGNITIVE TRAINING IN INDIVIDUALS WITH MILD COGNITIVE IMPAIRMENT

Raksha Mudar[1,2], Hsueh-Sheng Chiang[2], Justin Eroh[2], Audette Rackley[2], Erin Venza[2], Kristin Martin-Cook[3], Kyle Womack[3], John Hart, Jr.[2,3], Sandra Chapman[2]; [1]University of Illinois at Urbana-Champaign, [2]The Univesity of Texas at Dallas, [3]Universiy of Texas Southwestern Medical Center at Dallas — Mild Cognitive Impairment (MCI) frequently represents a prodromal stage of dementia. There is impetus to identify pharmacological and non-pharmacological treatments that can slow and hopefully prevent progression from MCI to dementia to minimize its societal impact. In this pilot study we compared immediate benefits of two forms of cognitive training programs (strategy-based gist-reasoning training and information-based brain health workshop) on cognitive functions (measures of abstraction, strategic attention, memory, and executive function) and brain mechanics using event-related potentials (ERPs) in 36 participants with MCI in a random assignment design (18 in each group). Participants in both groups were comparable in age, MMSE and episodic memory scores at baseline. Both groups received 8-hours of training over a period of 4 weeks. Preliminary analysis of the data showed significant improvement (p □.05) in the gist-reasoning training group on experimental measures of abstraction and strategic attention, and on standardized measures of memory (immediate and delayed recall on Logical Memory subtest) and abstract verbal reasoning (Similarities subtest), whereas participants in the brain health workshop showed significant improvements in discourse memory measure and Digit Span Backwards. The gist training group also showed significant changes in ERPs involving tasks that examined semantic integration and semantic abstraction. These findings suggest that cognitive training in general has beneficial impact of cognitive abilities in individuals with MCI. More importantly, training that targets higher order cognitive functions appears to have a broader impact on cognitive and neural functions, providing compelling motivation to further examine sustenance of benefits.

D137

THE INFLUENCES OF THE APOE VARIANT ON FRONTAL BRAIN ACTIVATION EVOKED BY THE VERBAL FLUENCY TEST

Laura D. Mueller[1], Marcel Feher[1], Thomas Dresler[2], Julia B.M. Zeller[1], Thomas Polak[1], Martin Lauer[1], Andreas Reif[1], Jürgen Deckert[1], Martin J. Herrmann[1]; [1]University of Wuerzburg (Germany), [2]University of Tuebingen (Germany) — The Apolipoprotein E (APOE) ε4 allele so far represents the most influential genetic risk factor for Alzheimer's disease (AD), whereas the ε2 allele may be considered as a protective factor. Carriers of the ε4 allele preclinically show structural as well as functional brain differences when compared to non-carriers and in some cognitive domains even deviant behavioural performances. However, the exact nature of these differences is still being intensively discussed, especially since most studies only compare ε4 carriers with non-carriers. Therefore this study investigated prefrontal brain activity of healthy elderly subjects with different APOE variants. Three genetic groups were differentiated, consisting of a risk group (ε4/ ε3 and ε4/ ε4 carriers), a protective group (ε2/ ε3 and ε2/ ε2 carriers) and a control group (ε3/ ε3 carriers). The prefrontal brain activation evoked by a verbal fluency test (VFT) was measured with functional Near-infrared Spectroscopy (fNIRS) using a 52-channel probe set. The VFT is a commonly applied early diagnostic test for AD involving semantic and phonemic word generation. On the behavioural level, in both conditions no significant differences between groups were found. The fNIRS results showed prefrontal activations in line with earlier studies. Furthermore a difference in brain activation between the APOE groups was found. To our knowledge these are the first results demonstrating the effects of the APOE status on the brain activity evoked by the VFT and can thereby contribute to the understanding of APOE as a risk factor for AD.

D138

AGE-RELATED DIFFERENCES IN THE EFFECT OF STATISTICAL STRUCTURE ON LEARNING IN A SEQUENTIALLY-CUED PREDICTION TASK.

Kendra Seaman[1], Alissa Forman-Alberti[1], Jason Rights[1], Darlene Howard[2], James Howard, Jr.[1,2]; [1]The Catholic University of America, [2]Georgetown University — Age-related deficits in risky decision making have been linked to learning in older adults (Mata, Josef, Samanez-Larkin, & Hertwig, 2011) and studies of sequence learning suggest older adults are less sensitive to the predictive relationships in their environments (Howard & Howard, 1997; Howard, Howard, Dennis, & Kelly, 2008). Research has indicated that predictive relationships are more easily learned between temporally adjacent events than for those separated by random events. Additionally, learning is better in young adults than older adults (Stillman, Howard & Howard, 2011). Here we investigate age differences in the effect of statistical structure on learning to predict outcomes using the Triplets Prediction Task (TPT). In the TPT, subjects see two successive visual cues and predict which target will follow. Unknown to subjects, there is a relationship between one of the cues and the target such that each of four cues predicts one of four targets 80 percent of the time. In the first-order structure, the predictive cue (Cue 2) was the cue adjacent to the target event. In the second-order structure, the predictive cue (Cue 1) was the cue separated from the target event by a random event. In addition to the expected age differences in overall performance, we found that learning was better for second-order structure than first-order structure in young adults. In contrast, for older adults learning was marginally better for first-order than second-order structure. Collectively, these results reveal age-related differences in the ability to learn environmental regularities with different temporal structures.

D139

LINKING SUBITIZING FLUENCY WITH NEURAL SYSTEMS FOR EXACT QUANTITY

Gillian Starkey[1], Edward Hubbard[2], Bruce McCandliss[1]; [1]Vanderbilt University, [2]University of Wisconsin-Madison — Developmental studies have established that subitizing (the rapid enumeration of small quantities) is a precursor to success in addition and multiplication. Mental representations of these quantities increase precision with development. Research in cognitive neuroscience has revealed a neural network for representing exact quantities, including the temporo-parietal junction (TPJ), which is involved in representing subitizable quantities. To explore the relationship between subitizing and the precision of numerical represen-

tations in the TPJ, we measured fMRI responses in 48 children in grades K-3. Using an fMRI-adaptation paradigm, children viewed dot arrays of an adapting quantity, interspersed with presentations of Arabic numerals that were numerically close (one away) or far (three away) from the adapting quantity. As an index of precision, we calculated the difference between neural responses for close and far deviant numerosities: a small difference in response indicates greater precision because even close deviants cause dishabituation. Children also performed an enumeration task in which they viewed arrays of dots and named the total. Individual reaction time slopes across set sizes 1-3 were calculated as a measure of subitizing fluency: flat slopes indicate more fluent subitizing. Individual differences in subitizing slope correlated with decreasing distance effects in the TPJ: children with smaller distance effects had flatter subitizing slopes. This result indicates that the precision of number representations in the TPJ contributes to individual differences in subitizing fluency. Since subitizing is a critical building block for arithmetic, this finding suggests that neural changes in the TPJ contribute to the development of math competence.

D140

GRADUATE EDUCATION LEVEL PREDICTS EPISODIC METAMEMORY, BUT NOT MEMORY ACCURACY IN HEALTHY AGING AND ALZHEIMER'S DISEASE

Jacquelyn Szajer[1], Claire Murphy[1,2]; [1]San Diego State University, [2]University of California San Diego — Episodic memory is known to decline in healthy aging and Alzheimer's disease (AD), however, these declines in are heterogeneous, influenced by cognitive-reserve factors like education (Batterham, Mackinnon, & Christensen, 2011). Another factor shown to influence aging episodic memory is metamemory (Mm), which plays an essential role in strategies used for encoding and retrieval of information, as well as the control of memory output. A potential link between the effects of education and Mm on episodic memory is that more education is associated with fewer age effects on frontal-dependent activities like strategy use and switching tasks (Plumet, Gil, & Gaonac'h, 2005). Because Mm abilities are frontal-dependent (Chua, Schacter, & Sperling, 2009), higher levels of education may also influence age- and AD-related declines in Mm-accuracy. Thus, the main aim of the current study was to investigate the effect of education level on Mm-accuracy in healthy aging and AD. Using a sample of 143 controls and 143 patients with AD, predictors of the accuracy of retrospective Mm judgments of an episodic recognition-memory task were analyzed. Education level had a significant effect on Mm-accuracy for incorrect-responses: those with a graduate education reported more accurate Mm than those with a college education or less. Neither education nor Mm-accuracy was related to performance on the episodic memory task. More research is needed to fully elucidate the relationships between education, Mm, and episodic memory in aging and AD. Supported by NIH grants #AG04085-25 to CM and #AG005131-28 to the UCSD ADRC from the National Institute on Aging.

Poster Session E

E1

AGE-RELATED REDUCTION OF DIFFERENTIATED NEURAL RESPONSES TO DIFFERENT STIMULUS TYPES Katherine Mott[1], Brittany Alperin[1], Tatyana Zhuravleva[1], Phillip Holcomb[2], Dorene Rentz[1], Kirk Daffner[1]; [1]Harvard Medical School, Brigham and Women's Hospital, [2]Tufts University — The dedifferentiation theory of cognitive aging stresses the failure of older adults to recruit specialized neural mechanisms, often viewed as being due to a common underlying process that uniformly disrupts cognitive functions. Here, ERPs were employed to determine if there is an age-related reduction in generating differentiated neural responses to target and standard stimuli. Twelve young (mean age 23), 14 middle-aged (mean age 51), 15 young-old (mean age 74), and 23 old-old (mean age 85) well-matched, cognitively high-performing adults responded to rare visual target letters under low and high memory load. The anterior P3a was used as an index of orienting/executive control, and the posterior P3b as an index of categorization/memory updating. For both the P3a and P3b components, the difference in amplitude between targets and standards decreased substantially as a function of age. Advancing age predicted decreasing size of the P3b to targets and increasing size of the P3a to standards. The magnitude of these age-associated differences was similar under low and high load conditions. These findings indicate that older adults generate increasingly less differentiated neural responses to target and standard stimuli. The age-related reduction in P3b to targets may reflect attenuation of the categorization process, whereas the age-associated increase in P3a to standards may represent compensatory frontal-executive activity to support the task of distinguishing between different stimulus types. This pattern of results does not suggest a ubiquitous process of dedifferentiation, but may be the consequence of different kinds of mechanisms across various cognitive operations.

E2

THE EFFECTS OF VISUAL ATTENTION ON AGE-RELATED PATTERNS OF OBSTACLE AVOIDANCE BEHAVIOUR Lindsay Nagamatsu[1], Craig Chapman[1], Teresa Liu-Ambrose[1], Todd Handy[1]; [1]University of British Columbia — Previous research has found that older adults show decrements in visually attending to the left side of space. To what extent might such deficits actually impact our behaviours? In the following study, we used a novel obstacle avoidance task to examine this question. We had young and older adults complete a manual reaching task, where they were required to reach their dominant hand to a target location on a table. Physical objects were placed on the table between the participant and the target, with distance (close together versus far apart) and number of objects (one versus two) counterbalanced between trials. Using an advanced motion tracking system, we measured the trajectories of participants' reaching motions for each trial. We found that compared to young adults, older participants did not show the expected avoidance trajectory patterns towards obstacles placed on the left side of the environment. Rather, older participants appeared to "ignore" objects placed on the left, without adjusting their trajectory away from these obstacles. These results are consistent with the prevailing notion that older adults have impaired visual-spatial attention to the left side of visual space, and support the idea that underlying right hemispheric deficits may be characteristic of aging. Our results have implications for safe navigation and mobility in older adults, where failing to notice obstacles and hazards in the environment may result in an increased risk for falls.

E3

LONG-TERM VISION LOSS AFTER MACULAR DEGENERATION RESULTS IN ENHANCED VISUAL CORTEX ACTIVITY ASSOCIATED WITH PREPARING FOR A VISUAL TASK, BUT NOT PROCESSING VISUAL INPUT. Rodolphe Nenert[1], Lesley Ross[1], Dawn Decarlo[1], Martha Graham[1], Kristina Visscher[1]; [1]University of Alabama at Birmingham — Macular degeneration (MD) results in loss of central vision, and with it the high acuity necessary for reading, driving and recognizing faces. Some patients with MD are able to learn to use their eccentric visual field to perform these tasks. Some studies suggest that, after retinal lesions, cortical resources once used for processing information from central vision are remapped to process peripheral vision. However, several studies have challenged this idea. The goal of this study is to reconcile these two sets of data. We compare brain activity in participants with MD and matched controls during a task requiring visual attention. We use an experiment design that allows separation of stimulus-driven effects from effects driven by attention. Analyses were made on anatomically defined brain regions of interest corresponding to: central vision, peripheral vision, and hand motor cortex. Stimulus-driven BOLD responses in visual areas were consistent with the impoverished visual inputs of the participants with MD, and not consistent with a remapping of cortical resources. However, visual cortical responses reflecting attention were stronger in participants with MD than controls. No differences were found in the motor regions, indicating that this was specific to the visual regions. No evidence of cortical remapping was found. However, the data provide evidence that MD participants make more use of visual cortex to set up the attentional state required to perform a visual task. This is evidence that MD participants may make more efficient use of attentional resources as a partial compensation for visual loss.

E4

DISRUPTED SALIENCE NETWORK ARE CORRELATED TO COGNITIVE DECLINE WITH AGING: RESTING-STATE FMRI STUDY Keiichi Onoda[1], Masaki Ishihara[1], Shuhei Yamaguchi[1]; [1]Shimane University — Salience network consisted of anterior cingulate cortex and bilateral insula, play important role in identifying the most homeostatistically relevant event and integrating highly processed sensory data. Our previous work reported that disrupted salience network attributes cognitive decline with aging. In this study, we investigated whether functional connectivities between the salience network and other brain regions are associated with cognitive decline in aging. Healthy middle-aged and elderly people (n=193, mean age: 60.1, sd: 12.1, range: 34-87 male/female ratio: 78/115) participated in MRI examination and underwent a neuropsychological assessment (mini-mental state examination, frontal assessment battery, and Kohs block design test, etc). In the functional MRI analysis, we first selected three region-of-interests (ROIs) as seeds: anterior cingulate cortex, left insula, right insula. We performed seed-to-seed and seed-to-voxel analyses. The results showed that (1) the connectivities between the anterior cingulate cortex and bilateral insula negatively correlated with age, (2) the connectivity between the anterior cingulate cortex and left lateral parietal cortex was negatively correlated with the Kohs block design test score even after controlling age, and (3) the connectivity between the salience and thalamus was also negatively correlated with the score. These results strengthen the idea that the disrupted salience network is one of the reasons for the cognitive decline with aging.

E5

INATTENTIONAL BLINDNESS AND PERCEPTUAL CAPACITY IN AUTISM SPECTRUM CONDITION Anna Remington[1], John Swettenham[2], Nilli Lavie[2]; [1]University of Oxford, [2]University College London — Our research examines selective attention in Autism Spectrum Condition (ASC) using Load Theory (Lavie et al 2004). Load theory states that distractor processing depends on the extent to which a task engages full capacity (high load conditions) or leaves spare capacity that 'spills over' resulting in distractor processing. Our previous results showed that as perceptual load increases, distractor stimuli continue to be processed in adults with ASC but not controls, suggesting higher perceptual capacity in the condition (Remington et al 2009; 2011). Here we test the implication of this finding for inattentional blindness (IB) in ASC. IB, the failure to notice an unexpected task-irrelevant stimulus, is greater under higher perceptual load (Cartwright-Finch & Lavie, 2007). Our hypothesis of increased perceptual capacity in ASC leads to the counterintuitive prediction that children with ASC will show less IB than typically developing (TD) controls in tasks with higher perceptual load, because these will be insufficient to exhaust their higher capacity. Participants performed a line-length judgement task (high load: lines

similar; low load: lines dissimilar in length), with an unexpected stimulus presented on final trial. As predicted, rates of noticing the task-irrelevant stimulus were reduced by increasing perceptual load in TD children but not in children with ASC. The ASC group showed equally high stimulus-detection in both load conditions, and higher detection-rates than TD group overall. These results support the hypothesis that individuals with ASC have a higher perceptual capacity than neurotypical controls, and show this effect for the first time in children.

E6

ATTENTIONAL BIAS SHIFTS THE POINT OF SUBJECTIVE EQUALITY IN VISUAL MAGNITUDE ESTIMATION. Nele Demeyere[1], Lixia He[2], Elitsa Slavkova[1], Glyn W Humphreys[1]; [1]University of Oxford, [2]Chinese Academy of Sciences, Beijing — We assessed whether visual neglect and/or extinction affect magnitude estimation, or whether magnitude estimation is unaffected by the perceptual and attentional changes in these patients. We report data on an estimation task, where groups of patients with left neglect and/or extinction (patients were selected on their clinical symptoms and had lesions centred on right posterior parietal cortex), controls and left-hemisphere lesioned patients were asked to compare displays of dots presented to both visual fields. We manipulated the distance to the reference quantity, and computed psychometric functions when the target was on the left and the reference on the right and vice versa. In a first experiment where participants are asked to determine which location has more elements, psychometric functions demonstrate a clear rightward shift of the PSE (point of subjective equality) when the test stimulus appears on the left, for patients with left neglect. This is indicative of gross underestimations of the quantities presented to their inattentive side. Right sided test stimuli are also overestimated when compared to reference. In contrast, left hemisphere damaged patients who do not demonstrate behavioural neglect, showed a small overestimation for left side stimuli. Follow up experiments demonstrate that this effect cannot be explained by response bias (in an experiment which asks for the 'least' amount of dots, similar function fittings are found), or extinction (when stimuli are presented sequentially, rather than simultaneously). We conclude that magnitude estimation is affected by perceptual and attentional change contingent on right posterior parietal damage.

E7

ATTENTIONAL SELECTION FOR SHORT-TERM MEMORY: GAZE-DIRECTION PREDICTS RETRIEVAL ACTIVITY IN FRONTO-PARIETAL CORTEX Simona Arianna Di Francesco[1,2], Valerio Santangelo[2,3], Davide Nardo[2], Emiliano Macaluso[2]; [1]Sapienza University of Rome, Italy, [2]Santa Lucia Foundation, Rome, Italy, [3]University of Perugia, Italy — In everyday life short-term memory involves processing of complex and unrepeated environments, which is in striking contrast with standard experimental paradigms typically utilizing highly stereotyped, simple and repeated stimuli. Remembering of complex visual stimuli demands a tight interplay between memory functions and attentional selection. Here, we examined this interplay during free-viewing of complex and dynamic visual scenes (8 videos, approx. 5 min each). Each video was characterized by 8 different actors/actresses who entered twice into the scene, at unpredictable times: the first appearance corresponded to the memory "encoding" phase, while the second presentation represented the memory "retrieval" phase. Participants were asked to watch the videos without any specific task-requirement. During fMRI scanning, we monitored gaze-direction and we used the tendency of the subjects to look towards each actor/actress as an index of attentional selection. Accordingly, we categorised each actors/actresses as: "high probability of selection/encoding", when subjects fixated the actor more during the first than the second presentation; versus "low probability of selection/encoding", when subjects fixated the actor more during the second than the first presentation. The fMRI analyses considered the second presentation of the actors/actresses (i.e. the memory retrieval phase) and compared activity for actors with "high versus low" indexes of selection. This revealed activation of fronto-parietal regions, including the inferior frontal gyrus and the intra-parietal sulcus, plus the middle temporal complex (MT+). We conclude that differential patterns of eye-movements can predict retrieval-related activation in fronto-parietal regions during passive viewing of complex and dynamic visual environments.

E8

ATTENTIONAL DYNAMICS MEDIATED BY SUBCORTICAL MECHANISMS Shai Gabay[1], Marlene Behrmann[1]; [1]Carnegie Mellon University — Following a salient cue that attracts attention to a specific spatial location, perceptual processing of information at that location is facilitated if the interval between cue and target is brief, or is inhibited if the interval between cue and target is long. The mechanisms mediating these attentional dynamics continue to be the subject on ongoing debate. According to the classic reorienting theory, IOR and facilitation are two ends of a continuum, generated by the same underlying mechanism. We report data from an experiment in which a cue and its ensuing target are presented to the same or different eyes at varying cue-target intervals. Whereas facilitation was observed only when the cue and target shared the eye-of-origin, IOR was present in all conditions. This finding not only reveals a dissociation between facilitation and IOR but is consistent with the view of facilitation emerging at subcortical levels of the visual pathways.

E9

ATTENTIONAL STATE TRAINING IMPROVES SPATIAL AND NON-SPATIAL ATTENTION DEFICITS IN PATIENTS WITH HEMISPATIAL NEGLECT Jose Gallegos[1], Ativ Zomet[1,4], Christina Marini[1], Alana Vernon[1,2], Sawsan Dabit[1], Michael Merzenich[1,3], Thomas Van Vleet[1,2]; [1]Brain Plasticity Institute, [2]VA Medical Center, Martinez, [3]University of California, San Francisco, [4]Tel-Aviv University, Israel — Several recent studies suggest that cognitive training focused on the promotion of a more optimal state of attention can improve deficits in attention and higher-order cognitive function (e.g., working memory and executive control) in patients with hemispatial neglect. One method (Tonic and Phasic Alertness Training, TAPAT) that targets executive control functions, such as inhibition and sustained attention, has been shown to produce such benefits that endure for days to weeks following completion of 5 hours of training. Given the debilitating effect of deficits in attention and higher-order cognitive operations and the need to identify enduring treatment options, in the current study we examined the effects of 10 hours of multimodal TAPAT training (i.e., visual, auditory, spatial). Twenty one patients with hemispatial neglect, due a wide variety of etiologies (e.g., stroke, TBI, tumor resection) were assessed on standardized and experimental neuropsychological measures of attention, working memory and executive function before being randomly assigned to either 10 hours of TAPAT training or an active control training condition (online computer games: Sporcle.com). Post-training, changes in performance on the outcome measures revealed significant improvement in attention, working memory and executive function in the TAPAT group vs. the active control training group that endured throughout the extended post-training follow-up period. The results suggest that training to achieve a more optimal state of attention may benefit spatial and non-spatial deficits in attention, as well as higher-order cognitive operations in neglect.

E10

NEURAL ACTIVITY ASSOCIATED WITH ATTENTIONAL SUPPRESSION PREDICTS VISUAL WORKING MEMORY CAPACITY John Gaspar[1], Gregory Christie[1], John McDonald[1]; [1]Simon Fraser University — The finite capacity of visual short-term memory (VSTM) necessitates that attentional processes govern which items gain preferential access to the VSTM system. This access may involve enhancement of task-relevant items or suppression of task irrelevant information. Consistent with a suppression-based mechanism, it has been shown that individuals with high VSTM capacity are better able to prevent irrelevant stimuli from accessing VSTM. Using event-related potential recordings, we investigated whether individual VSTM capacity scores (k) relate to the suppression of salient distractors as indexed by the PD (distractor positivity), an ERP component associated with suppression of irrelevant visual items. Here, participants searched for a yellow target within a visual search array, with either a high-salience or low-salience singleton present on most trials. Consistent with prior work, only high-salient distractors elicited a PD. The amplitude of this PD correlated positively with k, suggesting that individuals who suppress distractors more efficiently have higher visual working memory capacities. These findings substantiate a role for suppression in the VSTM system and provide evidence that the PD may be an important neural mechanism for efficient VSTM processing.

E11

CONGRUENCY AND DISTANCE EFFECTS ARE OBSERVED WHEN ARROWS AND NUMBER CUES ARE COMBINED

Laura Gibson[1], Daphne Maurer[1]; [1]McMaster University — Low numbers (e.g., 1-4) and downwards-pointing arrows cue attention downwards, while high numbers (e.g., 6-9) and upwards-pointing arrows cue attention upwards (Schwarz & Keus, 2004; Hommel et al., 2001). We designed a task in which these two cues were combined in a congruent (e.g., a low number superimposed on a downwards-pointing arrow) or incongruent (e.g., a high number superimposed on a downwards-pointing arrow) manner. Participants (n=21) made a speeded judgment concerning whether number magnitude (greater or less than 5) and arrow direction were congruent. We predicted that congruent trials would elicit faster responses than incongruent trials; further, based on the distance effect (Lorch & Myers, 1990), we predicted that the effect of congruency would be more pronounced on trials in which numbers further from 5 (e.g., 1 and 9) were presented. There was a significant effect of Congruency, $F(1,20)=162.119$, $p<0.001$, such that congruent trials were responded to significantly faster than incongruent trials, $t(20)=-5.544$, $p<0.001$. As predicted, there was also an interaction of Congruency and Number Magnitude, $F(1,20)=32.214$, $p<0.001$, as congruent trials were responded to significantly faster for numbers further from 5 than numbers closer to 5, $t(20)=5.360$, $p<0.001$. Overall, these data suggest that the presence of two congruent directional cues decrease, while competing directional cues increase, RTs; further, the distance effect is still manifest even when an additional direction cue is added to that of number magnitude.

E12

FUNCTIONAL SPECIALIZATION OF SPATIAL ATTENTION IN PARIETAL CORTEX: A CYTOARCHITECTONIC MAPPING STUDY

Celine R. Gillebert[1,2], Dante Mantini[1,2,3], Ronald Peeters[4], Patrick Dupont[2], Rik Vandenberghe[2,4]; [1]University of Oxford, UK, [2]KU Leuven, Belgium, [3]ETH Zurich, Switzerland, [4]University Hospitals Leuven, Belgium — Parietal coordinates associated with attentional reorienting and selection between competing stimuli are widely variable across studies. Here we used a cytoarchitectonic reference frame to contrast these two spatial attentional processes by means of functional magnetic resonance imaging (fMRI) in a total of 26 healthy volunteers. In a spatial cueing paradigm, the target was presented at the cued location either alone or in combination with a contralateral distracter, or at a location opposite to the cued location. The expectancy rate of 'double stimulation trials' and 'invalidly cued trials' (each occurring in 20% of trials) was matched. In areas hIP1 and hIP3, double stimulation trials exerted a significantly stronger attentional effect than invalidly cued trials. Conversely, area PF in the right hemisphere showed an invalidity effect in the absence of competition effect. A third type of response was found in areas PFm and PGa which showed both an invalidity and a competition effect. In addition, hierarchical clustering analysis revealed that the areas could be subdivided based on their resting-state activity. Specifically, right PF showed a temporal profile dissimilar from other areas; a second cluster contained PGa, and a third cluster included hIP1, hIP3 and PFm. To conclude, we demonstrated within a same experiment a functional dissociation between two spatial attentional processes in parietal cortex. Furthermore, the use of a cytoarchitectonic reference frame and the combined study of attentional reorienting and selection enabled us to resolve the wide between-study variance in inferior parietal coordinates associated with the invalidity effect.

E13

THE DEVELOPMENTAL MISMATCH IN STRUCTURAL BRAIN MATURATION DURING ADOLESCENCE

Kathryn Mills[1,2], Anne-Lise Goddings[1,3], Liv S Clasen[2], Sarah-Jayne Blakemore[1], Jay N Giedd[2]; [1]Institute of Cognitive Neuroscience, University College London, London, UK, [2]Child Psychiatry Branch, National Institute of Mental Health, Bethesda, MD, USA, [3]Institute of Child Health, University College London, London, UK — Regions of the human brain develop at different rates across the first two decades of life, with some maturing before others. It has been hypothesized that a mismatch in the timing of maturation between evolutionarily older structures within the limbic cortex, and relatively newer regions within the prefrontal cortex, underlies the increase in risk-taking and sensation-seeking behaviors observed in human adolescents. However, most support for this "dual-systems" hypothesis relies on cross-sectional data, and it is not known if this pattern can be observed on an individual level. This study utilizes longitudinal structural magnetic resonance imaging (MRI) data to describe the developmental trajectories of structures associated with risk-taking and sensation-seeking behaviors, the amygdala, nucleus accumbens (NAcc) and prefrontal cortex, across adolescence. Structural trajectories of grey matter volumes were analyzed using Freesurfer in 32 participants (148 scans), aged 7-30 years. Each individual in this sample had at least three high-quality MRI scans spanning three developmental periods: before puberty, during puberty, and after puberty. We assessed the developmental trajectories between the amygdala, NAcc, and prefrontal cortex. The majority of individuals in our sample showed relatively earlier maturation in the amygdala and/or NAcc, compared to the prefrontal cortex, providing evidence for a mismatch in the timing of maturation between these structures.

E14

AN FMRI STUDY OF FEATURES OF BORDERLINE PERSONALITY DISORDER, STRESS, AND RISKY-DECISION MAKING

Ahrareh Rahdar[1], Adriana Galván[1,2]; [1]The University of California Los Angeles, Department of Psychology, [2]The University of California Los Angeles, Brain Research Institute — Borderline personality disorder (BPD) is characterized by risky and impulsive behaviors. Previous research has found a high level of comorbidity between BPD, pathological gambling, substance abuse, and a history of sexually transmitted diseases (Genna et al., 2011; Sacco et al., 2007; Trull et al., 2000). Moreover, stress has been found to exacerbate these symptoms. Based on these findings, it is plausible that having greater features of BPD may lead to risky decision-making, particularly when stressed. BPD is rarely examined during adolescence, some arguing that symptoms of BPD too closely resemble typical adolescent behaviors. One implication of this is that very little is known about the development of BPD. The goal of this study was to address this question and associated neural correlates. Twenty adolescents and nineteen adults were tested on a self-reported high-stress day and low-stress day. Participants completed a screening instrument for BPD. During fMRI, participants chose between a potentially risky (greater monetary gain or loss/no win or loss) or a non-risky decision (certain monetary gain or loss). Greater BPD features predicted risky decision-making ($\beta = .40$, $p < .05$), particularly during loss trials on high-stress days ($\beta = .45$, $p < .05$). fMRI analyses are ongoing, but preliminary results suggest greater limbic activation during risky choice as a function of BPD features. These findings are consistent with previous work demonstrating a relationship between BPD and risky-decision making. The current research adds to extant literature by examining this relationship using fMRI in a subclinical population, across genders and ages.

E15

NEURAL CORRELATES OF RESPONSE-MONITORING IN ADOLESCENTS DURING AN EMOTIONAL FLANKER TASK.

Rebecca Reed[1], Renee Migliaccio[2], Jill Grose-Fifer[1,2]; [1]The Graduate Center, CUNY, [2]John Jay College of Criminal Justice, CUNY — Research suggests that response-monitoring is still developing during adolescence. However, most studies investigating the development of the neural correlates of this behavior have not used emotional stimuli in their tasks. In this study, we used event-related potentials (ERPs), to examine brain activity associated with response-monitoring and error detection in a flanker task using happy and fearful emotional faces. We compared amplitude and latency differences of the error-related negativity (ERN) and the correct-related negativity (CRN) in adults (25-35 years) and adolescents (13-18 years) between an emotional face flanker task and a traditional letter flanker task. We found that the ERN was larger for letter stimuli than for face stimuli in both adults and adolescents, and adults had larger ERNs than adolescents for both tasks. However, there were no age-related or stimulus-related differences for the CRN. Behaviorally, both groups were faster and more accurate on congruent than on incongruent trials, and more accurate on the letter than the face task. Adolescents were less accurate than adults in general. These data suggest that although the CRN is relatively mature in adolescence, the ERN is still developing. Since the ERN is thought to be useful in signaling the need to adjust future behavior, these data may help to explain why adolescents were less accurate than adults on these flanker tasks.

E16

THE DEVELOPMENT OF IMPULSE CONTROL AND ASSOCIATED CONNECTIVITY BETWEEN VMPFC-DLPFC PREDICTS AGE-RELATED CHANGES IN INTERTEMPORAL CHOICE DURING CHILDHOOD. Nikolaus Steinbeis[1], Johannes Haushofer[2,3], Ernst Fehr[2], Tania Singer[1,2]; [1]Max-Planck Institute for Human Cognitive and Brain Sciences, Leipzig., [2]Laboratory for Social and Economic Systems Research, University of Zurich, [3]Abdul Latif Jameel Poverty Action Lab (J-PAL), Massachusetts Institute of Technology — Forgoing immediate pleasure for the sake of a delayed but larger reward is necessary for the successful pursuit of long-term goals. This ability to resist temptation improves with age, but the precise neurocognitive mechanisms underlying its development remain elusive. Whereas some argue that less value is placed on immediate rewards with age others state that age-related improvements in impulse control help to delay gratification. To test both hypotheses, we studied twenty children (age range: 6.6-12.7 years; mean age: 9.7 years) using a valuation task (VT) and an intertemporal choice task (ICT) in and outside the scanner. In the VT children had to rate individually presented options varying in reward magnitude and delay. In the ICT children had to choose between two options differing in reward magnitude and delay, which always consisted of a small immediate reward and an alternative larger delayed reward. We found no age differences in the valuation of individual options. Instead, there was a strong developmental decrease in discounting future rewards, which was also highly correlated with a measure of impulse control. The imaging data showed ventromedial prefrontal cortex (vmPFC) to track subjective value of presented options, a region that also correlated with individual differences in temporal discounting. Using this region as seed for a connectivity analysis, we found functional coupling with left dorsolateral prefrontal cortex (DLPFC) to increase significantly as a function of age and impulse control. These data suggest that delaying gratification with age relies on the maturation of neural networks dedicated to impulse control.

E17

AGE-RELATED DIFFERENCES IN ANTERIOR CINGULATE-INSULA CONNECTIVITY ARE ASSOCIATED WITH THE FRONTO-EXECUTIVE BUT NOT EMOTIONAL SALIENCY NETWORK Matthew Sutterer[1,3,4], Michelle Voss[2,4], Merry Mani[2], Chelsea Wong[5,6], Gillian Cooke[5], Amy Belfi[1,3,4], Timothy Weng[2], Daniel Tranel[1,4], Edward McAuley[7], Arthur Kramer[5]; [1]University of Iowa, Department of Neurology, [2]University of Iowa, Department of Psychology, [3]University of Iowa, Department of Neurosurgery, [4]University of Iowa, Department of Neuroscience, [5]University of Illinois, Beckman Institute for Advanced Science and Technology, [6]University of Illinois, Department of Neuroscience, [7]University of Illinois, Department of Kinesiology — Research has shown that healthy aging is accompanied by declines in executive functioning, but enhanced emotion processing and regulation. The neural architecture hypothesized to underlie these processes has a high degree of shared regions. Studies of intrinsic connectivity networks, which look at temporally correlated patterns of activity across separate brain regions, may provide insight as to how aging is associated with differential changes in brain networks involved in executive function and emotional processing. The present study examined resting state functional MRI data from a group of 60 healthy adults between the ages of 19 and 83. We used a region of interest (ROI) approach to look at networks related to executive function and emotional processes, the fronto-executive network and the emotional saliency network, respectively. Because these networks share ROIs in the dorsal anterior cingulate (dACC) and the left and right insular cortex, we further examined age-related differences in network correlation strength between subsets of these networks that do not contain the overlapping regions. Age was associated with less connectivity strength in the fronto-executive network only when the dACC and insular cortex regions were included. Age was not associated with the functional integration of the dACC and insula with the salience network. Thus fronto-executive network changes appear to be driven by selectively lower connectivity between the dACC and insular cortices within the fronto-executive network in older adults. Preserved connectivity of the salience network in aging adults may reflect older adults' greater focus on emotion regulation and attending to positive affective information.

E18

SEX DIFFERENCES DURING HUMOR APPRECIATION IN CHILD SIBLING-PAIRS Pascal Vrticka[1], Michelle Neely[1], Elizabeth Walter[1], Jessica M. Black[1,2], Allan L. Reiss[1,3]; [1]Center for Interdisciplinary Brain Sciences Research (CIBSR), Dept. of Psychiatry and Behavioral Sciences, School of Medicine, Stanford University, [2]Graduate School of Social Work, Boston College, [3]Dept. of Radiology and Pediatrics, School of Medicine, Stanford University — The developmental origin of sex differences in adult brain function is poorly understood. Elucidating neural mechanisms underlying comparable cognitive functionality in both children and adults is required to address this gap. Humor appreciation represents a particularly relevant target for such developmental research because explanatory theories apply across the life span and underlying neurocircuitry shows sex differences in adults. As a positive mood state, humor is also of interest due to sex differences in rates of depression, a disorder afflicting twice as many women as men. In this study, we employed fMRI to investigate brain responses to funny, positive and neutral video clips in 22 children ages 6 to 13 years, including 8 sibling pairs. Prominent sex differences in brain responses to humor were observed indicating early developmental sex divergence in reward expectation and stimulus salience. These findings are discussed in the context of evolutionary and developmental theories of humor function.

E19

THE EFFECTS OF PRENATAL TOBACCO EXPOSURE ON DELAY TOLERANCE IN EARLY CHILDHOOD Sandra Wiebe[1], Nicolas Chevalier[2], Craig Johnson[3], Hua Fang[4], Kimberly Andrews Espy[3,5]; [1]University of Alberta, [2]University of Colorado, [3]University of Nebraska-Lincoln, [4]University of Massachussetts Medical School, [5]University of Oregon — Smoking during pregnancy is associated with childhood self-regulation, including externalizing behaviour problems and difficulty delaying gratification. Animal studies have shown that nicotine has neurotoxic effects on dopaminergic and serotonergic systems, implicated in self-regulation, at doses insufficient to cause preterm birth and low birthweight. The present study examined self-regulation in early childhood in a longitudinal follow-up of a prospective sample of prenatally-tobacco-exposed (PTE) infants. The sample included 159 three-year-old children (M age = 3 years 25 days; SD = 26 days; 84 PTE, 74 non-exposed). Children completed a battery of self-regulation tasks including two measures of delay tolerance, the Delay Frustration Task (where children played a computer game that periodically "froze" so that they had to wait for the game to resume) and Snack Delay (where children had to wait 4.5 minutes to eat a candy treat). Hierarchical regression was used to examine the effect of PTE on delay tolerance after controlling for potential confounds, including propensity scores reflecting risk factors related to mothers' risk for smoking during pregnancy, birth weight and concurrent tobacco exposure. Children's frustration and coping behaviours during the Delay Frustration Task were related to birth weight but not to PTE. PTE predicted children's inability to wait for a delayed reward in the Snack Delay task: 39% of tobacco-exposed children ate the snack during the delay, compared to 21% of non-exposed controls. PTE's impact on children's ability to tolerate delay was observed in the context of reward but not frustration.

E20

LANGUAGE AND SOCIABILITY IN CHILDREN WITH PERINATAL STROKE DURING THE COOKIE THEFT PICTURE DESCRIPTION TASK Philip Lai[1,2,3], Wenny Wong[1,3], Doris Trauner[3], Ursula Bellugi[1], Judy Reilly[2]; [1]The Salk Institute for Biological Studies, [2]San Diego State University, [3]University of California San Diego — Investigating development in children with Perinatal Stroke (PS) provides insight on how an insult early in life impacts brain, cognitive, and behavioral development. It has long been recognized that the consequences of a stroke are greatly reduced in children relative to adults, presumably due to the plasticity of the developing brain. This study investigates both language and sociability, to see how lesion site influences expression in two communicative domains. Participants included children (ages 7-14) with PS, 11 with left hemisphere injury (LHI), 16 with right hemisphere injury (RHI), and typically developing children (TD, n=30). Children described the Cookie Theft Picture from the Boston Diagnostic Aphasia Examination. As a measure of language production, the number of words for both oral and written portions were tabulated.

Sociability was measured through eye contact to the experimenter. There were no differences in language production across groups. However for sociability, the RHI group spent less time engaging in eye contact to the experimenter compared to the TD group, while no differences were found between the LHI and TD groups. Although children with PS were using language comparably to controls, with respect to sociability (eye contact), children with RHI were less engaged with the experimenter. Such findings regarding social behavior mirror the adult right hemisphere lesion profile and together suggest varying degrees of neuroplasticity across communicative domains. Investigating both the behavior and the brain of children with PS provide opportunities to explore the extent and limitations of neuroplasticity within these communicative domains.

E21

THE INFLUENCE OF CONDITIONED THREAT EXPECTANCY ON TIME PERCEPTION

Jessica Lake[1], Warren Meck[1], Kevin LaBar[1]; [1]Duke University — The anticipation of an aversive event can distort our subjective experience of time, suggesting that such temporal distortions may inform the study of threat-related processes. This study investigated how conditioned threat expectancy influences the perceived duration of an intervening neutral stimulus. Participants first completed a trace conditioning experiment in which two visual cues were followed (50% rate for each cue) by brief aversive electrical stimulation or non-aversive tactile stimulation. A duration discrimination task was then administered during which participants decided if a comparison tone (200-600 ms) was "longer" or "shorter" in duration than a preceding standard tone (400 ms). To assess whether conditioned threat expectancy can modulate time perception, conditioned cues were presented in between the standard and comparison tones. Skin conductance responses (SCRs) and state-trait anxiety scores were collected as a dependent measure of conditioned fear and as individual difference variables, respectively. Higher SCRs to the cue predicting electrical stimulation (CS+) relative to the control cue (CS-) indicated successful fear conditioning. The duration discrimination task findings showed that comparison tone durations were underestimated on CS+ compared to CS- trials, suggesting that threat expectancy directs attention away from temporal processing. The magnitude of this underestimation was positively correlated with trait anxiety. These findings demonstrate that temporal distortions can result from learned associations, potentially implicating hippocampal- and amygdala-dependent plasticity in threat-modulated time perception. The trait anxiety correlation further suggests that affective time perception studies may provide insight into the nature of anxiety and anxiety-related disorders.

E22

AN ERP STUDY OF THE ANGRY AND SURPRISED PHONOLOGICAL PROSODY IN SENTENCE PROCESSING

Ming-Chun Lee[1], Shih-tseng T. Huang[1]; [1]National Chung-Cheng University — The present study used ERP to investigate the auditory sentence processing of the angry and surprised prosody. Twenty young adults participated. Sentences varied with neutral and emotional tone were presented (80% of neutral tone versus 20% of angry or surprised emotion) in an event-related potential procedure. ERP responses were recorded by the 64 channels of the SynAmps2 brain-wave recording system of Compumedics NeuroScan. Data were analyzed in in the temporal phases of initial (N170, 100-300 msec) and morpho-syntactic (P3, 300-500 msec). The results found that on PO8, the N170 of angry prosody latency was longer than N170s evoked by the surprised prosody. It was also found female participants had longer N170 latency on Cz while listening to the emotional prosody than listening to the neutral sentence. Analysis on the P3 difference of mean amplitudes (MAs) in between the emotional prosody and neutral sentence on PO8 found that female participants had greater difference than their male counterparts. The results suggested that emotional prosody was processed early with differentiation of emotional content. N170 evoked by angry prosody was later than the N170 to surprised prosody suggesting that the subcortical feedback loop of angry prosody may activate a larger underlying neuronal network. The gender differences that females outperformed their male counterparts were consistent with previous research findings. The results of the present study suggested that females performed with longer and stronger activations in both initial and later phases.

E23

MODULATION OF MEMORY SYSTEMS BY OBSESSIVE-COMPULSIVE DISORDER AND STRESS REACTIVITY

Winifred Limmer[1], Valerie Voon[1], Neil Harrison[2], Christian Doeller[3], Barbara Sahakian[1]; [1]MRC/Wellcome Trust Behavioural and Clinical Neurosciences Institute, University of Cambridge, [2]Clinical Imaging Sciences Centre, Brighton & Sussex Medical School, [3]Donders Institute for Brain, Cognition, and Behaviour, Radboud University Nijmegen — Schwabe (2007) proposed that stress functions as a "switch" between the basal ganglia(BG) and hippocampal(HC) memory systems. They observed enhanced BG-mediated "habit" learning at the expense of HC-mediated "cognitive" learning resulting from acute and chronic stress. This theory may be a useful model of obsessive-compulsive disorder(OCD). Indeed, BG hyperactivity – of which compulsions may be a behavioural manifestation – and impaired HC functioning have been documented in individuals with OCD. We propose: (1) Schwabe's theory would unify these seemingly unrelated findings; (2) stress interacts with OCD to "flip the switch". In the present study, chronic stress questionnaires and a computerised object-location memory task were administered to individuals with OCD and controls. They learned the locations of several objects relative to either a boundary or landmark. In an fMRI study, boundary- and landmark-related learning were supported by the HC and BG memory systems, respectively, and each system's influence on learning was proportional to its level of activation. Concordant with those of a study of subclinical OCD (Limmer,2012), the present results indicate that landmark had a greater influence on learning than boundary, indicating greater activation of the BG relative to the HC. The OCD – and previously the subclinical – group reported increased stress reactivity – the duration and magnitude of a stress reaction. Reliance on landmark-related learning may reflect compensation for (1) long-term downregulation of HC activity owing to increased stress reactivity and resulting alterations of the HPA axis and/or (2) down/dysregulation of HC activity owing to OCD itself.

E24

THE IMPACT OF STIMULUS VALUE ON GOAL-DIRECTED AVERSIVE REINFORCEMENT LEARNING

Björn Lindström[1], Armita Golkar[1], Andreas Olsson[1]; [1]Karolinska Institutet, Sweden — Associations between stimuli with intrinsic negative value (e.g., threatening faces) and naturally aversive events (e.g., electric shocks) are more easily learned than between stimuli lacking such value. Such preferential learning has mainly been shown in the context of classical conditioning. In spite of its importance to real-world behavior, it is unclear if this learning bias generalizes to goal-directed reinforcement learning in humans. In the first experiment, we used a paradigm where participants learned to choose the option (pictures of angry or happy faces) that minimized the amount of electric shocks they received. We manipulated the risk of electric shocks for each option using a 2 (Phase: Initial/Reversal) x 2 (Group: HappyToAngry/AngryToHappy) design, where the happy face for one group initially represented the optimal choice (P(Shock|Happy) = .25), but subsequently changed to be the sub-optimal choice (P (Shock|Happy) = .75) during the reversal phase. This design allowed us to disentangle stimulus-driven and goal-directed processes in their impact on reinforcement learning. The results showed that the value inherit in the stimuli powerfully impacted reinforcement learning. As predicted, we observed facilitated learning when the angry face was most predictive of electric shocks, relative to when the happy face was most predictive of electric shocks. In the second experiment, we aimed to extend the effect to the social domain, using the same paradigm, but with stimuli signifying social group belonging (black and white faces shown to white participants). Taken together, these experiments show that stimulus value has a powerful impact on goal-directed reinforcement learning.

E25

WHITE MATTER CONNECTIVITY REFLECTS INDIVIDUAL DIFFERENCES IN THE CHILL RESPONSE TO MUSIC

Matthew Sachs[1], Robert Ellis[1], Gottfried Schlaug[1], Psyche Loui[1]; [1]Harvard Medical School, Beth Israel Deaconess Medical Center — The experience of chills in response to music is widely documented, but poorly understood. Although individual differences exist in the tendency to experience chills in response to music, little is known about neurobiological mechanisms underlying such individual differences. Here, we show that individual differences in strong emotional

responses to music are linked to differences in auditory-frontal white matter connectivity. Previous functional imaging research has shown that the anterior insula (AI) is activated during the experience of chills, and orbitofrontal cortex (OFC) is activated in tasks involving aesthetic judgment. Therefore, we predicted that people who frequently perceive chills during music listening would have increased structural connectivity between these frontal regions and secondary auditory processing regions in the Superior Temporal Gyrus (STG). We conducted large-scale screening (n = 237) using a musical aesthetic experience questionnaire, from which we identified 10 chill responders and 10 controls matched in demographics, musical training, and personality factors. In these two groups we obtained diffusion tensor imaging data and behavioral ratings, heart rate, and skin conductance during music perception. We used DTI to trace white matter pathways between STG, OFC, and AI. Results showed increased tract volume among chill responders in white matter volume connecting STG, OFC, and AI. Furthermore, tract volume was significantly correlated with heart rate during perception of chills in music. Our findings provide the first evidence that individual differences in the emotional response to music are associated with connectivity differences between sensory and emotional processing networks in the brain.

E26

EMOTIONAL AROUSAL DISRUPTS ASSOCIATIVE LEARNING: EVIDENCE FROM SIMULTANEOUS FMRI AND EYETRACKING

Christopher R Madan[1,2], Jeremy B Caplan[1], Esther Fujiwara[1], Tobias Sommer[2]; [1]University of Alberta, [2]University Medical Center Hamburg-Eppendorf — Emotional experiences are often remembered better than neutral ones. Due to the self-important nature of emotional experiences, one might also expect it would be adaptive to remember information related to emotional better than information related to neutral experiences. However, behavioral studies are now finding that association-memory is in fact impaired by emotional arousal. We hypothesized that this reduced association-memory is caused by reduced hippocampal engagement during study of emotional pairs compared to neutral pairs. We tested for this pattern of influence on hippocampal, as well as amygdalar, engagement during picture-association-learning with fMRI, and on fixation patterns with concurrent eyetracking. Behavioral results replicated the impairment of pairs of emotional items relative to pairs of neutral items using image stimuli and a 5-alternative forced choice associative recognition task. Subsequent memory effect (SME) analyses showed that the hippocampus was engaged less for correctly recognized emotional than neutral pairs. No SME was found in the amygdala for emotional pairs. The eye-fixation patterns showed a SME: Association-memory was better when participants made more saccades between the two images of a pair. Saccades between images may reflect a participant trying to relate to-be-associated items to one another. Additionally, participants made fewer saccades between the items of emotional pairs than neutral pairs. Taken together, effects of emotional arousal led to decreased hippocampal engagement and in-turn impaired learning of emotional than neutral pairs. Results further suggest that impaired association-memory due to arousal may be driven by modulating distribution of attentional allocation during association learning.

E27

CULTURAL AND RACIAL INFLUENCES ON THE NEURAL BASIS IN EMOTIONAL FACE PROCESSING: AN FMRI STUDY

Yoko Mano[1], Tokiko Harada[2], Hidetsugu Komeda[3], Lisa A. Hechtman[1], Todd B. Parrish[1], Norihiro Sadato[2], Tetsuya Iidaka[4], Joan Y. Chiao[1]; [1]Northwestern University, [2]National Institute for Physiological Sciences, [3]Carnegie Mellon University, [4]Nagoya University — In previous cross-cultural studies, activity of bilateral amygdala has been shown to vary as a function of environmental and social context. However, prior neuroscience studies demonstrating the influence of culture and race on amygdala response have not systematically examined independent contributions of culture and race, treating participants of different races from the same culture or participants of the same race from different cultures without distinction. Here we examined cultural (Caucasian-American; CA vs. Japanese-American; JA) and racial (JA vs. Native-Japanese; JP) influence on neural basis of emotional face processing. Participants completed an emotional face processing task, including stimuli of Caucasian and Japanese actors' faces (CFace and JFace consisting with emotional faces of fear or angry), and a shape matching task (Shape) as a control. Fifty participants were scanned with an fMRI while completed a match-to-sample task, specifically chose a face/shape that was of the same face/shape as the target face/shape. The task was consisted with 2 kinds of functional runs (CFace and Shape, JFace and Shape). Across both functional runs, activation of bilateral amygdala was observed in all groups and activation of right parahippocampal gyrus was observed in JP {(JFace - Shape) - (CFace - Shape)}. The results suggest that bilateral amygdala is associated with emotional face expression across cultures, and parahippocampal gyrus is associated with the in-group emotional face expression in JP. Taken together, the results of cultural and racial effects show that the emotional face processing depends on environmental and social context, such as culture and race.

E28

DIFFERENTIAL RESPONSE PATTERNS ON INDIRECT MEASURES OF IMPLICIT BIAS.

David March[1], Reiko Graham[1]; [1]Texas State University - San Marcos — Systemic racial and ethnic biases permeate the American social order, often manifesting without an individual's awareness. In this study, we examined implicit biases against Hispanics using two indirect measures, the startle eyeblink paradigm and the Implicit Association Test (IAT), as well as an explicit self-report measure. During the startle task, non-Hispanic Caucasian (White) and Hispanic participants viewed photo primes of White and Hispanic males, a random subset of which were accompanied by an auditory probe. The IAT utilized White and Hispanic male faces as exemplars. Startle data revealed larger eyeblink amplitudes during Hispanic vs. White primes, with no significant between-groups difference. IAT reaction times were longer in Hispanic + good compared to Hispanic + bad trials for both groups. However, there was a significant interaction wherein Hispanic participants were significantly faster on Hispanic + good trials than Whites. Correlational analyses revealed no significant relationships between the three measures, suggesting that each may be tapping into a different aspect of ethnic attitudes. This study extends prior research by demonstrating that findings from Black/White studies of implicit racial biases are generalizable across race and ethnicity.

E29

THE ROLE OF FRONTOPARIETAL CONNECTIVITY IN HIGH-STAKES CHOKING DEPENDS ON TRAIT RUMINATION

Andrew Mattarella-Micke[1], Sian L. Beilock[2]; [1]Vanderbilt University, [2]University of Chicago — In high-stakes tests, the pressure to succeed can cause students to perform below their ability (or "choke under pressure") instead. Behavioral studies trace the source of choking under pressure to a disruption of working memory (WM). In a first neuroimaging study, we extended this hypothesis, showing that individual differences in choking on a high-stakes math test can be predicted by task-related BOLD response in a frontoparietal WM network. Connectivity analyses also revealed a subset of WM-related regions decouple from the larger network during high-stakes performance. Greater uncoupling in one such region, the ventromedial prefrontal cortex (vmPFC), lead to improved performance under pressure. While previous research associates the vmPFC with emotion processing and internal rumination, its exact role in high-stakes performance remains speculative. In the current study, we explicitly investigate the underlying basis for the relationship between vmPFC connectivity and choking under pressure. Participants answered math problems under conditions of high and low-stakes incentive, and also completed a trait measure of rumination. Consistent with previous results, activity in the intraparietal sulcus (IPS) predicted which individuals choked on WM demanding problems. Critically, individual differences in trait rumination moderated the previously reported relationship between vmPFC connectivity and performance. For individuals high in trait rumination, increased connectivity between the IPS and vmPFC resulted in worse performance on WM demanding math problems. This did not hold for individuals low in trait rumination. Thus, choking under pressure may be related to negative ruminative content communicated from the vmPFC to other WM regions.

E30

SEX DIFFERENCES IN NEURAL CORRELATES OF EMOTIONAL MEMORY VS. VISUO-SPATIAL PROCESSING IN SCHIZOPHRENIA

Adrianna Mendrek[1,2,3], Nadia Lakis[2], Josiane Bourque[3]; [1]Department of Psychology, Bishop's University, [2]Centre de recherche Fernand-Seguin, [3]Department of

Psychiatry, Universite de Montreal — Sex differences in the prevalence and clinical course of schizophrenia have been well documented. More recently differences in structural and functional neuroanatomy between male and female patients have been reported. In our previous study of visuo-spatial processing we observed significantly diminished brain activations in male patients and significantly greater activations in female patients, relative to the same-sex controls. The purpose of the present investigation was to determine if the aforementioned effect reflected a generalized neurofunctional deficit in male patients and thus would be also apparent during emotional memory task. Forty-two schizophrenia patients (21 women) and 42 healthy controls (21 women) underwent functional magnetic resonance imaging (fMRI) while performing an emotional memory task. The task consisted of the recognition of pleasant, unpleasant and neutral photographic pictures (scenes, faces, objects). The fMRI data analysis revealed significantly stronger activations in male patients relative to control men in several brain regions associated with processing of emotional memories, during recognition of both positive and negative images. In contrast, female patients exhibited significantly weaker activations than control women during recognition of emotional stimuli. The results of the preset study show that the previously observed reversal of normal sexual dimorphism in schizophrenia patients could not be explained by a generalized deficit in neurocognitive function of male patients, but is task-dependent. In fact, sex differences in patients' cerebral activations during emotional memory were in the opposite direction to what we had observed during mental rotation in the same cohort of participants.

E31

BRAIN RESPONSES DURING EXTINCTION OF LEARNED FEAR TO RACIAL IN-GROUP AND OUT-GROUP FACES

Tanaz Molapour[1], Armita Golkar[1], Carlos Navarrete[2], Olof Hjort[1], Andreas Olsson[1]; [1]Karolinska Institutet, [2]Michigan State University — Previous research has shown that conditioned fear responses (CRs) to images of members of racial out-groups, as compared to in-groups, are more resistant to extinction. Much is known about the neural processes underlying the acquisition of CRs, involving a network of brain regions, such as the amygdala, anterior cingulate cortex (ACC), anterior insula (AI), and the extinction of CRs, involving the amygdala and prefrontal cortex (PFC). However, the neural mechanisms supporting the racial learning bias remains unexplored. The amygdala, AI and ACC have also been implicated during viewing of members of out-groups and stigmatized groups, providing a link to the research on fear learning. Here, we used functional magnetic resonance imaging (fMRI) to investigate the neural correlates of CRs to male Black and White faces in white participants. We found that during extinction, CRs to Black vs White faces showed greater activity in the fear conditioning network and the fusiform face area, which is known to be relatively enhanced during the perception of emotionally relevant faces. In addition, CRs to Black vs White faces were linked to increased activity in the PFC. Taken together, these results suggest that, relative to in-group faces, the persistence of CR to out-group faces might depend on an impaired down-regulation of the fear conditioning network and heightened perceptual processing in face specific regions. Our findings might help to explain the basic mechanisms underlying the acquisition and maintenance of aversions towards out-group individuals.

E32

RELATIONSHIPS BETWEEN REGIONS OF EMOTION PROCESSING NETWORK AND PERSONALITY TRAITS INDEXING EMOTIONAL AROUSABILITY, EXPRESSIVITY, AND CONTROL: A VOLUMETRIC APPROACH

Matthew Moore[1], Yifan Hu[1], Sarah Woo[1], Alexandru D. Iordan[1], Florin Dolcos[1], Sanda Dolcos[1]; [1]University of Illinois at Urbana-Champaign (IL), USA — Functional brain imaging studies of emotion have identified a network of cortical (including frontal, parietal, occipital, and medial temporal) and subcortical (basal ganglia) brain regions associated with various aspects of emotion processing. Here, we investigated the relationship between the gray matter volume of emotion processing network areas and personality traits indexing three aspects of emotion processing: Arousability, Expressivity, and Control. Automatic parcellation volumes obtained with Freesurfer were investigated in relation to ratings from the Scale of Emotional Arousability (SEA), Berkeley Expressivity Questionnaire (BEQ), Emotion Regulation Questionnaire (ERQ), and Barratt Impulsivity Scale (BIS) in 45 healthy subjects who underwent structural MRI scanning of their brains. Although overall there was little overlap in brain regions that volumetrically correlated across the scales, areas showing such overlaps included the entorhinal cortex (EC) and striatum. Specifically, the right entorhinal cortex (EC) negatively correlated with SEA-Lack of Control and with BEQ Positive Expressivity, while the left EC negatively correlated with BIS-Attentional Impulsivity, BIS-Attention, and BIS-Perseverance; in the striatum, BIS-Attention negatively correlated with bilateral caudate and SEA-General Emotionality negatively correlated with the right caudate. Despite the absence of relationships between gray matter volume and our scales in frontal areas, the right EC volume negatively correlated with the volume of lateral prefrontal cortical (PFC) areas. These findings suggests that the EC may act as a multimodal hub that integrates various levels of emotion processing, from sensitivity and arousal to expressivity and control, and is susceptible to modulatory influences from PFC areas involved in higher-order of emotion processing integration.

E33

AFFECTIVE PRIMING BY BIOLOGICAL MOTION

Edward Nguyen[1], Ayse P. Saygin[1]; [1]University of California, San Diego — Emotion is a pervasive and important aspect of human experience. Although it is well known that body movements can convey emotional information, relatively little is known about the mechanisms underlying the perception of emotional biological motion, despite its inherent presence and influence in our daily interactions with others. Here, we employed the affective priming paradigm using point-light biological motion animations as emotional primes. Subjects were presented with affective point-light arm movements that conveyed anger, happiness or neutral affect. They subsequently were asked to make affective judgments on target word stimuli that were either positive or negative in valence. Responses in affectively congruent trials were significantly faster than those in incongruent and neutral trials, while no significant difference was found between reaction times for incongruent and neutral trials. These results indicate that a positive priming effect occurs for affective priming of emotional words by affective biological motion. In a second experiment, the point-light displays were spatially scrambled to have no coherent form while retaining the same local motion; no significant difference was found between any of the prime-target conditions, indicating that the global form of the biological motion stimuli, rather than local motion are likely to be driving the affective priming effect. These results suggest that body movements expressing emotion are effective enough signals to influence responses to incoming emotional stimuli, a finding that adds onto the literature of both emotional biological motion and affective priming research.

E34

DIFFERENTIAL ELECTROCORTICAL PROCESSING IN THE PRESENCE OF STEREOTYPE-INCONSISTENT INFORMATION

Sierra P. Niblett[1], Eric D. Splan[1], Avi Ben-Zeev[1], Mark W. Geisler[1]; [1]San Francisco State University — Electrocortical processing during person perception is affected by stereotypic information that cues social category membership, such as race and gender. When information violates expected stereotypes, the subsequent response is frequently an increase in affective arousal, cortical processing, and working memory updating, reflected in larger amplitudes for later positive event-related brain potential (ERP) components (e.g., P3) (Bartholow et al., 2001; Osterhout, Bersick, & McLaughlin, 1997). Early sensory and attentional ERP components (e.g., N2) also show increases in amplitude for stereotype-violating information, as opposed to stereotype-confirming information (Dickter & Gyurovski, 2012). The current study is derived from Dickter & Gyurovski (2012) and adapted to include the standard oddball paradigm in order to better elicit the P3 ERP component in conjunction with an electrophysiological "surprise" response during a computer-identification task. Participants viewed either faces that differed in gender or faces that differed in race and were asked to indicate via button press when a target face appeared on the screen. Prior to the presentation of the faces, participants were primed with cues that were either stereotypic or counter-stereotypic in nature. Preliminary results indicate that differential processing, indexed by early attentional ERP component amplitudes and the P3 ERP component amplitudes, occurred in the presence of information that was counter-stereotypic as opposed to stereotypic of the target face. This line of research adds to the literature on the emergence of stereotypic biases during person perception.

E35

PHARMACOLOGICAL MANIPULATION OF EMPATHY USING OXAZEPAM Gustav Nilsonne[1,2], Sandra Tamm[1], Armita Golkar[1], Katarina Gospic[1], Andreas Olsson[1], Martin Ingvar[1], Predrag Petrovic[1]; [1]Karolinska Institutet, Department of Clinical Neuroscience, [2]Stockholm University, Stress Research Institute — Background: Violent criminals are reported to sometimes self-medicate with benzodiazepines in order to release inhibitions against violent behavior. Aims: We investigated the effect of Oxazepam on self-reported and psychophysiological measures of empathy. Methods: 66 healthy male experimental subjects were randomized to 25 mg oral Oxazepam or placebo, in a double-blind design. Subjects were introduced to an assistant who pretended to also be an experimental subject. Subjects completed questionnaires for dispositional empathy (IRI), alexithymia (TAS-20), and anxiety (STAI-T), as well as pain titration using a skin electrode to find pain thresholds of VAS 10 and VAS 80. Subjects were then seated next to the assistant so they could see only the other's hands. The experimental paradigm consisted of alternating electrical shocks to the subject and to the assistant, although the latter only pretended to receive pain stimulation. Cues were given on a screen. After each shock, the subject rated the intensity and unpleasantness of the stimulation. Skin conductance was recorded. Results: The Oxazepam group showed increased reaction times, reflecting the sedative effect of the drug ($p=0.02$), as well as lower self-reported anxiety after the experiment, reflecting the anxiolytic effect of the drug ($p=0.01$). Subjects were unable to guess treatment group, confirming integrity of the blinding. Oxazepam did not significantly decrease ratings of pain nor galvanic skin responses to others' pain. Self-rated unpleasantness to others' pain was significantly correlated to rated trait empathy using the Interpersonal Reactivity Index. Conclusions: 25 mg Oxazepam did not cause a significant decrease in empathy for pain.

E36

INTERACTION OF EMOTIONAL EXPRESSION AND EYE GAZE: AN EVENT RELATED POTENTIAL STUDY Jason S. Nomi[1], Candice Frances[2], Maia T. Nguyen[1], Stephanie Bastidas[1], Lucy J. Troup[1]; [1]Colorado State University, [2]New College of Florida — The current study examined the interaction of emotional expression and eye gaze in order to test the evolutionary theory predicting fearful averted-gaze expressions are prioritized over angry averted-gaze expressions while angry straight-gaze expressions are prioritized over fearful straight-gaze expressions. ERPs were acquired from 22 participants fitted with 19 electrodes (10-20 international system) in response to four emotions (happy, angry, fearful, neutral) each displaying three gaze-directions (left, straight, right; a total of 12 experimental conditions). Participants viewed trials consisting of a neutral image (700ms) followed by a fixation cross (500ms) and a target image (1000ms). Six blocks of 112 trials consisted of 96 target faces (8 for each condition) and 16 scrambled faces presented as targets; participants were instructed to press "1" whenever they saw a scrambled face. Repeated Measures ANOVAs were run on mean amplitudes for electrodes 01, 02, T5, and T6 with factors Emotion (happy, angry, fearful, neutral) and Hemisphere (left, right) for each gaze direction (left, straight, right) across three time windows (80-120ms, 120-200ms, 200-400ms). The overall results demonstrated that leftward gaze significantly interacted with expression from 120-200ms while rightward gaze significantly interacted with expression from 200-400ms. Additionally, fearful faces elicited significantly larger N170 mean amplitudes than angry faces for leftward and straight gazes. The results demonstrate that the interaction of leftward gaze and expression is temporally processed before the interaction of rightward gaze and expression. Further, fearful faces were preferentially processed over angry faces regardless of gaze direction; in opposition to what was predicted by evolutionary theory.

E37

META-ANALYSIS OF NEURAL CORRELATES OF EMPATHY AND REWARD: EVIDENCE FOR AN OVERLAP Garret O'Connell[1], Thom B Sims[2], Bhismadev Chakrabarti[3]; [1]University of Reading — As humans, we generally find social stimuli more rewarding than non-social stimuli. An emerging account suggests that this sense of reward in response to social stimuli underlies our higher-level social capacities such as empathy (i.e. the ability to understand the emotions and mental states of others). This has led to the hypothesis that people with autism do not empathise with social stimuli because they do not find them rewarding. Considerable evidence from social psychological and lesion studies in animals suggests an overlap between processes of empathy and reward. To examine if this overlap is observed neurally, we conducted a meta-analysis of functional magnetic resonance imaging (fMRI) studies investigating these processes. Coordinates of brain activity from scans of 1168 healthy people from 35 empathy and 40 reward papers were analysed using two meta-analytic techniques (Activation Likelihood Estimation and Multi-Kernel Density Analysis). The results show overlap in the (pre)supplementary motor area, inferior frontal gyrus (IFG), dorsal anterior cingulate cortex, anterior insula, and putamen. Further analysis show brain regions related to reward were more selectively activated by automatic emotional empathy (e.g. facial mimicry, vicarious pain) compared to controlled cognitive empathy (e.g. Theory of Mind, emotion recognition), $\chi 2 = 4.47$, $p = .035$. The spatial map defined by the empathy-reward overlap could be used as a template to focus the search for neural abnormalities underlying deficits in these processes in ASC. Overall, this meta-analytic evidence adds a level of support from fMRI for the link between empathy and the reward processes.

E38

MAKING SENSE OF OTHERS: THE NEURAL CORRELATS OF PERCEIVING PERSON INTERACTIONS Susanne Quadflieg[1,2], Francesco Gentile[2], Bruno Rossion[2]; [1]New York University Abu Dhabi, [2]University of Louvain — How social expectations shape our perception of people surrounding us has long been considered a core issue in vision science. What has not yet attracted widespread empirical attention, is the question of how perceivers make sense of others who are not encountered in isolation. Put differently, whether people shake hands, take a walk, or have a conversation, they are often witnessed in each other's company. At what stage in the person perception process does sensitivity to such interactions (and their inherent narrative) arise? To explore this issue, we used functional magnetic resonance imaging to measure neural activity while participants viewed images of two people presented on a uniform background. The shown agents were either interacting socially (e.g., involved in a marriage proposal or saying goodbye to each other) or not interacting. Non-interactions were created by presenting the exact same agents as in the interaction condition but not facing each other or by randomly pairing agents facing each other. Compared to these two control conditions, meaningful social interactions elicited reduced activity in cortical areas associated with person perception (e.g., the posterior temporal sulcus) and person understanding (e.g., the dorsomedial prefrontal cortex). In line with neural models of predictive coding facilitating information processing, these results support the view that social expectations shape the way our brains make sense of interacting others not only at an inferential level but also at a perceptual processing stage. More generally, these findings begin to elucidate the perception of person interactions in the human brain.

E39

NEUROPEPTIDE-S RECEPTOR GENE - MAGNETOENCEPHALOGRAPHIC CORRELATES OF ITS INFLUENCE ON VISUAL PROCESSING Maimu A Rehbein[1], Peter Zwanzger[1], Katharina Domschke[2], Andreas Reif[2], Jürgen Deckert[2], Markus Junghoefer[1]; [1]University of Muenster, Muenster, Germany, [2]University of Wuerzburg, Wuerzburg, Germany — Recent functional magnetic resonance imaging studies suggest a role of the neuropeptide-S receptor (NPSR1) gene in the processing of emotional material, with NPSR1 rs324981 T allele carriers showing altered activation patterns in cortical and sub-cortical brain areas in response to fearful stimuli. However, it remains unclear whether such functional alterations remain qualitatively similar during different stages of visual processing and whether they are specific for emotional, in particular fearful stimuli. In the present study, 60 healthy participants genotyped for the functional NPSR1 rs324981 A/T (Asn107Ile) polymorphism viewed faces varying in valence (fearful, neutral) and gender (male, female). Visual evoked magnetic fields were acquired using high-density whole-head magnetoencephalography (MEG) and compared with regard to differences between risk (AT/TT) and non-risk (AA) genotype groups and stimulus conditions (valence, gender). In the face-selective MEG component, the M170, T allele carriers showed enhanced responses to fearful compared to neutral faces and differential responses to stimuli varying in gender at secondary visual cortex regions. An overall group effect was observed, indicating greater brain activation

in the risk group irrespective of stimulus condition. Groups did not differ in behavioral measures assessing subjective ratings or reaction time. Our results are consistent with previous findings revealing enhanced visual processing of fear-related stimuli in risk allele carriers. Furthermore, our findings suggest that not only fear-specific, but also more general processing differences are conferred by NPSR1 gene variation that should be subject to future investigations. [This research was supported by the DFG: SFB-TRR 58 projects C01 and Z02]

E40

AN EEG STUDY OF MU FREQUENCY BAND ACTIVITY IN AUTISM SPECTRUM DISORDERS

Rheanna Remmel[1], Amy V. Van Hecke[1], Sheryl Stevens[1], Audrey M. Carson[1], Bridget Dolan[1], Jeffrey S. Karst[1], Kirsten A. Schohl[1], Noelle Fritz[1], Jenna Kahne[1], Grand McDonald[1], Alexandra Reveles[1], Janel Wasisco[1]; [1]Marquette University — The goal of this study was to determine if there are differences in EEG mu band (8-13 Hz) power between a group of adolescents with autism spectrum disorders (ASD; n=10) and a group of typically developing adolescents (TDG; n=10). Mu band power is representative of mirror neuron system activity, thought to be impaired in people with autism spectrum disorders. While EEG data was recorded, subjects watched a three-minute video of an adolescent delivering an autobiographical monologue. Movement artifacts were manually removed from EEG data before analysis with Neuroscan. The mu frequency band was isolated and averaged to obtain power for left and right hemispheres over the sensorimotor cortex, including electrodes C3 and C4 in the 10-20 system. Differences between groups and between hemispheres were explored using mixed repeated analysis of variance (ANOVA). Significant differences emerged between hemispheres, but not between groups. Power was significantly higher in the right hemisphere, $F(1,18) = 5.705$, $p < .05$. Neither age (ASD: M=12.7, SD=1.636; TDG: M=12.8, SD=1.398) nor full-scale IQ (ASD: M=102.7, SD=18.684; TDG: M=107, SD=20.005) were significantly different between groups. In further analyses, the sample size of each group will be increased. The results of this pilot testing suggest that, contrary to the "broken mirror theory" of autism, no difference in mirror neuron system activity arises between ASD and TDG groups when both groups engage in watching an adolescent speak, simulating a social situation.

E41

PERFORMANCE ON A NOVEL SPONTANEOUS THEORY OF MIND TASK CORRELATES WITH CORTICAL SURFACE AREA AND THICKNESS OF SOCIAL BRAIN REGIONS

Katherine Rice[1], Brieana Viscomi[1], Tracy Riggins[1], Elizabeth Redcay[1]; [1]University of Maryland — Research on the neural correlates of theory of mind (ToM) in adults has primarily employed simple story tasks, making it difficult to understand individual differences in unconstrained social settings. We developed a novel task to measure differences in spontaneous conceptualization of others' mental states. Given evidence that ToM develops into late adolescence, a sample of 31 young adults, aged 18 to 22 years, completed the novel ToM task and a battery of validated ToM measures. The novel task involved watching and then describing two silent film clips. Coders rated each participant's written responses to provide a ratio score of internal state phrases (i.e., describing emotions, intentions and beliefs) divided by total statements. After controlling for general memory and language ability, greater use of internal state phrases was significantly correlated with higher-order ToM comprehension and better pragmatic skills. A subset of 18 individuals underwent a structural MRI and their data were analyzed using FreeSurfer. Controlling for age, IQ, and total gray matter, spontaneous ToM scores were positively correlated with the surface area of anatomically defined social brain regions (including right mOFC, right IFG and insula), but not with control regions (e.g., visual areas). Whole-brain and region-based analyses revealed negative correlations with cortical thickness, although this effect was less specific to social regions. This novel measure of the spontaneous representation of others' beliefs, emotions, and desires captures meaningful behavioral and neuroanatomical variation. Further, these findings have implications for understanding brain-behavior relationships in autism, where deficits are more pronounced in unconstrained social situations.

E42

EXERCISE FREQUENCY PREDICTS BETTER INHIBITORY CONTROL AND BRAIN BLOOD FLOW REGULATION IN HEALTHY YOUNG ADULTS

Liana Machado[1], Hayley Guiney[1], Samuel Lucas[1], James Cotter[1]; [1]University of Otago — Young adults are presumed to be in their developmental prime, yet emerging evidence indicates that regular engagement in physical exercise could still benefit their executive functioning. However, little is known about which executive functions benefit from exercise or how the benefits might come about. To address this knowledge gap, we examined in 55 healthy young adults performance on a range of executive function tasks in relation to aerobic fitness, habitual physical activity, and cerebrovascular function (assessed using transcranial Doppler ultrasound). Multiple regression analyses revealed that more frequent physical activity, and to some extent higher aerobic fitness, predicted both better cerebrovascular function (evidenced by brain blood flow responses to changes in carbon dioxide levels) and superior inhibitory control. Cerebrovascular function also predicted better inhibitory control. Moreover, mediation analyses indicated that participation in frequent physical activity may bring about improvements in inhibitory control through improved brain blood flow regulation. These results provide novel insight into the cognitive and cerebrovascular benefits that may be gained with regular exercise, even in high-functioning populations. Importantly, they also point to a specific mechanism that may drive the exercise-cognition benefits.

E43

YOUNG CHILDREN'S INHIBITORY CONTROL SKILLS ARE ASSOCIATED WITH ERROR-RELATED BRAIN ACTIVITY

Loren M. Marulis[1], Matthew H. Kim[1], Jennie K. Grammer[2], Melisa Carrasco[3], Frederick J. Morrison[1], William J. Gehring[1]; [1]The University of Michigan, [2]Albert Einstein College of Medicine, [3]University of Rochester Medical Center — Executive functioning (EF) comprises a set of skills (cognitive flexibility, inhibitory control, and working memory) important for complex, goal-directed activity. Neurological processes related to errors may be implicated in EF and inhibitory control (IC) in particular, as both are conceptually related and influenced by development and often recruited to avoid making errors. The error-related negativity (ERN) reflects processes involved in detecting errors or response conflict (Gehring et al., 2012), while the error positivity (Pe) may reflect conscious awareness of errors and self-regulatory capacities (Overbeek, Nieuwenhuis, & Ridderinkhof, 2005). In the current study, we examined the association between error-related brain activity (ERN and Pe) and IC in preschool-aged children. Thirty-six children (12 females, M=5.4 years; n=23 for EEG data) were assessed using the Woodcock Johnson Pair Cancellation (WJPC; direct child assessment) and the Inhibitory Control subscale of the Children's Behavior Questionnaire Short Form (CBQ-IC; parent report). Children completed a Go/No-Go task during which continuous EEG data were acquired. A 3 (FCz/Cz/Pz) x 2 (Correct/Error) ANOVA yielded significant interactions for the ERN and Pe. The WJPC was not associated with error-related brain activity, while the CBQ-IC was negatively correlated with the Pe. This divergence may reflect measurement differences; the CBQ-IC, being a broader ecologically-valid assessment, may be more likely to reflect the day-to-day demands on IC (Duckworth & Seligman, 2006). The observed IC-Pe association establishes an empirical link between IC and error-related brain activity, suggesting that children with stronger IC skills may have a reduced need to engage in conscious error awareness.

E44

HOW REWARD AND PUNISHMENT INFLUENCE PROACTIVE AND REACTIVE INHIBITION

Tara Molesworth[1], Timothy Verstynen[1]; [1]Carnegie Mellon University — When performing an action, like reaching for a cookie, there are two ways your brain can stop the action. The stopping might be proactive, such as sticking to a diet, or reactive, like when you see a spider on the cookie. We wanted to determine whether reward and penalty differentially affected proactive and reactive inhibition. Twelve subjects performed two variants of the Stop-Signal Task (SST) that used different types of penalty and reward. In the reactive SST, subjects had to stop a moving bar as close to a target line as they could and inhibit their key press if the bar stopped before it reached the line. The proactive SST required subjects to decide whether or not they would stop or go based on the bar's color, which represented the probability that the bar would stop 50 ms before hit-

ting the line. Both SSTs consisted of a Baseline condition (where successful stop and go trials are rewarded equally), a High Reward condition where bonus for successful stops increased, and a High Penalty condition where more money was subtracted from the total for unsuccessful stops. Overall, subjects were more efficient at stopping in the reactive SST than proactive SST ($F[1,11]=618.47$, $p<0.001$). Within both tasks, the efficiency of stopping was improved in the High Penalty condition, relative to Baseline. For proactive SST trials, the High Reward condition improved stopping efficiency more than in the reactive SST. These results demonstrate that proactive and reactive inhibition are manipulated by contextual factors that influence motivation.

E45

CHANGES IN COGNITIVE CONTROL REGIONS ASSOCIATED WITH SUCCESSFULLY ADAPTING TO TASK ENVIRONMENT MODIFICATIONS

Jarrod Moss[1], Winston Jones[1], Hao Bai[1], Stephanie Doane[1]; [1]Mississippi State University — Prior research has shown that a set of regions, called the cognitive control network, decrease in activity with increasing levels of task experience. These cognitive control regions were examined in a functional magnetic resonance imaging (fMRI) study of multitasking. In this study, participants were trained to perform a multitasking task where they must prioritize the sorting of a set of objects based on the features of those objects while frequently being interrupted by new objects to sort. After training, participants performed this task during an fMRI session in which participants performed the originally trained task followed by a version of the task in which the function of a key part of the interface was modified. This task modification required a change in a portion of the task set in order to be able to maintain prior levels of performance. Participants differed on how effectively they adapted to the task modification, and it was found that the functional connectivity of the anterior insula with the other regions of the control net significantly decreased in those participants who were most successful in adapting. The connectivity of the anterior insula predicted performance change better than other individual difference variables collected (e.g., working memory capacity, ravens). The anterior insula is thought to be part of a salience network, and the change in connectivity observed in this study indicates that successful adaptation may rely on this salience network to help inhibit old rules of the task set that must be replaced by new rules.

E46

DISSOCIATION OF THE PEA AND PEB FOLLOWING ERRORS AND UNCERTAIN RESPONSES

Ana Navarro-Cebrian[1,2], Andrew S. Kayser[1,2]; [1]Ernest Gallo Clinic and Research Center, [2]University of California, San Francisco — Error monitoring processes are essential for adaptation and learning; however, the associated neural mechanisms are still unidentified. For example, the function and underlying neural generators of the 'error positivity', PE, remain unknown. Due to its resemblance in timing and scalp topography to the P300, it has been suggested that the PE could share a neural substrate with the P300 and reflect a P300-like component associated with the motivational significance of an error. Two P300 components have been distinguished: a fronto-central P3a that reflects bottom-up attention-orienting mechanisms, and a parietal P3b related to the update of stimulus representations. We hypothesized that there are similarly two distinct PE components: a PEa, reflecting an error-driven orienting mechanism, and a PEb, that may be related to the update of the response representation. Our data show that errors are followed by a PE (PEa) activity with a fronto-central topography that resembles that of a P3a component. Also, a strong negative correlation between the PEa amplitude and the number of errors was found. This result indicates a habituation of the attention response, which has also been identified in the P3a. Secondly, uncertain responses (when people were not confident of their response) were followed by a strong P3b-like activity (PEb). This finding is in agreement with previous research that shows that the P3b increases with uncertainty. These results support the idea that the PE may be a manifestation of more general orienting and updating processes, rather than being specific for errors.

E47

IMPACT OF EMOTIONAL IMAGE VIEWING ON NEURAL MECHANISMS OF RESPONSE INHIBITION.

Tara K. Patterson[1], Agatha Lenartowicz[1], Elliot T. Berkman[2], Russell A. Poldrack[3], Barbara J. Knowlton[1]; [1]UCLA, [2]University of Oregon, [3]University of Texas, Austin — In the stop-signal paradigm, response inhibition is measured by having participants withhold a practiced key press response when accompanied by a stop-signal. Previous work in our lab has shown that viewing negative emotional stimuli prior to performing the stop-signal task compromises stopping performance by increasing stop-signal reaction time. In the present experiment we investigated how negative emotion impacts the neural mechanisms that facilitate stopping. We collected fMRI data from 19 participants who performed the stop-signal task after they viewed negatively emotional images or neutral images. During stopping following negative image viewing, we observed reduced BOLD activity in three regions previously implicated in successful stopping: the right inferior frontal gyrus, middle frontal gyrus, and medial superior frontal gyrus. We also observed a positive correlation between amygdala activation following negative versus neutral image viewing and the corresponding slowing in stop-signal reaction time. The results indicate that the neural network supporting response inhibition is disrupted by negative image viewing, and that this effect may be mediated by the amygdala.

E48

FORETHOUGHT IN ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)

Helene Poissant[1], Adrianna Mendrek[2], Lucile Rapin[1], Noureddine Senhadji[3]; [1]Université du Quebec a Montreal, [2]Bishop University, [3]Institut Universitaire de Gériatrie de Montreal — Attention-deficit hyperactivity disorder (ADHD) is associated with neuroanatomical anomalies. The existence of 1) a prefrontal dysfunction associated with behavioral inhibition and executive control deficits in ADHD and 2) the link of forethought to working memory and inhibition, has lead us to hypothesize that children with ADHD will show atypical patterns of prefrontal activations while performing a forethought task. Methods: Twenty-one TD and 23 ADHD adolescents underwent a functional magnetic resonance imaging (fMRI) while performing a forethought task: presentation of 56 cartoon stories (23 congruent; 23 incongruent). Participants had to answer if "yes" or "no" the sequences of actions make sense according to their expectation. Stories were presented in block of seven stories in a randomized manner. Results: The fMRI revealed significant activations during performance of the incongruent relative to congruent condition in the left middle orbito-frontal cortex, the right superior and inferior frontal gyri, right frontal inferior operculum, as well as the left supplementary motor area in the group of adolescents with TD. In the ADHD group, results showed significant activations only in the right inferior frontal gyrus (IFG) and the right portion of the basal ganglia (globus pallidus). Conclusion: These findings are consistent with studies of executive functions and inhibition, which found the involvement of the frontostriatal network in the pathophysiology of ADHD. They confirm the role of the PFC in cognitive control and in the ability to orchestrate thought and action and confirm its dysfunction in ADHD.

E49

DIFFERENTIAL EFFECTS OF TWO MEDITATION PRACTICES ON THE NEURAL RESPONSES TO PAIN IN EXPERT MEDITATORS

Antoine Lutz[3,1], David Perlman[2,3], Cort Dahl[2,3], Richard Davidson[2,3]; [1]Waisman Laboratory for Brain Imaging and Behavior, University of Wisconsin–Madison, USA, [2]Department of Psychology, University of Wisconsin—Madison, USA, [3]Lyon Neuroscience Research Center, INSERM U1028, CNRS UMR5292, Lyon 1 University, Lyon, France — Pain is an unpleasant sensory and emotional experience that can be regulated by many different cognitive mechanisms. We compared the regulatory qualities of two different meditation practices during noxious thermal stimuli: Focused Attention (FA), directed and sustained at a fixation cross away from the stimulation, which could regulate negative affect through a sensory gating mechanism; and Open Presence (OP), which could regulate negative affect by cultivating an effortless and open awareness of whatever is occurring in the present moment, without reacting, rejecting or absorbing the contents of the experience. We used neuroimaging in 19 expert meditators (>10,000 h of practice) and 19 matched novices to dissociate neural activation patterns associated with pain, and its recovery during these two practices. Compared to novices,

expert meditators reported equal pain intensity, but less unpleasantness during OP compared to FA. During OP, this difference was associated with enhanced activity in the so-called 'salience network' for experts. The contrast of FA versus OP showed enhanced deactivation in medial prefrontal cortex as well as in occipital regions during pain, suggesting enhanced recruitment of these regions before pain during FA. This effect was stronger for experts than novices in occipital regions. Experts showed more activity compared to novices in the pain-descending pathway after pain than after warm stimuli during FA but not during OP. This study suggests that OP practice facilitates the immediate regulation of negative affect by decreasing the ongoing load of medial prefrontal activity, and by increasing the recruitment of attentional resources during pain.

E50

BEHAVIORAL EXPLORATIONS IN PREPARATORY PROCESSING USING THE AX-CONTINUOUS PERFORMANCE TASK

Lisa D. Ankeny[1], Jeremy R. Reynolds[1]; [1]University of Denver — Patterns of behavior in the AX-continuous performance task (AX-CPT) have proven useful in identifying and characterizing differences in cognitive control across a number of groups, including older adults, patients with schizophrenia, and young children (Chatham, Frank & Munakata, 2009; Braver et al., 1999). Further, neuroimaging studies have manipulated task variables in order to investigate control processes associated with distinct parts of prefrontal cortex, particularly frontopolar PFC (Braver & Bongiolotti, 2002). However, it is unclear whether such manipulations result in similar diagnostic behavioral patterns as seen in earlier, more canonical task versions. The first goal of the study was to directly compare behavioral performance patterns across different variants of the AX-CPT, in order to determine whether uncommon variants might demonstrate similar patterns that could be helpful in characterizing behavioral disorders or developmental trajectories. One advantage of the AX-CPT task is that it can be decomposed into cue- and probe-based activity. Results of the first study revealed differential effects of trial type depending on contextual manipulations of task variables. More specifically, one variant mimicked the typical, expected patterns of results seen in the AX-CPT, while another variant showed that a particular cue is potentially more influential. This suggests that manipulating task variables may reflect different strategies related to task preparation. To further examine the role of preparatory activity, a second experimental manipulation involved the inclusion catch (partial) trials to examine behavioral responses were altered in the context of the AX-CPT. The inclusion of catch trials did not appear to affect behavioral performance.

E51

FLUID INTELLIGENCE IS DIFFERENTIALLY ASSOCIATED WITH NEURAL EFFORT IN THE TASK-POSITIVE AND THE TASK-NEGATIVE NETWORK

Ulrike Basten[1], Christian J. Fiebach[1,2,3]; [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 — Previous studies on individual differences in intelligence and brain activation during cognitive processing focused on brain regions where activation increases with task demands (task-positive network, TPN). Our study additionally considers brain regions where activation decreases with task demands (task-negative network, TNN) and compares effects of intelligence on neural effort in the TPN and the TNN. In a sample of 52 healthy subjects, functional magnetic resonance imaging was used to determine changes in neural effort associated with the processing of a working memory task. The task comprised three conditions of increasing difficulty: (a) maintenance, (b) manipulation, and (c) updating of a four-letter memory set. Neural effort was defined as signal increase in the TPN and signal decrease in the TNN, respectively. In both functional networks, TPN and TNN, neural effort increased with task difficulty. However, intelligence, as assessed with Raven's Matrices, was differentially associated with neural effort in the TPN and TNN. In the TPN, we observed a positive association, while we observed a negative association in the TNN. In terms of neural efficiency (i.e., task performance in relation to neural effort expended on task processing), more intelligent subjects (as compared to less intelligent subjects) displayed lower neural efficiency in the TPN, while they displayed higher neural efficiency the TNN. The results illustrate the importance of differentiating between TPN and TNN when interpreting correlations between intelligence and fMRI measures of brain activation. This implies the risk of misinterpreting whole brain correlations when ignoring the functional differences between TPN and TNN.

E52

CORTICAL ENHANCEMENTS TO REINFORCEMENT LEARNING: A ROLE FOR PREFRONTAL CORTEX IN STATE ABSTRACTION

Christopher Chatham[1], David Badre[1]; [1]Brown University — Reinforcement learning (RL) is a powerful framework for understanding how state-action pairings acquire value. However, basic RL scales poorly to problems with many states and actions. One solution in the RL literature, policy abstraction, reduces this problem's dimensionality by packaging actions into abstract classes. The brain is thought to implement a similar process across a hierarchical prefrontal-striatal circuit, whereby more rostral areas of prefrontal cortex represent more abstract action classes. A second and complementary solution to this problem involves dimensionality reduction of states. But, such "state abstraction" could require distinct mechanisms: states cannot always be hierarchically decomposed, and too much abstraction can lead to neglect of goal-relevant boundaries between states. We tested whether prefrontally-mediated top-down biasing might support state abstraction by training neural networks to categorize a continuous state space. Top-down biasing was manipulated in a simulated prefrontal layer. Intermediate values of bias sharpened the boundaries between states and optimized the placement of those boundaries, but extreme values caused distinct states to be conflated. These results suggest two testable hypotheses. First, state abstraction may involve the inverted U-shaped performance curves that characterize other domains with prefrontal recruitment, though here in a context where stability and flexibility are not directly pitted against one another. Alternatively, the conflation of distinct states might be ameliorated with the recruitment of pattern separation mechanisms, such as those supported by the medial temporal lobe. These novel empirical predictions act as a theoretical framework for understanding how the brain might "scale up" basic RL to real-world problems.

E53

WHY DO WE STRUCTURE OUR KNOWLEDGE? TWO LEVELS OF RULE GENERALIZATION IN REINFORCEMENT LEARNING.

Anne Collins[1], Michael Frank[1]; [1]Brown University — People do not need supervision or incentives to learn rules. When learning stimulus-action mappings through reinforcement, they structure their policy into abstract rules (Collins & Koechlin 2012, Frank & Badre 2011), even when this does not afford any immediate advantage (Collins & Frank in press). We further investigate how and why individuals build such rules, using our structured reinforcement learning model to derive and test behavioral predictions. Subjects learned to select correct actions in response to stimuli presented in three different contexts. There were two stimulus-action rules, where one of them was valid in two contexts and the other only in a third context (but where each rule was equally frequent across trials). Subsequent phases introduced new stimuli in old contexts and new contexts with old stimuli. Consistent with model predictions, subjects transferred their self-constructed rule structure to new situations, at different processing levels. First, they gathered rule-specific, rather than context-specific, knowledge about new stimuli, thus learning faster by clustering contexts cueing the same rule. Second, they learned faster in new contexts by generalizing known rules across stimuli. Finally, when faced with a new context, subjects were more likely to try rules that were valid across multiple contexts than those that applied to only one, controlling for rule frequency. These results confirm our model's predictions, and show that the seemingly suboptimal strategy of building complex structure affords long term advantages given the opportunity to generalize across contexts.

E54

TRAINING SEQUENCE LEARNING AS A WAY TO IMPROVE LANGUAGE: AN ERP STUDY

Gretchen Smith[1], Christopher M. Conway[1]; [1]Georgia State University — Recent research suggests that certain language and communication disorders may be caused, in part, by disturbances to more fundamental, domain-general learning abilities such as sequence learning (Conway et al., 2010; 2011). However it is not yet known whether language impairments can be treated by improving sequence learning skills. The first step to answering this question requires investigating whether

sequence learning can be improved, and if so, whether such gains also result in improvements to language processing. The goal of the proposed study then was to test the feasibility of using cognitive training techniques to improve sequence learning and language abilities in typically-developing adults. Participants first were assessed on several pre-training tasks to provide baseline measures of sequence learning and language abilities, as measured by event-related brain potentials (ERPs). Participants were then quasi-randomly assigned to one of three groups, a treatment group that involved adaptive sequence training, an active control group, or a passive control group. Following 10 days of training or control, participants were assessed with the same pre-training ERP measures. The preliminary findings indicate training-related enhancements – and a functional neural reorganization -- to sequence learning and language abilities in the training group only. These results suggest not only that sequence learning can be improved through cognitive training but that such improvements also generalize to language abilities, which holds the promise for treating certain language and communication disorders.

E55

EEG CORRELATES OF SPONTANEOUS THOUGHTS TRIGGERED BY EXTERNAL STIMULI AND STIMULUS-INDEPENDENT COGNITIONS

Christine A. Godwin[1], Andrew C. Garcia[1], Ezequiel Morsella[1,2], Mark W. Geisler[1]; [1]San Francisco State University, [2]University of California, San Francisco — Spontaneous thoughts can arise from past memories (Andrews-Hanna et al., 2010), future tasks (Morsella et al., 2010), and environmental cues (Berntsen, 1996). Additionally, people have reported experiencing spontaneous thoughts triggered by various cues (Berntsen, 1998). Despite recent advances elucidating the cognitive and neural mechanisms underlying spontaneous thought (e.g., Christoff, 2012), little research has compared the neural correlates of spontaneous thoughts triggered by external stimuli or internal, stimulus-independent factors (e.g., memories and wandering thoughts). In the current study, continuous electroencephalogram (EEG) was recorded as participants (n = 49) pressed a button upon experiencing a thought. Participants indicated whether the thought arose from internal or external factors. Participants also reported the number of thoughts they believed comprised the sequence of cognitions leading to the spontaneous thought. To exclude motor activity, a 500-ms epoch preceding each button press by 400 ms was extracted. EEG within the alpha (8 – 13 Hz), beta (13 – 30 Hz), delta (1 – 5 Hz), and theta (4 – 8 Hz) bands was analyzed for each epoch. Increased alpha coherence in the right hemisphere was observed for internal compared to external thoughts ($p < .05$). Additionally, increased EEG coherence for reported thoughts compared to a baseline condition (eyes-opened resting) was observed over parietal and fronto-parietal regions. These findings are in line with previous research implicating distinct brain networks for internal and external awareness (Vanhaudenhuyse et al., 2011). Additionally, the current paradigm provides a novel way to investigate both the neural correlates and subjective aspects of spontaneous thoughts.

E56

SPONTANEOUS ALPHA OSCILLATIONS PREDICT ENCODING IN VISUAL SHORT-TERM MEMORY

Nicholas Myers[1], Mark G. Stokes[1], Anna C. Nobre[1]; [1]Oxford University — Stimulus-guided and top-down attention are known to improve the encoding of stimuli into visual short-term memory (VSTM). We explored the role of attention-related neural synchrony for VSTM encoding by investigating how spontaneous fluctuations in power lateralization and phase of alpha (8-14 Hz) oscillations over posterior cortex influence the likelihood of memorizing items. We collected EEG data from 17 healthy participants during a sequential VSTM task (1000 trials each). Participants saw a stream of 3-4 oriented bars (displayed for 150 ms) appearing at random locations (6° from fixation), at intervals of 950-1200 ms. After a memory delay, participants rotated a probe to the remembered orientation. We calculated 8-14 Hz power lateralization and instantaneous phase around the stimulus presentation to get an index of spontaneous alpha fluctuations, and regressed these measures onto trial-wise accuracy to test for a relationship with behavior. Spontaneous alpha desynchronization around 300 to 50 ms before stimulus onset predicted memory accuracy (corrected $p < 0.005$). Alpha phase preceding stimulus onset by 250 to 100 ms also correlated significantly with accuracy. These results indicate that periodic changes in excitability of the visual cortex may, in part, contribute to the efficient encoding of visual stimuli into VSTM. We found this effect even though stimuli were presented in isolation, and well above contrast threshold, suggesting that alpha biases encoding even when stimuli are easily detectable. We conclude that spontaneous parieto-occipital oscillations can mimic the effects of top-down attention on VSTM, improving the quality of encoding.

E57

PREFRONTAL CORTEX ORGANIZATION: DISSOCIATING EFFECTS OF TEMPORAL ABSTRACTION, RELATIONAL ABSTRACTION, AND INTEGRATION WITH FMRI

Derek Nee[1], Andrew Jahn[2], Joshua Brown[2]; [1]University of California, Berkeley, [2]Indiana University — The functions of the prefrontal cortex (PFC) underlie flexible and intelligent cognition. Varying proposals suggest that the PFC is organized along a rostral-caudal gradient of abstraction with more abstract representations/processes associated with more rostral areas. However, different theories disagree regarding how abstraction is operationally defined. Here, we directly contrasted two prominent theories of abstraction - temporal and relational – using fMRI. Critically, we separated manipulations of temporal and relational abstraction from integration demands that also implicate the PFC. While the data demonstrated robust effects of relational abstraction in the PFC, temporal abstraction effects were absent. Instead, we found activations specific to the integration of relational rules in areas previously associated with temporal abstraction. We suggest that previous effects of temporal abstraction were due to confounds with integration demands. We propose an integration framework to understand the functions of the PFC that resolves discrepancies in prior data.

E58

FMRI CORRELATES OF TRANSFER IN TRAINING WITH A COMPLEX TASK.

Aki Nikolaidis[1], Michelle Voss[2], Vo Loan[1], Kirk Erickson[3], Kramer Art[1]; [1]University of Illinois Champaign Urbana, [2]University of Iowa, [3]University of Pittsburg — One of the goals of cognitive training is examining improvements in untrained tasks; this phenomenon is known as transfer. We describe the neural correlates of individual differences in transfer using functional magnetic resonance imaging (fMRI). Forty-five participants trained for 30 hours with Space Fortress, a multimodal game that challenges working memory, reasoning, procedural learning, motor control, and both dorsal and ventral attention streams. Before and after training subjects were scanned in the MRI while playing the full Space Fortress game, and they were assessed with a variety of neuropsychological measures focusing on visual attention and memory. We found that transfer to both the Sternberg Memory task and Attentional Blink task correlated with activity in the superior parietal lobe in a gameplay>fixation contrast, and we also replicated previous literature indicating that greater fMRI signal in the caudate correlates with increased transfer to a working memory task. We replicated our findings in a separate fMRI scan while the same trainees played the working memory subtask of Space Fortress. Furthermore, we found that the pre-post changes in fMRI percent signal change in the superior parietal lobe and caudate were mediated by transfer. These data demonstrate a relationship between transfer and changes in functional activation over time, and could be an indication of a link between training induced plasticity and transfer. We discuss the theoretical implications of these results for the field of cognitive training as well.

E59

POSTERIOR PARIETAL CORTEX ACTIVATION PREDICTS WORKING MEMORY CAPACITY FOR FACES

Walker S Pedersen[1], Alexander J. Shackman[2], Julie A. Blaisdell[1], Emily L. Belleau[1], Daniel M. Stout[1], Christine L. Larson[1]; [1]University of Wisconsin - Milwaukee, [2]University of Wisconsin - Madison — Faces play a key role in the complex socioemotional interactions characteristic of humans. Although the neural circuitry underlying face perception is relatively well characterized, much less is known about the mechanisms supporting the storage of faces in working memory (WM). To address this challenge, we collected fMRI data during a change-detection task (1-5 neutral face targets; n=13). A whole-brain ANOVA with load as a single factor revealed load-sensitive activation in several regions, including the dorsolateral prefrontal and posterior parietal cortices ($p<.05$, corrected). Working memory capacity (Cowan's k) and activation in most of the frontoparietal clusters monotonically increased from one to three faces, with

saturation at higher loads (i.e., a quadratic profile). Individuals with higher WM capacity (k) showed enhanced activation in the superior parietal lobule and intraparietal sulcus at the higher load (3-faces vs. 1-face; $r>.65$, $p<.05$), suggesting that activity in these regions is linearly related to the number of stored faces (i.e., activation saturates with smaller arrays in individuals with lower capacity). Taken with prior work, these results suggest that similar mechanisms underlie the storage of faces and non-face stimuli in WM. More broadly, they set the stage for understanding how variation in this circuitry contributes to normative social processing and psychopathology.

E60

GROUPING VIA THE GESTALT PRINCIPLE OF SIMILARITY ALTERS CONTRALATERAL DELAY ACTIVITY Dwight Peterson[1], Marian E. Berryhill[1]; [1]University of Nevada, Reno — Gestalt principles of grouping facilitate visual perception, but can they help chunk information in visual working memory (VWM)? Expanding the VWM capacity limit (~3-4 items) would facilitate wide-ranging cognitive performance. If a Gestalt grouping principle can enhance VWM then the capacity estimates should increase. One neurophysiological index of VWM capacity is a posterior event-related potential (ERP) component called the contralateral delay activity (CDA). CDA amplitude increases according to the number of items held in VWM reaching asymptote at capacity (Vogel & Machizawa, 2004). Our goal was to see whether stimuli grouped by similarity would produce CDA amplitudes associated with smaller set sizes thereby reflecting enhanced VWM capacity. Participants performed a color change-detection task with 1-6 stimuli per visual field. The grouping manipulation (grouped, ungrouped) occurred at large set sizes. In grouped trials, some of the stimuli matched in color. EEG recordings were recorded from left and right posterior parietal cortex. CDA amplitudes were reduced for grouped arrays compared to ungrouped arrays suggesting that fewer neural resources were needed to maintain the grouped arrays. VWM capacity was larger when the Gestalt principle of similarity was available to chunk stimuli together. One promising extension of these findings is that VWM may be expanded by judicious use of Gestalt principles.

E61

EGOCENTRIC BUT NOT ALLOCENTRIC SPATIAL WORKING MEMORY IS IMPAIRED IN PRODROMAL HUNTINGTON'S DISEASE Katherine Possin[1], Erica Johnson[1], Gigi Satris[1], Michael Geschwind[1], Sharon Sha[1], Bruce Miller[1], Joel Kramer[1]; [1]University of California - San Francisco — Huntington's disease is an autosomal dominant neurodegenerative disease with early and prominent caudate nucleus atrophy. Working memory deficits are often apparent even during the prodromal period (pdHD); i.e., prior to the onset of motor or other obvious clinical symptoms. Cognitive neuroscience investigations have demonstrated a critical role for the caudate nucleus in egocentric (self-based) but not allocentric (landmark-based) memory (e.g., Postle & D'Esposito, 2003). We administered tests of egocentric and allocentric spatial working memory to 16 pdHD individuals and 17 age matched controls. Each test had 60 trials during which subjects remembered 2 locations over 1-sec delays. Although the tests were nearly identical, they differed in one important way: on the egocentric test, the subject remembered locations in self-based coordinates, whereas on the allocentric test, the subject remembered locations in landmark-based coordinates. Accuracy on the two tests was analyzed using a mixed model ANOVA. The test by group interaction was significant, $p = .02$. Whereas the pdHD patients performed normally on the allocentric working memory test, $p = .45$, $d = -0.3$, they exhibited a severe impairment on the egocentric working memory test, $p < .001$, $d = -1.4$. In conclusion, the pdHD patients exhibited a selective impairment in egocentric working memory, which may be due to caudate dysfunction. These results have implications for the selection of cognitive biomarkers for pdHD and also support the application of insights and methods from cognitive neuroscience to patient research.

E62

ERP EFFECTS OF LEXICAL PRE-EXPOSURE DURING L2 VOCABULARY ACQUISITION He Pu[1], Katherine J. Midgley[1], Matthias Scheutz[1], Jonathan Grainger[2], Phillip J. Holcomb[1]; [1]Tufts University, [2]CNRS and Aix-Marseille University — It has been hypothesized that difficulties encountered during the acquisition of a vocabulary in a second language (L2) is due to the formation of asymmetrical links between stored concepts and L1 and L2 lexical representations during learning. For example, in Kroll and Stewart's Revised Hierarchical Model, the mapping of L2 lexical units to concepts is mediated by the L1 lexicon, which has stronger connections to concepts. Given this reliance on the existing L1 lexicon during L2 vocabulary acquisition, pre-exposure of the lexical forms of L2 words prior to establishing any form-meaning associations should minimize the strong L2 to L1 lexical link and strengthen the direct links between the L2 lexicon and concepts. We tested the pre-exposure hypothesis on Spanish vocabulary learning by utilizing a series of ERP lexical decision tasks. 14 L1 English speakers who were enrolled in an introductory Spanish class were pre-exposed to a set of the course vocabulary items without their L1 translations throughout the semester. ERPs were then recorded to Spanish words and pseudowords (PWs), half of which had been pre-exposed. Results showed larger N400 amplitudes in response to pre-exposed Spanish words compared to non-pre-exposed Spanish words. Critically, this effect was not due to repetition, as the N400 amplitude for pre-exposed Spanish PWs was smaller than that for non-pre-exposed Spanish PWs. This contrast suggests that lexical pre-exposure leads to larger N400s and perhaps more lexical activation for learned L2 vocabulary.

E63

ASYMMETRY IN SEMANTIC ACTIVATION BY MISPRONOUNCED WORDS: EVIDENCE FROM ERP AND REACTION TIME STUDIES Adam Roberts[1], Allison Wetterlin[1], Aditi Lahiri[1]; [1]University of Oxford — Although mispronunciations and misperceptions of speech can both hinder word recognition, native listeners tend to discern some meaning out of any item they perceive, be it accurate or not. Because of this, a conflict arises: although mispronounced words may activate some meaning, they can also be recognised as nonwords. Here we investigate to what extent certain mispronunciations are accepted while others are rejected. We present three sets of crossmodal semantic priming experiments using real words and mispronunciations as primes, recording both reaction times and evoked potentials. Mispronunciations were created by replacing the place of articulation of the medial consonant in English disyllabic words (e.g. image becoming *inage), this alteration being chosen as alternation of medial consonants does not occur under normal coarticulatory conditions. Both differences in N400 amplitudes and priming in reaction times show that words with mispronounced medial coronal consonants (e.g., *temor) are accepted as their real word counterparts (e.g., tenor) and activate corresponding semantically related words (e.g., SINGER). In contrast, non-coronal mispronunciations (e.g., *inage) fail to access the real words (e.g., image) and do not activate their semantically related words (e.g., PICTURE). These results indicate there is an asymmetry in acceptance, where certain mispronunciations activate a phonologically related word along with its meaning, reflecting lexical access, whereas others do not. Neither storage of detailed acoustic information, nor contextual information can account for the asymmetry seen here, only an asymmetric lexical representation predicts asymmetry in perception.

E64

LATERALITY, HEMISPHERIC INTERACTION, AND TASK DIFFICULTY: SHIFTS TO HIGH FAMILIARITY WORDS FROM LOW FAMILIARITY WORDS Barbara Rutherford[1]; [1]UBC Okanagan — Two lexical decision experiments extend tests of laterality and the role of hemispheric interaction in two novel ways. First, the potential for dynamic influence of context to orthographic and phonological strategies for high familiarity words is assessed. Second, letter strings are presented at fixation to more closely approximate normal viewing behaviour. A lateralized distractor or no distractor at all loads processing of the letter string to one or both hemispheres, respectively. High familiarity words, pseudowords, and orthographically incorrect letter sequences are presented in Experiment 1. The same strings and low familiarity words are presented in Experiment 2. Experiment 1 found that letter strings were more accurately processed by the right hemisphere than both hemispheres, supporting the ideas of a right hemisphere advantage for orthographic processing and a cost from hemispheric interaction when a task is simple. Experiment 2 found that high familiarity words were more accurately processed by both hemispheres than the right hemisphere alone, revealing a benefit rather than a cost from hemispheric interaction as the task context became more difficult. In addition, high familiarity words were more quickly processed by the

left hemisphere than right hemisphere, just as low familiarity words were more accurately processed by the left hemisphere. These findings fit the assumption that the left hemisphere shifts to phonological processing as words become more challenging, and provide new evidence that laterality and the effect of hemispheric interaction are subject to context effects.

E65

PHONEME RELATED SOMATOTPY AND LEXICO-SEMANTIC KNOWLEDGE BECOME ACTIVATED IN PARALLEL WITHIN 200 MS DURING OBJECT NAMING.

Kristof Strijkers[1], Friedemann Pulvermuller[2], Albert Costa[3]; [1]Laboratoire de Psychologie Cognitive, CNRS and Université d'Aix-Marseille, Marseille, France, [2]Brain-Language Laboratory, Free University of Berlin, Berlin, Germany, [3]Center for Brain and Cognition, UPF, ICREA, Barcelona, Spain. — In this study we explored the time course of processes related to lexical and phonological access during speech production. Fifteen native English speakers named objects aloud while their MEG was recorded. We orthogonally manipulated the lexical frequency of the object names, as an index for lexico-semantic retrieval, and the articulator movement of the first phoneme of a picture's name (i.e., labial: Monkey vs. dental: Donkey), as an index of when the brain starts retrieving phonological-phonemic knowledge. Consistent with previous data we found early MEG activation for the lexical frequency effect (160 – 240 ms), with a stronger brain response for low frequency compared to high frequency items in the mid temporal gyrus and the left inferior frontal gyrus. Crucially, differences associated to the articulator movement of the first phoneme were also present at this time-window. In the pre- and post-central gyri we observed a single dissociation in that there was more cortical activity in that region responsible for tongue-movements when a picture's name started with a dental sound compared to a labial sound. Furthermore, we also encountered a double dissociation in the superior temporal gyrus (STG), a region typically associated with acoustic-to-phoneme mappings. Anterior portions of the STG responded more strongly for labial than for dental sounds, and the opposite was observed in posteriors sections of the STG. In contrast to the traditional hierarchical view underlying word production, these data offer compelling evidence for very rapid and parallel retrieval of lexico-semantic and phonological-phonetic knowledge associated with perceived objects.

E66

CHARACTERIZING OBJECT NAMING ERRORS IN PREOPERATIVE SPEECH MAPPING VIA NAVIGATED TRANSCRANIAL MAGNETIC STIMULATION

Noriko Tanigawa[1,2], Phiroz Tarapore[1], John Houde[1], Srikantan Nagarajan[1]; [1]University of California, San Francisco, [2]University of Oxford — Navigated transcranial magnetic stimulation (nTMS) during the object naming task has been used to map cortical areas causally related to speech functions in the preoperative context. To improve the mapping efficiency, the present study investigates phonological and semantic properties that may affect rates and spatial distributions of object naming errors in preoperative nTMS speech mapping using the NexSpeech® module with the NBS system 4 (Nexstim Ltd., Helsinki, Finland). Only the correctly responded pictures without TMS were presented in the nTMS condition. A 5-Hz 2-second pulse train started at each picture onset. Data from seven English-speaking left-hemisphere tumor patients were analyzed for phonological and semantic properties preselected from interdisciplinary findings. All error types (Corina, 2010) were collapsed. Overall, error rates were higher for targets starting with a [-CONTINUANT] feature (e.g., /b/, /m/, /d/) than those with a [+CONTINUANT] feature (e.g., /v/, /l/, /o/). Typical of one-word production, error-prone targets included disyllabic words with three different consonants (e.g., bucket), multisyllabic words with stress on a non-standard syllable position (e.g., banana). Semantic specificity differed by tumor locations. Whereas insula and temporal tumor patients were more susceptible to phonological constraints, handknob and inferior parietal lobe tumor patients were more susceptible to region-specific semantic constraints, 'hand-related objects' (e.g., glove) and 'tools' (e.g., globe) respectively. The semantically selective error distributions accord with the conceptual category-specificity literature (e.g., Mahon_et_al_2009). The present study adds to the models of object naming (e.g., Indefrey_2011), the global phonological, and location-specific semantic constraints, tailoring word lists for efficient preoperative nTMS speech mapping.

E67

CHOOSING FIRST OR SECOND LANGUAGE PHONOLOGY IN 125 MS

Kalinka Timmer[1,2], Lesya A. Ganushchak[1,3], Yulia Mitlina[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, [3]Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands — We are often in a bilingual situation (e.g., overhearing a conversation in the train). We investigated whether first (L1) and second language (L2) phonologies are automatically activated. A masked priming paradigm was used, with Russian words as targets and either Russian or English words as primes. Event-related potentials (ERPs) were recorded while Russian (L1) – English (L2) bilinguals read aloud L1 target words (e.g. РЕЙС /reis/ 'flight') primed with either L1 (e.g. РАНА /rana/ 'wound') or L2 words (e.g. PACK). Target words were read faster when they were preceded by phonologically related L1 primes but not by orthographically related L2 primes. ERPs showed orthographic priming in the 125-200 ms time window. Thus, both L1 and L2 phonologies are simultaneously activated during L1 reading. The results provide support for non-selective models of bilingual reading, which assume automatic activation of the non-target language phonology even when it is not required by the task.

E68

TRACKING LEXICALITY EFFECTS IN SECOND LANGUAGE VOCABULARY LEARNING

Yen Na Yum[1], Katherine J. Midgley[1], Jonathan Grainger[2], Phillip J. Holcomb[1]; [1]Tufts University, [2]CNRS and Aixs-Marseille University — Second language (L2) learning in adulthood often begins with acquiring new visual word forms and mapping meanings onto them. One measure of L2 word knowledge is sensitivity to lexicality, which is indexed by larger N400 amplitudes to L2 pseudowords (PWs) and non-words (NWs) than L2 words. Previous research has shown that learning-related changes in ERPs, including the emergence of lexicality effects, could occur rapidly following L2 word learning. While effects of visual familiarity and lexicality were demonstrated for learners whose L1 and L2 were both alphabetic, the emergence of these effects has not been shown for learners with visually distinct L1 and L2. To address this, we followed native English speakers during their first 5 weeks of Chinese word learning. In 3 ERP recording sessions, participants made lexicality judgments to learned Chinese words, Chinese PWs (unfamiliar words that obey Chinese orthographic structure), and Chinese NWs (unfamiliar words that violate orthographic structure). At the beginning of learning, N400 amplitudes to Chinese words, PWs and NWs were indistinguishable. Across the sessions, an increase in N400 amplitude was observed to Chinese PWs relative to Chinese words. In addition, a larger N400 was seen to Chinese NWs compared to Chinese PWs. Results suggested that beginning learners readily acquired both the orthographic structure and meaning of Chinese words. Although learning a visually distinct L2 could feel more challenging than learning a visually familiar L2, lexical knowledge could be acquired at a comparable rate.

E69

PRE-ATTENTIVE PITCH PROCESSING IS LEFT HEMISPHERE LATERALIZED IN CANTONESE SPEAKERS

Caicai Zhang[1,2], Feng Gu[3]; [1]Haskins Laboratories, Yale University, USA, [2]Language Engineering Laboratory, the Chinese University of Hong Kong, Hong Kong, [3]CAS Key Laboratory of Brain Function and Diseases, University of Science and Technology of China, China — There is a continuous debate between two views regarding the brain asymmetry for speech and music. Function-dependent lateralization suggests that left hemisphere (LH) lateralization for speech and right hemisphere (RH) lateralization for music is determined by the functional properties of speech and music. Acoustic-dependent lateralization suggests that the hemispheric asymmetry is determined by temporal and spectral cues of acoustic signals irrespective of speech and music. Tone languages in which spectral cues are lexically contrastive can provide insights into these two views. In this study we examine the hemispheric lateralization of lexical and acoustic pitch processing in Cantonese speakers. We found LH lateralization for mismatch negativity (MMN) response elicited by lexical pitch contrast in speech stimuli, supporting the function-dependent lateralization. Importantly, the MMN elicited by pitch contrast in nonspeech stimuli is also LH lateralized. The lateralization pattern in Cantonese is different from previous studies of non-tone languages which found a RH lateral-

ization for spectral (pitch) processing. To provide an integral explanation, we propose a "lateralization-carryover hypothesis" which suggests that the acoustic-dependent brain asymmetry is a consequence of carryover effect from function-dependent brain asymmetry. That is, speech related acoustic processing (i.e. temporal processing in non-tone languages; temporal and spectral processing in tone languages) is modulated by language experience to be lateralized to the speech dominant hemisphere. This hypothesis is consistent with many studies that reported a carryover effect from tone language experience to general acoustic pitch processing, including the finding of more prevailing absolute pitch ability in tone language speakers.

E70

SEMANTIC AND WORLD-KNOWLEDGE INTEGRATION DURING SECOND LANGUAGE COMPREHENSION Clara Martin[1,2,3], Xavier Garcia[3], Audrey Breton[4], Guillaume Thierry[5,6], Albert Costa[3,7]; [1]Basque Center on Cognition, Brain and Language, San Sebastian, Spain, [2]IKERBASQUE, Bilbao, Spain, [3]University Pompeu Fabra, Barcelona, Spain, [4]Institut des Sciences Cognitives, University of Lyon – CNRS, Lyon, France, [5]Bangor University, UK, [6]Economic and Social Research Council Centre for Research on Bilingualism in theory and Practice, Bangor University, UK, [7]Institució Catalana de Recerca i Estudis Avançats, Barcelona, Spain — Speakers of a foreign language (L2) often experience difficulties when understanding the message conveyed in this language. To advance in our knowledge about the origin of these difficulties in L2 sentence comprehension, we assessed whether L2 comprehenders are able to integrate semantic and world-knowledge information in an on-line fashion as native language users do (L1 comprehenders). We investigated event-related brain potentials elicited by the critical word of English sentences in three conditions: (1) correct; (2) semantic violations; (3) world-knowledge violations (semantically correct but false). The processing of semantic violations differed from that of correct and false sentences as early as the P2 component time-window (150-200 ms after the critical word onset) in L1 but not in L2 comprehenders. In the N400 time-window (350-550 ms), the processing of both semantic and world knowledge violations differed significantly from that of correct sentences and from each other. The effect was similar in the two groups, with an overall latency delay in L2 compared to L1 comprehenders. We conclude that when reading in L1, the brain needs on average 200 ms more to show sensitivity to a world-knowledge violation than for semantic violation detection. When reading in L2, the brain integrates semantic and world-knowledge information simultaneously with no earlier processing for semantics. L2 sentence comprehension difficulties can be partly explained (1) by a lack of early literal semantic processing of the sentence and (2) by the fact that semantic and world-knowledge integration processes are overall delayed in L2 compared to L1 sentence processing.

E71

TAKING A LOOK AT METAPHORS Marguerite McQuire[1], Geena Ianni[1], Anjan Chatterjee[1]; [1]University of Pennsylvania — Comprehending literal sentences ("The device was a pendulum") and novel metaphors ("His thoughts were a pendulum") presumably engage different cognitive and neural processes. One hypothesis is that metaphor comprehension entails an initial rejection of a literal interpretation (Grice, 1975). Another is that metaphors are understood effortlessly (Lakoff, 1980). The predictions made by these hypotheses regarding eye movement patterns are not clear. The structure-mapping hypothesis proposes that metaphors involve a comparison between the target ("thoughts") and the base ("pendulum") to identify shared properties relevant to the metaphorical meaning (Gentner, 1988). This more granular account would predict that eye-movement patterns around the target and base terms should differ when participants read literal and metaphoric sentences because the latter entails comparison in a way that the former does not. Participants (n=24) read 40 novel metaphors and 40 literal sentences matched for valence, interpretability, familiarity, naturalness, imageability, figurativeness, length, frequency and concreteness. Dependent measures included fixation time on the base and the probability of recursive eye movements from the base to the target in the metaphor and literal conditions. Greater fixation time on the base would suggest increased processing demands. Recursive eye-movements between the base and the target would suggest mapping between the terms. We found that fixation times on the base word and likelihood of recursive eye-movements between the base and the target were greater in the metaphor than the literal condition. These data demonstrating readers' recursive engagement with the base and target terms is consistent with the structure-mapping hypothesis.

E72

WHO IS DOING WHAT? LEFT TEMPORAL INVOLVEMENT FOR SENTENCE READING Nicola Molinaro[1], Simona Mancini[1], Ileana Quiñones[1], Manuel Carreiras[1,2]; [1]BCBL, Basque center on Cognition, Brain and Language, [2]Ikerbasque, Basque foundation for science — Comprehending subject-verb agreement involves decomposing nominal and verbal forms to extract grammatical information; this information subsequently maps onto different semantic-pragmatic representations concerning the type of speech participants (1st=Speaker, 2nd=Addressee, 3rd=non-participant) and their numerosity (a single entity vs. a multitude). In this event-related fMRI study we employed a grammatical violation paradigm to determine the brain regions – within the sentence processing network – that are involved in mapping morphosyntactic features onto semantic-pragmatic representations. Subject-verb agreement was manipulated in Spanish to create mismatches in person (Person Mismatch, PM) and number (Number Mismatch, NM) to be contrasted with correct sentences. The processing of both PM and NM determined increased activation - compared to correct sentences - in a large network of parietal and frontal brain regions such as left medial frontal areas (BA45/46), precuneus and the cingulate cortex. Crucially, a dissociation emerged between left anterior and posterior middle temporal regions: The anterior temporal was specifically activated by PM, while the posterior patch activity was enhanced by both PM and NM, being larger for PM. The experimental design here employed revealed the differential role of anterior vs. posterior middle temporal regions in semantic processing at the sentence level. The common posterior temporal activation would mainly reflect basic semantic-syntactic integration. Critically, person features directly map onto the participants of the speech act: The anterior temporal effect can thus reflects the difficulty in integrating subject and verb information to determine "who" is the actor in the utterance.

E73

INDIVIDUAL DIFFERENCES IN ASPECTUAL COERCION Martin Paczynski[1,2], Ray Jackendoff[1], Phillip Holcomb[1], Gina Kuperberg[1,3]; [1]Tufts University, [2]University of Miami, [3]Massachusetts General Hospital — Understanding that the sentence "For several minutes the girl jumped" means the girl jumped multiple times requires aspectual coercion, a form of enriched semantic composition. Using Event Related Potentials (ERPs), we have previously shown that aspectual coercion is associated with a sustained broadly distributed negativity at the critical verb, the point at which aspectual coercion is first licensed. In the current study, we built upon these findings to examine how individual differences affect online aspectual coercion computation in 32 undergraduate participants. We used the "Sentence Combining" and "Word Similarities" subtests of the Test of Adolescent and Adult Language, 4th ed. (TOAL-4) to access participants' language proficiency. We found that neural activity in response to aspectual coercion was significantly correlated with participants scores on the Sentence Combining subtest ($p < 0.005$); as proficiency increased, so did the amplitude of the anterior negativity . On the other hand, Word Similarities scores were not found to predict modulation of ERPs evoked by aspectual coercion ($p > 0.1$). Taken together, these findings suggest that online computation of aspectual representations, at least those requiring coercion, may rely on combinatorial linguistic processes. Additionally, our findings of individual differences in online aspectual coercion costs may help explain apparent discrepancies in earlier studies of aspectual coercion.

E74

A COMMON NEURAL ENCODING OF SPATIAL AND SEMANTIC DISTANCE Carolyn Parkinson[1], Shari Liu[1], Thalia Wheatley[1]; [1]Dartmouth College — One window into the cognitive operations that support abstract thought is the language we use to describe them. The spatialization of form hypothesis (Lakoff, 1987) highlights the widespread use of spatial words (e.g., "outside", "far") to describe conceptual relations, suggesting that spatial schemata structure mental representations as "cognitive maps." The prevalence of spatial figurative language may reflect "recycling" (Dehaene & Cohen, 2007) of circuitry originally devoted to spatial processing to "plot" increasingly abstract contents over the course of evolution. How-

ever, exactly how neural representations of abstract information relate to those of physical information is poorly understood. In the current study, participants were asked to participate in 2 consecutive functional magnetic resonance imaging experiments. One involved passively viewing shapes at varying distances from one another, and the other involved passively viewing word pairs. Each word (e.g., "blizzard") was conceptually close to one word (e.g., "hurricane") but far from another (e.g., "parrot"). A linear support vector machine learning algorithm was trained on each participant's patterns of brain activity while viewing "near" and "far" shape pairs, and tested on patterns of brain activity in response to "near" and "far" word pairs. Results from both region of interest and multivariate searchlight analyses indicate that semantic distances can be decoded from physical distances in areas traditionally implicated in physical distance processing, such as the hippocampus, parahippocampal gyrus and inferior parietal lobule. These results suggest that neural representations of physical distances may serve as a "scaffolding" for representations of conceptual similarity.

E75

THE NEURAL CORRELATES OF CROSS-LINGUISTIC SOUND SYMBOLISM: EVIDENCE FROM FMRI AND DTI

Kathleen Pirog Revill[1], Lynne C. Nygaard[2], Laura L. Namy[2], Lauren Clepper[2]; [1]Georgia Institute of Technology, [2]Emory University — Non-arbitrary correspondences between spoken words and categories of meanings exist in natural language, with mounting evidence that listeners are sensitive to this sound symbolic information. Sound symbolism may be a product of crossmodal integration whereby aspects of speech production or perception lead to activation of multimodal properties of the word's referent. Previously, we developed a multi-language stimulus set of antonym pairs to investigate the extent to which native English speakers display sensitivity to sound-to-meaning correspondences for foreign words. We identified a subset of sound symbolic foreign words for which listeners match words to meanings at above chance rates. For each of four antonym meaning pairs (round-pointy, big-small, moving-still, fast-slow) from this set, we selected ten sound-symbolic and ten non-symbolic items. Fifteen participants without previous experience with the languages in the stimulus set completed the experiment. During fMRI data collection, participants indicated which antonym corresponded with the meaning of a spoken word via button press. Trials were blocked by antonym pair and sound symbolism status. The contrast between sound-symbolic and non-symbolic words revealed an area of significant activation in left superior parietal lobe (33, 65, 45). Using TBSS, we also found a significant correlation between an individual's accuracy on sound symbolic words and fractional anisotropy in left superior longitudinal fasciculus, near the locus of the functional difference. These findings are consistent with previous research demonstrating correlations between parietal lobe structure and function and multisensory integration. These findings support the idea that synesthetic or crossmodal correspondences underlie sound symbolism in spoken language.

E76

CONFLICT AND INTEGRATION IN SENTENCE PROCESSING: FMRI EVIDENCE

Ileana Quiñones[1], Nicola Molinaro[1], Simona Mancini[1], Juan Andrés Hernández[2], Manuel Carreiras[1,3,4]; [1]Basque Center on Cognition Brain and Language, BCBL, Donostia-San Sebastián, Euskal Herria, Spain, [2]University of La Laguna, Tenerife, Spain, [3]Ikerbasque, Basque Foundation for Science, Bilbao, Spain, [4]Departamento de Filología Vasca, EHU/UPV, Bilbao, Spain — Language comprehension is incremental, involving the integration of information from different words together with the need of resolving conflicting cues when unexpected information occurs. The present event-related fMRI design seeks to segregate the neuro-anatomical substrates of these two processes by comparing well-formed and ill-formed (person agreement violation between subject and verb, PAV) sentences during a grammaticality judgment task. Well-formed sentences included standard agreement constructions and a particular Spanish phenomenon, Unagreement, i.e. a subject-verb agreement mismatch that results in a grammatical sentence ("Los pintores trajimos..." [The painters3.pl (we)brought1.pl...]). Comprehension of this construction implies a shift in the semantic interpretation of the subject from 3rd-person to 1st-person, enabling the phrase "The painters" to be re-interpreted as "We painters". The results included firstly a functional dissociation between well-formed and ill-formed sentences: While PAV recruited a fronto-parietal network associated to monitoring operations, grammatical sentences (both Unagreement and standard agreement) recruited a fronto-temporal network related to syntactic-semantic integration. Second, activation in the left dorso-lateral medial frontal cortex by both PAV and Unagreement was found, reflecting processing of the initial morphosyntactic mismatch detection. Third, we demonstrate that successful Unagreement identification as a well-formed construction depends on the recruitment of the left angular gyrus. Incremental sentence processes in subject-verb dependencies depend on agreement patterns: Only after the evaluation of the available morphosyntactic cues (in left dorso-lateral medial frontal regions) subject-verb integration can start. Critically, when unexpected information occurs, angular gyrus activity can supply the reading network for the comprehension of semantically complex but non-anomalous constructions.

E77

SIMULATING THE N400 COMPONENT AS SEMANTIC NETWORK ERROR: INSIGHTS FROM A FEATURE-BASED CONNECTIONIST ATTRACTOR MODEL OF WORD MEANING

Milena Rabovsky[1], Ken McRae[2]; [1]Humboldt University, Berlin, [2]University of Western Ontario, London, Canada — The N400 component of the event-related brain potential is widely used in research on language and semantic memory. Although the component's relation to semantic processing is well-established, the specific mechanisms underlying N400 generation are currently unclear. We explored the mechanisms underlying the N400 by examining how a connectionist model's performance measures covary with N400 amplitudes. We simulated six N400 effects obtained in human empirical research. Network error was consistently in the same direction as N400 amplitudes, namely larger for low frequency words, larger for words with many features, and smaller for semantically related target words as well as repeated words. Furthermore, the repetition-induced decrease was stronger for low frequency words, and for words with many semantic features. In contrast, semantic activation corresponded less well with the N400, and instead seems related to lexical and semantic decision performance. Our results suggest an interesting relation between N400 amplitudes and semantic network error. In psychological terms, error values in connectionist models have been conceptualized as implicit prediction error, and we interpret our results as support for the idea that N400 amplitudes reflect implicit prediction error in semantic memory.

E78

THE SELF-REFERENCE EFFECT ENHANCES MEMORY FOR NARRATIVE INFORMATION IN HEALTHY AGING

Nicole Carson[1], Kelly J. Murphy[2,3], Morris Moscovitch[2,3,4], R. Shayna Rosenbaum[1,4]; [1]York University, Toronto, Canada, [2]Baycrest Centre, Toronto, Canada, [3]University of Toronto, Toronto, Canada, [4]Rotman Research Institute, Baycrest Centre, Toronto, Canada — The Self-Reference Effect (SRE), enhanced memory for information encoded through self-attribution, has been exhibited in young and older adults. Past studies, however, primarily used trait adjectives as stimuli. The present study sought to examine whether the SRE can be extended to memory for narratives, which has been shown to decline even with healthy aging. Twenty younger (age 18-26) and 20 older (age 65-79) adults encoded short narratives by deciding: 1) whether they could easily imagine themselves as the protagonist (self-reference condition); 2) whether the event described was positive (semantic condition); or 3) whether the word "the" appeared more than four times (structural condition). Results indicated that although self-referential and semantic encoding benefitted memory to a similar extent when measured by a recognition task, an accompanying remember/know decision indicated that self-referential processing promoted recollection of narrative material more than the other encoding conditions. Further, in a recall test, the SRE was clearly evident for narratives: memory was greatest in the self-reference condition compared to the other two conditions. Performance in the structural condition was worse than in the others. Although younger adults outperformed their older counterparts on both overall recognition and recall of narratives, the SRE promoted recall and recollective retrieval experience, capacities shown to decline with aging. The SRE may therefore provide an effective intervention strategy for enhancing recall and episodic re-experiencing of narrative information in healthy aging.

E79

IMPAIRED SEMANTIC AND LOGICAL MEMORY IN EARLY ALZHEIMER'S DISEASE AND MILD COGNITIVE IMPAIRMENT--A MULTIMODAL IMAGING ANALYSIS

Ming-Jang Chiu[1,2,3,4], Fan-Pei Yang[5], Ya-Fang Chen[6], Ta-Fu Chen[1], Tien-Wen Tseng[1], Jia-Chun Chen[1,3], Shih-Ching Lee[5,7], Wei-Kai Liao[5,8], Kai-Yuan Tzen[9,10], Mau-Sun Hua[1,3]; [1]Department of Neurology and-College of Medicine, National Taiwan University, [2]Institute of Brain and Mind Sciences, College of Medicine, National Taiwan University, [3]Department of Psychology, National Taiwan University, [4]Graduate Institute of Biomedical Engineering and Bio-informatics, National Taiwan University, [5]Department of Foreign Languages and Literature, National Tsing Hua University, [6]Department of Medical Imaging, College of Medicine, National Taiwan University, [7]Graduate Institute of Linguistics,National Tsing Hua University, [8]Department of Computer Science, National Tsing Hua University, [9]Department of Nuclear Medicine, National Taiwan University Hospital, College of Medicine, National Taiwan University, [10]Molecular Imaging Center, National Taiwan University — Alzheimer's disease (AD) causes tissue loss and neuronal death, which drastically affect cognitive functions. The most remarkable signs of brain damage in AD include shrinkage of the brain volume and white matter disruption. Patients with mild cognitive impairments (MCI) also display similar but less prominent change in the brain. Although previous research has reported poor neurocognitive performance of these patients, the relationship between brain damage and cognitive impairments remains unclear. Little research has investigated both grey and white matters in these 3 populations. The present study employed volumetric measurement, voxel-based morphometry (VBM) and tract-based spatial statistics (TBSS) to compare the group differences. The correlations of performance in the attention, memory and language domains and indices of grey and white matter integrity were also examined. We observed significant difference in the total hippocampus volume among the three groups. The VBM analysis showed significant difference in the hippocampus, thalamus, the PFC, visual and motor cortices between the AD and control groups, but only the hippocampus, thalamus, and the visual cortex between the control and MCI groups ($p<0.001$). The TBSS analysis only revealed significant difference in FA and MD between controls and ADs. The regions displaying significant difference included inter-commissural and association tracts. Pearson correlation analysis showed significant correlations in multiple grey and white matter ROIs with Delayed recall of Logical Memory and Semantic Verbal Fluency. This study demonstrates the relationship of brain damage and cognitive deficits and is consistent with clinical observation of memory and verbal deficits typically present in patients.

E80

LEARNING FROM DELAYED FEEDBACK IN ADOLESCENCE

Juliet Y. Davidow[1], Karin Foerde[1], Adriana Galván[2], Daphna Shohamy[1]; [1]Psychology Department, Columbia University, [2]Psychology Department, UCLA — Learning from outcomes is critical at all stages of human development. However, the timing of these outcomes varies. Converging evidence shows that even small changes in the timing of feedback can impact neural systems underlying learning. Learning from immediate response-contingent feedback depends on the striatum. In adults, delaying feedback even a few seconds leads to a shift from the striatum to the hippocampus and enhances episodic memory for feedback events. Over the course of adolescence, the striatum undergoes developmental change in functional connectivity to cortical regions, whereas the hippocampus undergoes less developmental change. Thus we predict that the dynamic interactions between multiple learning systems change over adolescence, with consequences for what is learned, and how. Here, we test this prediction by determining how feedback timing modulates neural and cognitive systems for learning in adolescents (13-17 years old). We employed a feedback-learning paradigm where outcomes were either presented immediately or after a 7 second delay. Behaviorally, we found that adolescents learned equally well from feedback that was immediate and feedback that was delayed, similar to healthy young adults (25-30 years old). This positions us to determine whether feedback timing modulates the neural systems underlying learning. Here, we use event-related and resting-state fMRI to characterize the neural systems in adolescents that support learning under different feedback timing conditions. We will discuss the implications of the behavioral and fMRI findings for the engagement of multiple learning systems in the adolescent brain, and how they interact to support feedback-driven learning.

E81

STABILITY ACROSS AGE AND ASSOCIATIVE MEMORY PERFORMANCE IN THE ENGAGEMENT OF A CORE NETWORK SUPPORTING RECOLLECTION

Marianne de Chastelaine[1], Julia Mattson[1], Tracy Wang[1], Michael Rugg[1]; [1]Center for Vital Longevity and the School of Behavioral and Brain Sciences, The University of Texas at Dallas — Functional magnetic resonance imaging (fMRI) studies of episodic retrieval have identified a network of cortical regions – each interconnected with the medial temporal lobe (MTL) – that are consistently engaged during successful recollection. Here, we used an associative recognition task to investigate the effects of age and associative memory performance on the engagement of this 'core' recollection network. Young, middle-aged and older adults were scanned during an associative recognition test. At study, participants made relational semantic decisions on a series of visually presented word pairs. At test, they made associative recognition judgments on studied, rearranged and new pairs. fMRI recollection effects were operationalized as greater activity for studied pairs endorsed as 'intact' than for studied pairs endorsed as rearranged. In all three age groups, robust effects were identified across the putative core recollection network – the MTL, posterior cingulate/retrosplenial cortex, ventral posterior parietal cortex and medial prefrontal cortex, as well as in the ventral striatum. Engagement of this network did not significantly differ across age groups. Furthermore, engagement of the network was stable in the face of different levels of associative memory both across and within groups. The findings suggest that associative recognition may be a useful means of assessing the functional integrity of the recollection network.

E82

EFFECTS OF FLUENCY ON RECOGNITION MEMORY DECISIONS IN YOUNG AND OLDER ADULTS: AN FMRI STUDY

Ilana Dew[1], Roberto Cabeza[1]; [1]Duke University — A vast body of evidence indicates that people use fluency – the ease with which information is processed – as a heuristic when making inferential decisions, including judgments of truth, aesthetics, and frequency. Older adults are typically as likely as young adults to use fluency as a cue for recognition memory, the decision of whether a stimulus is old or new. Very little is known about the interaction between age and fluency on the neural basis of recognition memory decisions. The current fMRI study used a masked priming technique to investigate fluency-based memory decisions. Following incidental encoding, participants completed a recognition test in which they made old/new decisions followed by confidence judgments on studied and unstudied items. Each recognition item was preceded by a subliminal prime that was either semantically related or unrelated to the item. Older adults showed reduced overall memory accuracy relative to young adults. Consistent with previous studies, however, older adults showed an equivalent influence of fluency on recognition decisions, whereby old and new items preceded by a related prime were more likely to be judged "old." In both young and older adults, fluency reduced neural activations in perirhinal cortex (PRC), and PRC reductions predicted behavioral misattributions of oldness in both young and older adults. These results are consistent with age-related preservations in PRC function. However, the fluency manipulation interacted with age in several cortical regions outside PRC, suggesting ways in which fluency may affect the retrieval network differently for the old relative to the young.

E83

NEURAL CORRELATES OF EMOTIONAL MEMORY RETRIEVAL ACROSS THE ADULT LIFESPAN

Jaclyn Ford[1], John Morris[1], Halle Zucker[1], Elizabeth Kensinger[1]; [1]Boston College — Recent research has identified significant age-related changes in neural recruitment during the encoding of emotional information. It is unclear, however, whether these neural differences associated with healthy aging extend to retrieval of emotional stimuli. The current study addressed this question by examining the effect of aging on neural activity (using fMRI) during retrieval of positive, negative, and neutral information. The effect of age was examined using a lifespan perspective in which age was treated as a continuous variable (ages 18-80)

as opposed to having dichotomous groups of young and older adults. This allowed us to identify changes across the entire course of healthy aging. Prior to scanning, participants encoded positive, negative, and neutral images paired with neutral titles. After a thirty minute delay, participants engaged in a scanned recognition task in which they viewed the neutral titles and indicated whether the title had been presented with an image during the study phase. Neural activity during retrieval of positive, negative, and neutral memories was compared with age as the regressor of interest. Results suggest that age was associated with decreased activity in frontal and temporal regions during retrieval of all valences, but only during the retrieval of negative memories was age associated with increased activity in regions within the emotional memory network, including the ventromedial prefrontal cortex. These findings suggest that there are both shared and unique effects of age on retrieval of emotional and neutral information.

E84

FAMILIAR FACES DON'T JUST LOOK FAMILIAR: ELECTROPHYSIOLOGICAL EVIDENCE THAT 'SEMANTIC' PERSON IDENTIFICATION IS SUPPORTED BY 'EPISODIC' RECOLLECTION

Graham MacKenzie[1], David Donaldson[1]; [1]University of Stirling — Two quite distinct models of 'face recognition' exist. Semantic face processing models incorporate discrete computations of familiarity and person knowledge, whereas episodic models of recognition memory describe separable retrieval processes of familiarity and recollection. Here we used Event-Related Potentials (ERPs) to investigate potential overlap between these models in the context of familiar face recognition. Brain activity was recorded whilst participants viewed a series of famous face images. Participants were required to indicate the quality of their memory experience, noting whether each face was recognised, and if so whether it simply felt familiar, or whether person-specific information was retrieved (akin to the remember/know procedure). With respect to faces that were not recognised, familiarity decisions were associated with a left frontal ERP old/new effect (200–400msec), while retrieval of associated person-specific information elicited a temporally and topographically dissociable left parietal effect (500–800msec). This finding is important because previous ERP studies of recognition memory have shown that recollection of words elicits the left parietal old/new effect, but recollection of unfamiliar faces elicits frontal old/new effects. The presence of a left parietal effect for recognition of familiar faces suggests therefore that the processes supporting recollection of faces differ depending on whether to-be-retrieved faces are represented in semantic memory, and that pre-existing semantic representations are required in order for the left parietal old/new effect to be observed. More broadly, these data imply that face familiarity is associated with different cognitive operations from retrieval of person knowledge, and that episodic memory subserves person identification.

E85

ALZHEIMER'S GENE APOE MODULATES NEURAL ACTIVITY ASSOCIATED WITH RECOGNITION MEMORY RETRIEVAL OF PICTURES IN HEALTHY YOUNG PARTICIPANTS.

Catherine A. MacLeod[1], David I. Donaldson[2]; [1]Bangor University, [2]University of Stirling — Apolipoprotein E (APOE) supports brain repair mechanisms (e.g., neuronal repair and beta-amyloid metabolism) that are implicated in Alzheimer's. The effectiveness of the repair mechanisms are thought to vary as a function of APOE genotype, for example E4 allele possession causes impairment that increases the risk of Alzheimer's disease. Currently, however, the full functional consequences of these genotypic differences are unknown, particularly in relation to young participants. Here we employ Event-Related Potentials (ERPs) to look at changes in brain function and cognition associated with APOE polymorphisms in healthy adults. ERPs provide a powerful method for investigating gene-dependent cognitive changes because they allow neural correlates to be identified for distinct stages of cognitive processing. In the current study we examined ERP correlates of episodic memory retrieval as a function of APOE genotype, in the context of an old/new recognition memory test for pictures. Analysis focused on ERP effects present during a 500-800ms post-stimulus time-window, previously identified as best capturing neural activity associated with recollection (i.e., conscious retrieval of contextual information about prior study episodes). Results revealed significant differences in the distribution of recollection-related ERP effects as a function of APOE genotype. Carriers of the E4 allele were found to exhibit greater activity over frontal electrodes compared to E2 allele carriers, who conversely showed greater activity over parietal electrodes. These results reveal engagement of different neural processes during episodic memory retrieval as a function of genotype, suggesting APOE-dependent physiological changes in the brain occurring prior to the onset of cognitive ageing and disease.

E86

DO SUBJECTIVE RATINGS CORRESPOND TO THE CONTENT OF IMAGINED FUTURE EVENTS?

Victoria Martin[1], Donna Rose Addis[1]; [1]The University of Auckland, New Zealand — Many studies of episodic future thinking incorporate subjective participant ratings intended to capture information about the imagined events. However, the construct validity of participant ratings for imagined future events has not yet been systematically investigated. Validity assessment is important if such ratings are to be accurately interpreted. The present study explores the validity of ratings made about imagined future events using an adapted version of the Autobiographical Interview (AI). Twenty-one young adult participants imagined future events out loud in response to cue words, and provided a number of subjective ratings for each event. Their event descriptions were transcribed and coded by trained raters to assess the different kinds of details comprising the event. Results of hierarchical linear modelling analyses indicated that participant ratings of vivid detail and temporal clarity significantly predicted the number of AI internal (episodic) details comprising future events, but not the number of external (non-episodic) details. Moreover, events rated highly in vivid detail were significantly more likely to contain AI details classified as containing visual information, and events rated as having a clear temporal context were more likely to contain temporal information. Participant ratings of location clarity did not significantly predict the number of spatial details in the AI; however, participant ratings of vivid detail did predict the amount of spatial information. These results suggest that participants' understanding of what constitutes a vivid and temporally-specific event corresponds to the content of their verbal descriptions as coded using the AI scoring scheme.

E87

DISTINCT PATTERNS OF FAMILIARITY RESPONSES FOR FACES AND BUILDINGS REVEALED WITH MULTI-VOXEL PATTERN ANALYSIS IN PERIRHINAL AND PARAHIPPOCAMPAL CORTEX

Chris Martin[1], D. Adam McLean[1], Edward O'Neil[1], Stefan Köhler[1,2]; [1]University of Western Ontario, [2]Rotman Research Institute — The functional organization of the medial temporal lobes (MTL) remains a topic of intense debate. One influential view is that the hippocampus and parahippocampal cortex (PhC) play specific roles in the encoding and recovery of contextual information about a stimulus encounter, whereas perirhinal cortex (PrC) supports recognition based on the familiarity of the stimulus itself. Other evidence, however, points to a stimulus-specific organization of MTL responses. The mapping of both principles of organization remains poorly understood. Scene specific responses in the PhC provide a critical source of support for the proposal that this region represents episodic context. Yet, PhC is also known to respond differentially to buildings - which can be recognized without any reference to episodic context in memory decisions. Here, we employed high-resolution fMRI in combination with multi-voxel pattern analyses to compare distributed patterns of activity associated with perceived feelings of familiarity for faces, buildings, and chairs in PrC and PhC. In right PrC, we found familiarity responses for faces but not buildings. In right PhC, by contrast, we observed familiarity responses for buildings but not faces. Familiarity signals for chairs were present in both structures, but showed little overlap with the pattern of familiarity signals we observed for the other two stimulus classes. Together, these findings suggest that PrC does not invariably represent item-familiarity, and that PhC does not invariably represent episodic context. A full understanding of MTL organization requires consideration of the nature of the stimulus as well as the distinction between item and context.

E88

DMN DURING SUCCESSFUL AND UNSUCCESSFUL EPISODIC MEMORY ENCODING: AN FMRI STUDY. Penelope Martinelli[1], Marcela Perrone-Bertolotti[1,2], Cedric Pichat[1], Jean-François Lebas[3], Monica Baciu[1]; [1]Laboratoire de Psychologie et NeuroCognition, UMR CNRS, Grenoble, France, [2]Lyon Neuroscience Research Center, INSERM U1028 - CNRS UMR, [3]Unité Mixte de Service "Image", CNRS/CHU/UJF Grenoble, France — Introduction. Our memory is built up from a variety of events encountered and stored. A handful of studies have investigated the neural substrates of intentional encoding success but encoding failure is scarcely studied. Neuroimaging methods may allow to predict if an event will subsequently be remembered or forgotten. In respect of failing encoding, several authors proposed to draw a parallel between regions activated by encoding failure and Default Mode Network (DMN) regions. Actually, both types might include posterior and anterior midline cortices such as temporo-parietal junction and superior frontal gyrus. The aim of our experiment was to evaluate (1) neural correlates of encoding success and failure in incidental condition and, (2) the link between specific activation and DMN regions. Method. Twenty-two right-handed healthy volunteers were scanned (3T Brucker MR Scanner) during an incidental encoding of verbal and non-verbal items. Afterward, participants were asked to take part to a "yes-no" recognition paradigm. Encoding success vs. failure was evaluated and measured by the performances on the subsequent memory paradigm (hit vs. miss). Results and Discussion. In line with previous studies encoding success was associated with greater activity in bilateral hippocampus, fusiform and left superior prefrontal cortices. Interestingly, encoding failure was sub-served by a widespread posterior activation of midline cortices including posterior cingulate and bilateral precuneus. These results stress the implication of posterior DMN during exogenous-items encoding of attentional demanding task; and suggest that attention is orienting toward more internally and self-referential processes during unsuccessful encoding.

E89

NEURAL SUBSTRATES UNDERLYING EFFECTS OF POST-ENCODING STRESS AND EMOTIONAL AROUSAL ON RECOLLECTION AND FAMILIARITY Andrew McCullough[1], Maureen Ritchey[1], Andrew P. Yonelinas[1], Charan Ranganath[1]; [1]University of California Davis — Stress and emotional arousal are both known to affect learning and memory. For example, memory for emotional images tends to be stronger than memory for neutral images, an effect that appears to be related to enhanced amygdala and medial temporal lobe (MTL) activity during encoding. Previous work from our lab has demonstrated that stress also appears to modulate memory, in that post-encoding stress manipulations increase the relative contribution of familiarity to recognition memory performance. Previous work has also demonstrated a relationship between neural activity during encoding and subsequent memory performance. Here we tested the novel hypothesis that this relationship between neural activity during encoding and subsequent memory is modulated by post-encoding stress. Functional magnetic resonance imaging data were collected while subjects incidentally encoded negative and neutral pictures; then half of the subjects were stressed using an ice-water cold-pressor procedure. Recognition memory confidence was tested after a 24-hour delay to examine recollection and familiarity. We found that post-encoding stress increased familiarity-based recognition, but did not affect subsequent recollection-based recognition. Preliminary neuroimaging results suggest that activation of MTL regions was related to subsequent memory, and that amygdala activity was more strongly related to subsequent memory for emotional images than to memory for neutral images, whereas parahippocampal activity was more strongly related to memory for neutral images.

E90

BIGGER IS BETTER! HIPPOCAMPAL VOLUME AND EPISODIC MEMORY PERFORMANCE IN HEALTHY YOUNG MEN Patric Meyer[1], Sebastian T. Pohlack[1], Raffaele Cacciaglia[1], Traute Demirakca[2], Herta Flor[1]; [1]Department of Cognitive and Clinical Neuroscience, Central Institute of Mental Health, Medical Faculty Mannheim / Heidelberg University, [2]Department of Neuroimaging, Central Institute of Mental Health, Medical Faculty Mannheim / Heidelberg University — Functional imaging studies support the notion of a specific role of the hippocampus for episodic memory processes. Important convergent evidence about the functional relevance of a brain region can be provided by studies on individual differences in brain structure. Whereas functional studies usually reveal the most reliable activation of brain areas across individuals, structural analyses focus on the variability that gives rise to inter-individual differences in behaviour. These inter-individual differences, normally discarded by averaging data across participants, can be a valuable source of information and can be exploited to reveal the neural basis of distinct cognitive operations. For this purpose 50 healthy young male participants performed the California Verbal Learning Test whose various components permit a fine-grained separation of critical memory subprocesses. Hippocampal volume was assessed by manual segmentation of high-resolution 3D magnetic resonance images. We found a significant positive correlation between short-delay retention, long-delay retention, discriminability and percent hippocampal volume. No significant correlation was found with measures rather related to working memory processes. The volume of the amygdala was used as a control region and was not related to any of these measures. The contribution of extra-hippocampal medial temporal lobe structures was tested by means of voxel-based morphometry as an exact manual segmentation of these structures is difficult due to considerable variability in shape and size across individuals. Our data advance previous findings reported in studies of brain-damaged individuals in a large and homogeneous young healthy sample and are important for theories on the neural basis of episodic memory.

E91

RE-THINKING THE ROLE OF THE HUMAN HIPPOCAMPUS IN RETROGRADE EPISODIC MEMORY Thomas D. Miller[1], Clive R. Rosenthal[1], Anne Aimola Davies[1], Michael R. Johnson[2], Sarosh R. Irani[1], Christopher R. Butler[1], Angela Vincent[1], Christopher Kennard[1], Penny A. Gowland[3]; [1]University of Oxford, [2]Imperial College, [3]University of Nottingham — Retrograde amnesia in individuals with medial temporal lobe damage is associated with relative sparing of remote episodic memories. This is argued to reflect hippocampal involvement in establishing new memories but not long-term storage. We re-examined this time-limited role in twelve amnestic individuals to determine whether this pattern would be replicated when damage was confined to the hippocampus proper. Standardised neuropsychological tests, the Autobiographical Memory Interview and the Autobiographical Interview were administered. Detailed volumetric measurement of the hippocampal subfields, related subregions and whole-brain segmentation were conducted at 7-Tesla, and these data were related to functional circuits involving the hippocampus using resting-state functional MRI. The neuropsychological tests indicated that performance was within the average range for visuo-perceptual processing, executive function and working memory. Memory impairment was found on Doors and People and the Logical Memory and Word Lists subtests of the WMS-III. Episodic memory impairment did not exhibit a time-dependent gradient and co-occurred with intact personal semantic memory. Results from manual volumetry revealed reduced hippocampal subfield volumes relative to age-matched controls. Changes in functional connectivity within a resting-state matrix centred on the default mode network were associated with the memory impairment. The absence of a time-dependent gradient of retrograde episodic memory loss in the amnestic individuals is at variance with a time-limited role of the human hippocampus in memory consolidation. These results are striking because the amnestic individuals performed within the average range on neuropsychological tests other than memory. We discuss the implications of these results for neurobiological models of episodic memory.

E92

OSCILLATORY DESYNCHRONIZATION DURING SOURCE MEMORY RETRIEVAL Matthew Mollison[1], Tim Curran[1]; [1]University of Colorado Boulder — Time-frequency measures of the electroencephalogram (EEG) reveal effects of neural synchronization, a mechanism involved in the storage and retrieval of memories. Desynchronization in the alpha (8-12 Hz) and beta (12-28 Hz) bands is correlated with memory retrieval, but previous results have not differentiated recognition processes. Previous analyses using behavioral measures and event-related potentials demonstrated that familiarity contributes more to remembering spatial compared to color information, implying the material-specific involvement of recognition processes (Mollison & Curran, 2012). In the present experiment extrinsic source monitoring was examined using memory judgments for pictures of common objects. Source information was either spatial or a color association. Scalp

EEG was recorded during retrieval, and widespread alpha and beta desynchronization were seen for retrieval of item and source information. Importantly, the patterns of desynchronization were modulated by the type and amount of information retrieved from memory. Both source conditions showed greater late (600-1000 ms) posterior alpha desynchronization for source recognition (correct greater than incorrect source and new items). Only the spatial condition showed this pattern over frontal electrodes. Late widespread beta desynchronization during the spatial condition also varied with source recognition accuracy, while the color condition only distinguished old from new items, demonstrating item recognition. Assuming that source recognition is indicative of recollection and item recognition is indicative of familiarity, these results suggest that alpha desynchronization is associated with recollection of both color and location; whereas beta desynchronization is associated with location recollection, but only item familiarity when source information is defined by color.

E93

ELECTROPHYSIOLOGICAL EVIDENCE THAT UNITIZATION IS AN EFFECTIVE STRATEGY FOR INCREASING EPISODIC FAMILIARITY.

Jamie G. Murray[1], David I. Donaldson[1]; [1]University of Stirling — How can the loss of recollection in aging and disease best be alleviated? One avenue of research is to examine the benefits of encoding strategies on memory, including the use of 'unitization', whereby multi-component stimuli are encoded as a single item rather than as a set of associated parts. Recent studies of associative recognition suggest that unitization can improve episodic memory by increasing the availability of familiarity during retrieval, helping to alleviate deficits in recollection. Here we provide neuroimaging evidence for the benefits of unitization in health adults, in the context of learning novel associations between words. We compared memory for word pairs learnt using compound definitions (i.e. VEGETABLE-BIBLE: reference book on gardening) to memory for word pairs learnt using sentence frames (i.e. TOKEN-POUND: The___for the ride cost a ___). We employed a standard associative recognition paradigm and measured neural activity during retrieval using Event-Related Potentials (ERPs). Behavioural results indicated that compound definitions (compared to sentence frames) produced a selective memory benefit in terms of both discrimination accuracy and response time. Analysis of ERP data was focused on retrieval-related old/new effects thought to reflect recollection and familiarity. Clear left parietal old/new effects (recollection) were observed regardless of encoding condition. By contrast, mid frontal old/new effects were only observed when stimuli were encoded using the compound definition strategy. The results provide electrophysiological evidence for unitization using compound definitions, demonstrating improved associative recognition via a selective increase in familiarity during retrieval, and validating this method for use in investigations of memory decline.

E94

UPDATING MEMORY WITH TO-BE-REMEMBERED AND TO-BE-FORGOTTEN INFORMATION

Katharine Newman-Smith[1], Rebecca L. Gomez[1], Lynn Nadel[1]; [1]University of Arizona, Tucson — Reactivating a previously consolidated episodic memory returns it to a susceptible state, during which it can be modified with newly presented information (Hupbach et al., 2007). Here we manipulate the strength of the potential modifying information by using a "directed forgetting" paradigm. During Session 1, participants learned 20 objects (Set 1) paired with associated sounds (e.g. participants saw the image of a whistle and heard its sound). 48 hours later participants returned to the same room as Session 1 (same spatial context) or a different room. Set 1 memory was reactivated by playing half of the sounds heard during Session 1. Participants were then presented with 28 new objects (Set 2), half of which were surrounded by a blue border, with instructions to remember only the bordered objects. 48 hours later participants performed a recognition memory test for Set 1 and Set 2 items. Participants correctly recognized more of the Remember than Forget items from Set 2, underscoring the effectiveness of the Directed-Forgetting manipulation. This manipulation also influenced memory updating – remember items from Set 2 were more likely to update memory for Set 1 when reactivation occurred in the same spatial context as original learning. However, an equally high percentage of forget items were incorporated into Set 1 memory regardless of the Set 2 learning context. This suggests that weak memory facilitates reconsolidation and, hence, memory updating.

E95

BRAIN NETWORKS RELATED TO THETA OSCILLATORY ACTIVITY DURING EPISODIC MEMORY RETRIEVAL

Erika Nyhus[1], David Badre[1]; [1]Brown University — Evidence from fMRI has consistently located a widespread network of frontal, parietal, and temporal lobe regions during episodic retrieval. However, the temporal limitations of the fMRI methodology have made it difficult to assess the transient network dynamics by which these distributed regions coordinate activity. We recently proposed that theta oscillations represent interactions between brain systems for the cognitive control of episodic retrieval (Nyhus & Curran, 2010). However, the spatial limitations of the EEG methodology make it difficult to assess the relationship between these oscillatory signals and the distributed networks identified with fMRI. The present study used simultaneous EEG/fMRI to identify networks related to theta oscillations during episodic retrieval. Subjects studied adjectives and either imagined a scene (Place Task) or imagined how pleasant the object the word represented was (Pleasant Task). During the recognition test subjects judged which task was performed with each word ("Old Place Task" or "Old Pleasant Task") or "New". EEG was recorded with a 64-channel MRI compatible system. EEG analysis was performed on channel and ICA component data after MR gradient and cardioballistic artifacts were removed. Frontal theta power increased from 1000-1500 ms. Theta component power was correlated with the fMRI BOLD activity by entering single-trial theta power as a regressor in the fMRI analysis. Combined EEG/fMRI results showed that theta power was correlated with the fMRI BOLD response in anterior PFC, VLPFC, and parietal cortex. These results suggest that a fronto-parietal network interacts at theta frequency during episodic retrieval.

E96

RECOLLECTING THE UNFAMILIAR: ERP EVIDENCE FOR RECOLLECTION IN THE ABSENCE OF FAMILIARITY

Jason Ozubko[1], Fahad Ahmad[2], Colin MacLeod[3], Jonathan Fugelsang[3]; [1]Rotman Research Institute, Baycrest Centre, [2]Wilfrid Laurier University, [3]University of Waterloo — Although considerable research has demonstrated that recollection and familiarity can be behaviourally dissociated, they rely in part on common neural substrates. To date, however, there has been very little research examining the overlap of the subjective experiences of recollection and familiarity. In fact, one of the most basic questions regarding recollection and familiarity is still unanswered: Are recollections also familiar? Ozubko and Seli (submitted) have recently demonstrated that recollections not only can be familiar, but in common circumstances can even be more familiar than non-recollected but highly familiar items. In the present project, we investigated the related issue of whether recollections must always be familiar. To accomplish this, we examined event-related potentials (ERP) in the recognition failure of recallable words paradigm, which involves participants producing studied and new words in response to semantic associate cues, and then recognizing those produced words as either "old" or "new." Compared to new (unstudied) words, words that could be both recalled and recognized showed both early mid-frontal and late parietal ERP effects, indicators of familiarity and recollection, respectively. Words that could be recalled but not recognized, however, showed only a late parietal ERP component, consistent with recollection in the absence of familiarity. Our results highlight an important gap in traditional methodologies, which do not measure recollection or familiarity of unrecognized items. Yet when explicit recognition fails, it may be especially important to gauge both recollection and familiarity.

E97

INVESTIGATING THE IMPACT OF IMPLICIT PRIMING DURING AN EXPLICIT RECOGNITION TEST USING EVENT-RELATED POTENTIALS

Joanne L Park[1], David I Donaldson[1]; [1]University of Stirling — Does priming from the encoding phase carry over in recognition tests? In recent years talk of implicit contamination has been widespread, whereas attempts to identify how and when priming impacts recognition testing have been limited. To address this question we employed a deep encoding task combined with masked priming during the test phase to allow assessment of priming carried over from encoding. Half of the studied and unstudied test trials began with a brief (48ms) masked repetition of the to-be-recognized word prior to the onset of test items (shown for 300ms); the remaining unprimed

trials were preceded by the word 'blank'. The data demonstrated facilitation of response times for all primed vs. unprimed words, which was greater for studied (~100ms) than for unstudied words (~70ms). The ERP data revealed two priming-related modulations, an early (0-150ms) central negativity and a later (250-500ms) posterior positivity for primed vs. unprimed words. Mapping onto the RT data, this posterior difference was also larger for studied than for unstudied words. Memory ERPs revealed old/new differences with a Left-Parietal distribution in both conditions, but the conditions differed in the onset time of these effects. Unprimed ERPs were consistent with previous identifications of recollection (500-800ms), but in primed ERPs the old/new effect was only evident between 300-500ms. These data demonstrate that under deep encoding conditions; priming can carry over in recognition tests and although masked primes also contributed to changes in the old/new effect, it is clear that repetition priming can also impact ERP correlates of recognition.

E98

THE EYES KNOW TIME: EXAMINING TEMPORAL MEMORY WITH A NOVEL EYE-MOVEMENT PARADIGM

Thanujeni Pathman[1], Simona Ghetti[1]; [1]University of California, Davis — Relatively little is known about the processes underlying temporal memory, a critical feature of episodic memory. Eye-movements have been found to track associations between episodes and other types of context and rely on the hippocampus. We asked whether eye-movements during retrieval of temporal information could reflect an implicit signal of veridical memory for temporal information. In Experiment 1 (N=30), after the encoding of sequences of 4 objects, participants were shown one studied item (cue) and asked to select which of three objects came immediately after it in the encoded quadruplet (target). In the temporal order condition, the distracters were from the same sequence as the cue/target; thus recollection of the order with which quadruplet items were presented was necessary. In the temporal context condition, distracters were from other sequences; recollection of which item was presented around the same time as the cue was sufficient. Overt judgments were less accurate for the temporal context condition. Eye-movements reflected an implicit signal of veridical memory for temporal order across conditions. Experiment 2 (N=30) was identical to Experiment 1 except that in the temporal context condition each item in the retrieval array had a unique ordinal position in their respective encoding sequence. This change eliminated the accuracy difference across conditions, suggesting that event absolute ordinal position is a fundamental organizing principle of temporal memory. Eye-movement effects remained. Across experiments, eye-movement effects occurred seconds before participants responded, and were correlated to behavioral accuracy, suggesting that early eye-movements influence later overt judgments of temporal order.

E99

VISUAL EXPLORATION MODULATES EVENT-RELATED POTENTIALS IN RESPONSE TO NOVEL TOOLS

Naima Ruether[1], Marco Tettamanti[2], Stefano Cappa[3], Christian Bellebaum[1]; [1]Ruhr University Bochum, Bochum, Germany, [2]San Raffaele Scientific Institute, Milan, Italy, [3]Vita-Salute San Raffaele University, Milan, Italy — Categorization of objects requires automatic access to stored semantic concepts. Modality-specific accounts propose a distributed cortical network storing concepts in the brain, determined by the modalities of object experience involved in knowledge acquisition for that concept. Functional neuroimaging studies support this assumption by showing that the sight of tools leads to activation of motor associated brain regions. The aim of the present study was to investigate the influence of modality-specific object experience on processing pictures of novel manipulable objects by means of event-related potentials. In three training sessions, participants visually explored one set of objects (visually trained objects - VTO) and manipulated another set of objects (manipulation trained objects - MTO) whereas a third, untrained object set served as a control condition (not trained objects – NTO). Pre and post training, participants completed a visual matching task with pictures of the objects while brain activity was recorded by means of electroencephalography. Training-related changes were found in the time window between 420 and 520 ms after stimulus presentation in an N400-like component which was significantly reduced after training for VTO, but not for MTO and NTO, over frontal and central electrode sides. The post-training effect was driven by a training-induced amplitude reduction for VTO. The pattern of findings is interpreted as a down-regulation of affordance-driven object associations for VTO due to the visual modality being dominant during object training in combination with a lack of manipulation experience. Accordingly, modality of object experience modulates the processing of manipulable objects.

E100

SEVERE RETROGRADE AMNESIA IN AMNESTIC MILD COGNITIVE IMPAIRMENT IS RELATED TO DAMAGE IN LATERAL TEMPORAL CORTEX

Christine N Smith[1,2], Larry R Squire[2,1]; [1]University of California, San Diego, [2]Veterans Affairs San Diego Healthcare System — Findings from patients with limited, bilateral damage to hippocampus (H patients) or more extensive damage to the medial temporal lobe (MTL patients) indicate that the severity of retrograde amnesia (RA) is related to the severity of anterograde amnesia (AA). Thus, H patients have moderately severe AA and moderately severe RA covering a few years before the onset of amnesia, whereas MTL patients have very severe AA and extensive RA covering decades before the onset of amnesia. The amnestic subtype of Mild Cognitive Impairment (aMCI) is considered to be a boundary or transitional condition between normal aging and Alzheimer's disease. We tested 15 patients with aMCI and 21 controls with four anterograde memory tests and one retrograde memory test (314 questions covering news events from 1931-2005). Paradoxically, aMCI patients exhibited mild AA (even less than H patients) together with very severe RA covering nearly four decades before their diagnosis (like MTL patients). Their mild AA corresponded to modest (but significant) damage to hippocampus and parahippocampal gyrus (19% and 16% volume reductions, respectively). Next, the aMCI patients were classified according to whether or not their RA was disproportionately more severe than their AA. aMCI patients whose RA was disproportionately more severe than their AA had additional damage in lateral temporal cortex, especially in inferior temporal gyrus. No other regions outside of lateral temporal cortex differentiated these two subgroups. Accordingly, the extensive RA in aMCI patients is likely due to damage outside the medial temporal lobe, specifically in lateral temporal cortex.

E101

WHEN CONCEPTS LOSE THEIR COLOR: A CASE OF SELECTIVE LOSS OF KNOWLEDGE OF OBJECT-COLOR

Alena Stasenko[1], Frank E. Garcea[1], Mary Dombovy[2], Bradford Z. Mahon[1]; [1]University of Rochester, [2]Unity Hospital — Color plays an important role in both low- and high-level visual processing. Previous neuropsychological studies have shown that color perception and object-color knowledge can doubly dissociate (achromatopsia versus color agnosia), and that both can dissociate from processing of object form (visual form agnosia). We present a case study of an individual (AC) who suffered a stroke affecting the left lingual gyrus (among other structures). AC was tested with a wide range of neuropsychological tests to assess visual and cognitive functioning, and displayed a selective impairment for knowledge of the typical colors of objects, with preserved color perception and color naming. He was normal for a range of tasks assessing mid- and high-level visual processing, including motion and form perception, size judgments and orientation discrimination. While AC's semantic memory was largely preserved, he had selective difficulty for naming living items (greater for animals than fruit/vegetables). These data show that knowledge of object color is stored separately from other types of visual semantic knowledge, and suggest a model of object semantic memory in which modality and semantic domain jointly constrain the organization of conceptual information.

E102

WHITE MATTER CHANGES AND CONFRONTATION NAMING IN RETIRED AGING NFL ATHLETES

Jeremy Strain[1], Nyaz Didebhani[1], Heather Conover[1], Sethesh Mansinghani[1], Michael Kraut[2], Munro Cullum[3], John Hart Jr.[1,3], Kyle Womack[3]; [1]University of Texas at Dallas, [2]The Johns Hopkins School of Medicine, [3]University of Texas Southwestern Medical Center — We studied confrontation naming and cerebral white matter in a group of retired professional football players along with a group of cognitively normal controls. Given the known exposure of football players to concussive and subconcussive injuries, and the vulnerability of white matter to head trauma, we evaluated correlations between white matter fractional anisotropy (FA) and performance on the Boston naming test. We performed an unbiased voxel-wise analysis using the tract-based spatial statistics

(TBSS) method as implemented in the FSL software package to determine if an association between FA and BNT T-scores existed in this population. The voxel-wise analysis was run on the entire group (athletes and controls) and on each group separately. We also analyzed the DTI data by grouping voxels together as white matter pathways and testing the strength of each tract's association with BNT T-scores. In the athlete group, the significantly correlated voxels were located throughout the left hemisphere and in posterior regions on the right. The voxel-wise analysis on the normal controls alone failed to produce any significant voxels. Within athletes alone, grouping voxels together as white matter pathways identified four tracts with significant correlations; the left inferior longitudinal fasciculus (ILF), forceps minor, left cingulum and forceps major. White matter integrity, as measured by DTI, is important for distributed cognitive processes and correlates with confrontation naming performance in athletes exposed to concussive and subconcussive head injuries, but not in normal controls without such exposure.

E103

DAMAGE TO THE VENTROMEDIAL PREFRONTAL CORTEX REDUCES A "FALSE MEMORY" EFFECT

David Warren[1], Melissa Duff[1], Daniel Tranel[1]; [1]University of Iowa — Recent neuroimaging evidence has suggested that ventromedial prefrontal cortex (vmPFC) contributes to memory for contextual, organizing information, often decribed as "schematic memory" (cf. Van Kesteren et al., 2012). We investigated this putative relationship with a neuropsychological approach, testing the neuroimaging-derived hypothesis that vmPFC damage would impair schematic memory; specifically, by reducing "false memory" effects. Patients with focal lesions to the vmPFC (N=8) were recruited from the Iowa Patient Registry, and compared to demographically-matched healthy participants (N=8) using a well-established word-list learning paradigm known to provoke "false memories" of semantically associated, non-presented items (Deese-Roediger-McDermott [DRM] paradigm; Roediger & McDermott, 1995). Word lists (18 lists, 15 words each) were presented to each participant aurally, with free recall immediately following each list, followed by a final omnibus visual recognition test. We found that vmPFC patients generated fewer non-presented items than comparison participants ($t(14)=2.600$, $p = 0.021$) despite similar recall performance overall ($t(14)=0.097$, $p > 0.9$) and across serial list positions ($F(14,196)=1.29$, $p > 0.25$). Intriguingly, during the recognition test both groups endorsed non-presented semantic associates above chance (each $t(7) > 10$, $p < 0.001$), but despite robust differences in recall of non-presented items, recognition endorsement did not differ between groups for either presented ($t(14)=1.519$, $p > 0.15$) or non-presented items ($t(14)=0.265$, $p > 0.7$). In sum, lesions of the vmPFC reduced false recall of non-presented semantic associates, but did not alter recognition of such associates. The results suggest that the vmPFC contributes to schematic memory, specifically in generative memory tasks requiring novel reconstruction.

E104

SEMANTIC CATEGORIZATION OF EVENTS DISRUPTS SUBORDINATE EPISODIC DETAILS

Sehjung Yi[1], Sanghoon Han[1]; [1]Yonsei University, Seoul, Korea — Grouping episodes into a semantically related category is necessary for constructing better mnemonic structure. However, its effect on memories of subordinate details was not clearly understood. In our fMRI study, we tested whether attending superordinates during semantic association disrupts or enhances subordinate episodic details. Cycles of five cue words which of each holding two detail words were presented, and participants were asked whether they could imagine a category that includes previously seen cue words in each cycle while rating their confidence. Participants were given cued recall tests on presented detail words after the session. Behavioral data indicates that categorization task RTs were decreased and confidence levels were increased significantly in the third trial of each cycle, rendering the third trial as "aha moment", where a semantic category was successfully established. Critically, accuracy of recalling detail words presented immediately prior to third trials was significantly lower than followed trials, indicating that subordinate details were disrupted during categorization. GLM analysis of third trials revealed significant activations of temporal gyrus(TG) and inferior frontal gyrus(IFG), areas of semantic memory network. In support of memory disruption on detail words, second trials showed significantly lower activation compared to other trials on hippocampus. Representative Similarity Analysis(RSA) also revealed activation patterns of third trials being significantly more consistent than second trials in TG, IFG, and hippocampus, as similarity peaked in third trials. Our research demonstrated that semantic grouping can disrupt memories of subordinate details, suggesting that semantic retrieval during categorization affects the quality of related episodic memory evidence.

E105

OERP SCALP TOPOGRAPHY AS A FUNCTION OF AGE AND APOLIPOPROTEIN E E4 DURING ENCODING OF OLFACTORY INFORMATION.

Lisa Graves[1], Melissa Cervantez[1], Amanda Green[2], Charlie Morgan[1], Claire Murphy[1,2]; [1]San Diego State University, [2]University of California at San Diego — Alzheimer's is a neurodegenerative disease associated with severe memory loss and cognitive decline. The disease affects 5.4 million Americans and costs $200 billion per year. Age and the Apolipoprotein E ε4 allele are major risk factors for AD. AD pathology first affects brain areas involved in memory and olfaction. Event-related potential recording offers high temporal resolution, making it a valuable noninvasive method for investigating olfactory function. Individuals at risk for AD display increased OERP latency and decreased amplitude in odor recognition memory tasks. These differences are evident before onset of dementia, indicating the potential contribution of OERPs in AD diagnosis. Furthermore, Alzheimer's disease, in relation to other dementias, is associated with specific deficits in encoding new information. Prior OERP studies focus on differences in OERP activity during retrieval. In the present study, sixty adults were equally divided into three age groups (young, middle, old) matched on ε4 status. OERPs were recorded as participants encoded odors that were presented with a computer-controlled olfactometer. In addition to univariate analyses of the effects of age and ε4 status on OERP latency and amplitude during encoding, differences in scalp topography were statistically analyzed using CARTOOL. Results indicated topographical differences as a function of age and ε4 status during encoding of odors. The findings reveal the effects of age and the ε4 allele on the neural correlates of odor recognition memory and improve our understanding of olfaction and its relation to neurodegenerative disease. This study is supported by NIH grant DC002064-15 and AG04085-25 to CM.

E106

IMPROVING FEAR EXTINCTION BY HIGH-FREQUENT RTMS TO THE PREFRONTAL CORTEX

Anne Guhn[1], Thomas Dresler[2], Marta Andreatta[1], Thomas Polak[1], Jürgen Deckert[1], Martin J. Herrmann[1]; [1]University of Wuerzburg, Germany, [2]University of Tuebingen, Germany — In rodents, it has been repeatedly demonstrated that electrical stimulation of the infralimbic region of the medial prefrontal cortex (mPFC) reduces the expression of a conditioned fear response (CR). However, in humans this effect still remains to be tested. Therefore we investigated the effects of high frequent repetitive transcranial magnetic stimulation (rTMS) to the mPFC on extinction acquisition and extinction recall in a two day discriminative pavlovian fear conditioning protocol. Healthy volunteers were conditioned using neutral faces (CS+, CS-) and a loud aversive scream that followed CS+ trials during the fear acquisition phase. Subjects were randomly assigned to receive 20 Hz offline rTMS to the mPFC in a placebo controlled manner. Subsequently, they underwent two extinction trainings: the first one directly followed the rTMS session, and the second one was applied 24 hours later to test for extinction recall. Repetitive TMS effects on conditioned fear responses were assessed by comparing fear-potentiated startle responses (FPS), skin conductance and CS arousal ratings in active and placebo stimulated volunteers. Consistent with our hypothesis of enhanced consolidation of extinction memory after active rTMS, subjects in the active group showed smaller conditioned responses across all dependent variables. They did not differentiate between CS+ and CS- and exhibited proportionately decreasing FPS responses to CS+ trials across both extinction sessions while placebo showed the characteristic fear return during extinction recall. These results indicate enhanced consolidation of extinction memory that might open up new treatment perspectives by adding rTMS to exposure based psychotherapy in anxiety patients.

E107

FRONTAL MIDLINE THETA AND N200 AMPLITUDE REFLECT COMPLEMENTARY INFORMATION ABOUT EXPECTANCY AND OUTCOME EVALUATION

Azadeh HajiHosseini[1], Clay B. Holroyd[1]; [1]University of Victoria — Frontal midline theta and feedback error-related negativity (fERN) have both been proposed to index a dopamine-like reinforcement learning signal in the anterior cingulate cortex (ACC). An essential property of a reinforcement learning signal is that other things being equal, it must be consistently larger (or smaller) for rewards relative to errors. We investigated whether both measures satisfy this property by comparing them with respect to their sensitivities to outcome valence and outcome probability in a previously collected EEG dataset. Data were recorded from twelve participants while they were engaged in a time-estimation and an oddball task. FERN amplitude (measured as N200 base-to-peak) was found to be highly correlated with evoked theta power, the portion of theta power related to theta oscillations that are phase-consistent across trials. Despite this correlation, Bayesian analysis on N200 amplitude and theta power revealed a dissociation so that N200 amplitude was mainly sensitive to outcome valence whereas theta power was mainly sensitive to outcome probability. Further, Bayesian analysis revealed that when the effect of theta power on N200 amplitude was statistically controlled, the sensitivity of N200 to probability decreased while its sensitivity to valence remained strong. Conversely, when the effect of N200 amplitude on theta power was statistically controlled, sensitivity of theta power to probability remained strong. These results suggest that although both measures provide valuable information about cognitive function of frontal midline cortex, fERN amplitude is specifically sensitive to dopamine reinforcement learning signals whereas theta power reflects the ACC response to unexpected events.

E108

MEASURING HIGH-LEVEL VISUAL DISCRIMINATION WITH A FAST PERIODIC ODDBALL PARADIGM

Joan Liu-Shuang[1], Anthony M. Norcia[2], Bruno Rossion[1]; [1]University of Louvain, Belgium, [2]Stanford University, USA — The mechanisms underlying the discrimination of visual objects remain poorly understood, especially in the case of human faces, which are efficiently individualised despite their high visual similarity. Here we present a novel paradigm that uses fast periodic oddball stimulation to objectively and rapidly quantify face discrimination. This measure is distinct from the general response to faces and does not require contrasting different conditions. We recorded 128-channel EEG in 20 observers presented with 60-second sequences of face stimuli shown at a constant frequency of 5.88Hz. One face (A) was repeated throughout each sequence. Different faces (B, C,…) were introduced at fixed intervals (every 4 stimuli: 5.88Hz/5=1.18Hz), resulting in the following sequence structure: AAAABAAAAC... The response at 1.18Hz is an index of face discrimination that is independent of the response at 5.88Hz. To ensure that our probe recruited high-level face processing, we manipulated size (face size randomly varied every cycle), orientation (upright vs. inverted, Experiment 1) and contrast (normal contrast vs. contrast-reversed, Experiment 2). In both experiments, normal faces showed highly significant responses at 1.18Hz and its harmonics (2F=2.35Hz, 3F=3.53Hz…), particularly on right occipito-temporal channels. Inversion and contrast reversal reduced the 1.18Hz responses, while the 5.88Hz response did not differ between conditions. Thus, the signal at the 1.18Hz oddball frequency and its harmonics represents an objective measure of face individualisation. Similar to recent studies (Rossion & Boremanse, 2011; Ales et al., 2012, JOV) the current study underlines the utility of the fast periodic paradigms for exploring fine-grained visual discrimination of complex patterns.

E109

USE OF FMRI FOR CROSS-VALIDATION OF EEG NEURAL SOURCE MODELING

Jessica R. Wise[1], Gwen A. Frishkoff[1], Kathleen P. Revill[2], Maruf Hoque[1]; [1]Georgia State University, [2]Georgia Institute of Technology — We conducted a study of sentence comprehension, using ERP (brainwave) and fMRI (brain imaging) methods to examine the brain's response to anomalous vs. unexpected words, two types of semantic violation that are often confounded. Consider the following sentence: "The barber trimmed the man's…." People are faster to make semantic judgments judgment if "beard" appears as the final word, versus "cuticles" (an unexpected ending) or "clock" (an anomalous ending). To dissociate neural responses to these two kinds of linguistic stimuli, we recorded ERP and fMRI data as participants viewed sentences that ended with a word from one of three categories: Expected (meaningful completions that were highly expected based on the context), Unexpected (meaningful completions that were unexpected), or Anomalous (words that did not fit the context). Analysis of fMRI data revealed greater activity in the left angular gyrus, left middle temporal gyrus, and left inferior prefrontal cortex for Unexpected versus Anomalous endings. ERP results showed a classical "N400 semantic effect," as well as a late, right frontal pattern that was unique to the anomalous endings and peaked at around 700ms. Neural source modeling suggested that this later effect was explained by sources in right inferior temporal and right inferior parietal cortex. We discuss implications for cross-modal studies of language, and the role of right temporal cortex in meaning integration (the N700).

E110

TRANSFER OF COGNITIVE TRAINING ACROSS MAGNITUDE DIMENSIONS ACHIEVED WITH CONCURRENT BRAIN STIMULATION OF THE PARIETAL LOBE

Marinella Cappelletti[1], Erica Gessaroli[2], Rosalyn Hithersay[1], Micaela Mitolo[3], Daniele Didino[4], Ryota Kanai[1], Roi Cohen Kadosh[5], Vincent Walsh[1]; [1]UCL Institute of Cognitive Neuroscience, London, UK, [2]Department of Psychology, University of Bologna, Italy, [3]Department of Psychology, University of Padova, Italy, [4]Department of Cognitive Sciences and Education, University of Trento, Italy, [5]Department of Experimental Psychology, University of Oxford, UK — Cognitive training has attracted interest by its potential to enhance cognitive abilities. However, improvements are often limited to the training task and do not culminate in generalized improvements across related tasks. Here we show that transfer of training across tasks can be achieved by concurrent non-invasive brain stimulation. Specifically, we show that successful training in numerical estimation transfers to other types of magnitude estimation such as spatial and temporal extent when brain stimulation was delivered to parietal lobes. The transfer was specific to the magnitude tasks that are thought to share common neural and cognitive substrates and no transfer was observed for other tasks such as face perception and arithmetic. These results indicate that with a suitably chosen task and stimulation, cognitive training can cause large long-lasting enhancement of cognitive functions that are shared across associated tasks.

E111

WALNUT- A PYTHON BIOPSYCHOPHYSICS TOOLBOX

Sven Hoffmann[1], Bernhard Siebelmann[1], Edmund Wascher[1], Gerhard Rinkenauer[1]; [1]Leibniz Research Centre for Working Environment and Human Factors (IfADo) — The methodological demands with respect to biosignal-processing increase permanently. For example, multivariate statistics are increasingly applied in the decomposition of electroencephalographic (EEG) data. Even more importantly, the amount of acquired variables increases in the applied context, where researchers become interested in the joint analysis of psychological and physiological data. For this purpose efficient and economic analysis tools are essential. Most existing software packages are dealing with either psychophysics, statistics or EEG analysis, and thus are solely suitable to one kind of analysis. Furthermore, they are often commercial and thus contradict the idea of research being independent of commercial interests. In recent years the Python programming language increasingly caught attention because of its highly object oriented structure, easy to learn syntax, and numerical capabilities. Furthermore, it is Open Source, and thus can be used by everyone. The license even allows the usage in commercial contexts, as long as Python itself is not commercially distributed. Our aim is to provide a free Open Source Software (WALNUT) based on Python, which is able to read and analyze not only time series data such as EEG data, but also is able to analyze behavioral data such as response times or analogue movement data on the basis of chronometric or kinematic models. Since the software is Open Source the source code is open to everyone. Every programmer who is willing and interested might contribute to its improvement and active development. Additionally, it might be adapted by the user to its own analysis strategy easily.

E112

IS EFFICACY OF ACUPUNCTURE TREATMENT A WISHFUL THINKING? FUNCTIONAL TEST OF ACUPUNCTURE FOR LOWER BACK PAIN, A CLINICAL STUDY Xiao Hong Liu[1], Ping Xiao[2], Scott N. Dr. MacKinnon[3]; [1]Memorial University of Newfoundland, St. John's Newfoundland, Canada, [2]Lawrence Berkeley National Laboratory, [3]Memorial University of Newfoundland — Abstract: The purpose of this study is to assess the effectiveness of acupuncture treatment protocol on lower back pain and lower back range of motion. Three acupuncture treatments were provided for 21 subjects with lower back pain. A lumber motion monitor was used to record trunk kinematics in 3-dimensions: the sagittal, lateral and twist planes for free movement and lifting tasks. There were 21 subjects (8 males and 13 females) who completed the study. The average age of the subjects was 44-years-old. Family physicians referred 9.52% of the subjects, while 90.48 % were referred by others. Measurements before the first acupuncture treatment were compared to measurements taken following the third acupuncture treatment. It was found that 80.95 % of the subjects exhibited an increased sagittal range of motion in either free sagittal movements or lifting task or in both movements; in sagittal movement the p-value = 0.02; during lifting tasks, the p-value=0.25 was in the sagittal movement along with associated lateral and twist. This study demonstrates the measureable effects of acupuncture treatment for lower back pain, in which the subject had measurable changes in trunk kinematics. This study suggests that acupuncture treatments can change a subject's angular range of motion in the sagittal plane. Efficacy of acupuncture treatment might not just a wishful thinking. Because the kinematics changes were greater in the third treatment, this may suggest that the acupuncture treatments have positive accumulative effects. With further treatments, additional improvements may be anticipated.

E113

CATHODAL TRANSCRANIAL DIRECT CURRENT STIMULATION: FACILITATORY, INHIBITORY, OR BOTH? Nazbanou Nozari[1], Kristina Woodard[1], Sharon Thompson-Schill[1]; [1]University of Pennsylvania — While anodal Transcranial Direct Current Stimulation (tDCS) often facilitates behavior, controversial cathodal effects have been reported. Depending on the task, montage, and temporal variables, facilitation, inhibition and null effects of cathodal stimulation have been observed. We explored the effects of cathodal stimulation of the left prefrontal cortex on behavior by holding the task constant, and varying the task-stimulation overlap and the position of the reference electrode. In a between-subject design, Flanker task with letters was administered either during cathodal stimulation, post-stimulation or under sham. Subjects who completed Flanker post-stimulation participated in a task with low demands for cognitive control during stimulation. To control for the effects of the site of the reference electrode, two montages were tried in the post-stimulation group: cathode was always placed over the left prefrontal area, but one montage placed the reference electrode over the right mastoid, and the other, over the right supraorbital area. The results showed a general inhibitory effect of cathodal stimulation when applied during the task (slower and less accurate responses). Interestingly, post-tDCS effects were reversed, showing pure facilitation compared to sham (faster and more accurate responses), regardless of the position of the reference electrode. These results suggest that, even within the same task, cathodal stimulation may induce different effects when task/stimulation temporal overlap is manipulated. This difference may be due to release from inhibition in the post-tDCS phase. Alternatively, the effect of cathodal stimulation may be modulated by the mental operations while under stimulation.

E114

HORMONAL CONTRACEPTIVES AND MARKERS OF PHYSIOLOGICAL STRESS: DIFFERENCES IN DIURNAL CYCLE ACTIVITY OF SALIVARY ALPHA AMYLASE AND CORTISOL Roxanna Salim[1], Karen Redwine[2], Ponchita Chaiyakam[2], Maria Pizana[2]; [1]Claremont Graduate University, [2]Whittier College — Activation of two key physiological systems, the Hypothalamic-Pituitary-Adrenal axis and the Autonomic Nervous System, are indicative of stress reactivity. Classically, and in recent literature, these systems are measured using cortisol and salivary alpha amylase, respectively. Evidence also indicates that both HPA axis and ANS activity follow distinct diurnal patterns. Moreover, evidence indicates that individual differences including sex, menstrual cycle activity, and use of hormonal contraceptives elicit differences in diurnal cortisol activity. While the influence of hormonal contraceptive use on diurnal cortisol is well-established, the influence of hormonal contraceptive use on sAA has not yet been investigated. The current study investigated the diurnal cycle activity of cortisol and salivary alpha amylase in 37 college-aged females who were on and off hormonal contraceptives. Consistent with previous literature, women on hormonal contraceptives showed blunted free cortisol responses. Women on hormonal contraceptives also showed significantly greater salivary alpha amylase responses, although only at evening and morning collection times. These results suggest a preliminary model for the influence of hormonal contraceptive use on diurnal ANS activity.

E115

BABIES IN TRAFFIC: INFANT VOCALIZATIONS MODULATE RESPONSES TO LOOMING SOUNDS John G. Neuhoff[1], Grace Hamilton[1], Amanda Gittleson[1], Adolfo Mejia[1]; [1]The College of Wooster — Infant vocalizations and "looming sounds" (sounds that move toward a listener) are two classes of environmental stimuli that are critically important to survival and reproductive fitness. Infant vocalizations capture parental attention and encourage proximity and care thereby increasing the likelihood of infant survival. Looming sounds elicit anticipatory judgments of auditory arrival time that can provide a margin of safety and a selective advantage in dealing with the looming object (Neuhoff, 1998, Nature; Neuhoff, Planisek, & Seifritz, 2009, JEP:HPP). Both classes of sounds have been shown to activate middle temporal gyri and amygdala. In this experiment we presented listeners with 3-D virtual looming tones and asked them to make time-to-arrival judgments by pressing a key when they perceived that the sound source had reached them. Listeners exhibited the characteristic anticipatory bias which would provide a margin of safety in perceiving the source's approach. However, an infant's laugh presented binaurally midway through the looming source's approach significantly reduced the anticipatory bias and resulted in less cautious judgments of arrival time. Conversely, when an intensity-matched infant's cry was presented midway through the source's approach, the anticipatory bias was significantly increased, resulting in more cautious judgments of arrival time. Consistent with previous work, we found that females exhibited a greater anticipatory bias than males. However there was no interaction of sex and the type of infant vocalization. Our results support that the valence of infant vocalizations can influence perception of auditory motion and can modulate motor responses to other behaviorally relevant environmental sounds.

E116

THE NEURAL BASIS OF SPEECH PERCEPTION IS TASK-DEPENDENT AND DOES NOT RELY ON THE MOTOR SYSTEM: A LESION STUDY Corianne Rogalsky[1], Kristin Raphel[2], Tasha Poppa[1], Steve Anderson[3], Hanna Damasio[2], Tracy Love[4], Gregory Hickok[1]; [1]University of California, Irvine, [2]University of Southern California, [3]University of Iowa, [4]San Diego State University & University of California, San Diego — The neural basis of speech perception is hotly debated, particularly regarding the role of the motor system, with several conflicting findings attested. Some of the confusion may result from task effects. For example, much of the evidence for motor involvement comes from syllable discrimination type tasks, which have been found to doubly dissociate from auditory comprehension tasks. The present study used two tasks to assess speech perception in patients with left hemisphere focal chronic lesions (n= 55) and age-matched controls. Subjects completed a psycholinguistic battery to assess their phonological, lexical, and sentence-level speech comprehension and production abilities. This battery included a syllable discrimination task in which pairs of non-words were presented. The words were either identical, or had different onset syllables. An auditory word-to-picture matching task was also administered in which an auditory single word was presented in white noise. The task was to select which picture in a 4-item array corresponds to the word presented. The picture array contained the target, as well as a phonological, semantic, and unrelated foil picture. For the syllable discrimination task, voxel-based lesion symptom mapping (VLSM) identified a temporal-parietal voxel cluster, including area Spt and extending into auditory and somatosensory cortex. Conversely, the word-to-picture matching task was not associated with damage to this same network, but rather implicated

mid-temporal regions (albeit at a more liberal threshold). These results suggest that speech discrimination tasks engage dorsal stream temporal-parietal regions, whereas auditory comprehension tasks engage temporal regions. Supported by NIH-DC03681.

E117

AN ERP INVESTIGATION OF DURATION ESTIMATIONS OF FLAT AND PERCUSSIVE TONES

Rajwant Sandhu[1], Michael Schutz[2], Benjamin Dyson[1]; [1]Ryerson University, [2]McMaster University — Pace-maker accumulator models of temporal processing suggest that duration estimates are made via the accumulation of pulses over an interval, with greater pulse accumulation implying longer durations. The contingent negative variation (CNV), an event related potential component, has been proposed as the neural marker of pulse accumulation due to greater amplitudes of this component being associated with subjectively longer compared to subjectively shorter durations. To date studies that have examined CNV modulation on auditory temporal estimation tasks have used either flat tones (those that end abruptly) or silent intervals. In the current study we examined the influence of tones which do not imitate those that occur in the natural environment (e.g., flat tones) against those that do (e.g., percussive tones) on duration estimates and resultant CNV effects. As expected we find different behavioural and neural patterns associated with these two types of tones. Behaviourally, percussive tones tended to be underestimated, while flat tones tended to be overestimated. Neurally and in line with previous work, we found greater CNV amplitude for subjectively longer tones. Furthermore, we found earlier and more fronto-central CNV effects for percussive tones, and later and more posterior CNV effects for flat tones. The data suggest that estimation strategies differ as a function of the properties of the to-be-judged tone. As such, the model of stimulus processing derived from flat envelope stimuli may not accurately describe the processing of sounds that are typically heard in the natural world.

E118

THE DISTRIBUTION OF CORTICAL SURFACE AREA DEDICATED TO AUDITORY TEMPORAL RECEPTIVE FIELDS IS SYMMETRIC BETWEEN HEMISPHERES IN HUMAN AUDITORY CORE AND BELT

Jonathan Venezia[1], Brian Barton[1], Kourosh Saberi[1], Alyssa Brewer[1], Greg Hickok[1]; [1]University of California, Irvine — The Asymmetric Sampling in Time (AST) theory proposes that auditory-cortical representations are elaborated on different timescales in left and right hemispheres. Specifically, AST posits that, (1) there are distinct neuronal ensembles that sample from time windows spanning roughly 25-50ms (40-20Hz) and 150-300ms (6.67-3.33Hz), and (2) these neuronal ensembles are distributed differentially across hemispheres. Thus, one measure that should dissociate by hemisphere is auditory-cortical magnification of Temporal Receptive Fields (TRFs). In the present fMRI study, we investigate magnification differences by mapping auditory cortex along two dimensions, frequency (tonotopy) and time (periodotopy). A modified version of the standard procedure in visual field mapping, the Traveling Wave method, was applied. Amplitude-modulated Gaussian noise of two types, narrowband and broadband, was varied across a range of center frequencies (400-6400Hz) and modulation rates (2-256Hz), respectively. Corresponding tonotopic and periodotopic gradients were measured. The orthogonal representation of these gradients in cortex allowed precise delineation of 11 auditory field maps (AFMs) in auditory core and belt. Within each AFM we measured cortical surface area dedicated to different bands within the range of TRFs represented in our broadband stimuli. Equally spaced bins were constructed around broadband stimulus values (i.e., TRF) and cortical surface area (mm2) within each bin was tabulated. Two results were of note: (1) significant cortical magnification was observed for certain TRFs, typically following a unimodal distribution centered near 8Hz, and (2) significant differences in magnification between hemispheres were not observed. Together, these results do not support AST at the level of auditory core and belt.

E119

NEWBORN INFANTS CAN NEURALLY DISCRIMINATE WESTERN MUSIC CHORDS

Paula Virtala[1,2], Minna Huotilainen[1,2,3], Eino Partanen[1,2], Mari Tervaniemi[1,2,4]; [1]Cognitive Brain Research Unit, Cognitive Science, Institute of Behavioural Sciences, University of Helsinki, Finland, [2]Finnish Centre of Excellence in Interdisciplinary Music Research, University of Jyväskylä, Finland, [3]Finnish Institute of Occupational Health, Helsinki, Finland, [4]Department of Psychology, University of Jyväskylä, Finland — Abstract skills in the auditory processing of newborn infants have been recently demonstrated in several studies using event-related potentials (ERPs). Here, the neural processing of chords was investigated in newborn infants. We studied whether the categorizations between the major and minor modalities and consonance versus dissonance already take place at the level of the change-related mismatch negativity (MMN). We found that newborn infants neurally discriminated both dissonant and minor chords in the context of major chords: while the dissonant chords elicited a large positive mismatch response, the minor chords elicited an MMN-like negativity. This indicates that they were processed differently by the infants' brain. The results show that the newborn infant is capable of abstract categorizations in auditory stimuli and that Western music categorizations play a role in infants' auditory organization.

E120

NEURAL SOURCES OF MISMATCH NEGATIVITY VARY WITH PARADIGM

Lawrence Ward[1], Shannon MacLean[1], Elizabeth Blundon[1]; [1]University of British Columbia — The neural mechanisms generating the Mismatch Negativity (MMN), the scalp potential indexing auditory change detection, remain largely mysterious. Most previous research localizes the generators of the MMN to regions in the superior temporal gyrus (STG), although there is some evidence that the prefrontal cortex (PFC) is involved. Importantly, the neural generators identified vary substantially from study to study. In order to elucidate the functional roles the implicated brain regions have in monitoring auditory environmental regularities and detecting changes in them, we used independent component analysis (ICA) of high-density EEG recordings to identify active brain regions during two different versions of a passive oddball paradigm. One was a simple, monotic, frequency deviant paradigm and the other was a complex, dichotic, frequency deviant paradigm in which deviants occurred in both ears and deviants and standards traded places across blocks. In both paradigms we found neural generators in the bilateral temporal cortices and in the PFC, consistent with some previous studies. In the more complex of our two experiments, however, a generator in the orbital frontal gyrus accounted for most of the variance of the scalp potential during the MMN period, which was later (120-200 ms). In the simpler paradigm, in contrast, the MMN was earlier (50-150 ms), and scalp potential variance during this period was mostly accounted for by a wider array of temporal, frontal, and parietal sources. We also identified several generators that have been strongly linked to attention networks, indicating that passive oddball tasks may transiently activate these networks.

E121

MUSICAL TRAINING EARLY IN LIFE PROTECTS AGAINST AGE-RELATED DECLINES IN COGNITION AND NEURAL SPEECH PROCESSING

Travis White-Schwoch[1], Kali Woodruff Carr[1], Samira Anderson[1,2], Nina Kraus[1]; [1]Northwestern University, [2]University of Maryland — Musical experience fundamentally alters the nervous system, instilling auditory cognitive and perceptual benefits. The auditory brainstem response to complex sounds (cABR) reflects plasticity from short- and long-term experience, including musical training. The brainstem transcribes sounds with millisecond-precise timing; this transcription is degraded with aging. Older adults with a lifetime of musical training exhibit subcortical timing similar to young adults with no musical training, suggesting extensive musical training offsets age-related neural declines. Moreover, older adult musicians demonstrate superior auditory cognitive abilities. It remains unknown, however, whether limited musical training early in life imbues any benefit years after training has stopped. We collected cABRs to the speech sound /da/ in older adults with no, some (1-3 years), or a moderate amount (4-15 years) of musical training during childhood and young adulthood, and measured auditory working memory and speed of processing. Brainstem timing in response to the speech syllable was earliest in the group with a moderate amount of training, followed by the group with some training, and slowest in the group with no musical training. Cognitive performance was similar, with the most-trained group having the highest auditory working memory and fastest speed of processing. These findings strongly suggest that a few years of auditory cognitive training early in life can shape the nervous system into older adulthood. Specifically, even a

small amount of musical training may protect against age-related declines in the neural and cognitive processes important for everyday communication. Supported by the NIH (R01 DC010016) and the Knowles Hearing Center.

E122

CONGRUENCY MATTERS: CORTICAL PROCESSING OF VISUAL-OLFACTORY INTEGRATION

Kathrin Ohla[1,2], Johan N. Lundström[2,3,4]; [1]German Institute of Human Nutrition Potsdam-Rebrücke, Arthur-Scheunter-Allee 114-116, 14558 Nuthetal, Germany, [2]Monell Chemical Senses Center, Philadelphia, PA, [3]Karolinska Institute, Stockholm, Sweden, [4]University of Pennsylvania, Philadelphia, PA — Before ingestion, the visual appearance and odor of a food constitute the primary sensory inputs and shape food choice. Experiences influence whether distinct sensory events are perceived as concordant and are integrated to one unitary percept. The brain mechanisms underlying these processes are poorly understood and were aim of the present study. We used electrical neuroimaging analyses of the electroencephalographic (EEG) responses following olfactory-visual stimulation in humans. Stimuli were odor-image pairs presented at three levels of concordance: congruent (e.g. peanut image with peanut odor), incongruent (e.g. peanut image with orange odor) and mixed (e.g. peanut image with orange-peanut odor mixture). Participants rated the stimuli for congruence, pleasantness and intensity. As expected, participants perceived concordant stimulus pairs as more congruent than mixed and incongruent pairs. Similarly, congruent pairs were rated as more pleasant that mixed and incongruent pairs. Waveform analysis yielded significant amplitude augmentation for congruent as compared to incongruent odor-image pairs between 120-200ms post stimulus onset. Source analysis revealed the source of the activation differences in visual cortex and left inferior temporal gyrus. Later differences were observed between 400-700ms in the parietal lobe, lateral frontal cortex and the bilateral insula. Concordance between olfactory-visual stimuli was associated with increased pleasantness and activation in unimodal visual and olfactory areas as well as in multimodal areas. The results suggest that cross-modal integration is a dynamic process regulated by both unisensory as well as higher order integration areas and that this process is modulated by learned associations and perceived congruence between the sensory inputs.

E123

RECENTLY LEARNED MULTIMODAL ASSOCIATIONS INFLUENCE VISUAL PERCEPTUAL SELECTION

Elise Piazza[1], Rachel Denison[1], Maxwell Schram[1], Michael Silver[1]; [1]University of California, Berkeley — We report that rapid learning of arbitrary crossmodal associations impacts visual perceptual selection. We measured perceptual selection with binocular rivalry, a phenomenon in which incompatible images presented separately to the two eyes result in a perceptual alternation between the two images. Previous work has shown that sounds that are temporally, directionally, or semantically congruent with one of a pair of rivalrous visual percepts can promote dominance of the congruent percept. Here we asked whether very recently learned, arbitrary audiovisual associations could impact rivalry. Subjects were presented with rapid streams of images and sounds during a brief (10-minute) passive exposure phase. For half of the stimuli, a given sound always preceded a specific image, creating an association between the two. The remaining sounds and images were randomly paired throughout the exposure phase. Pairings were randomly assigned and counterbalanced across subjects. Immediately after the exposure phase, subjects completed a rivalry test. On each rivalry trial, subjects were presented with a combination of a sound and a pair of rivalrous images, all of which had been presented during the exposure phase. We found that an image was more likely to be perceived when it was presented with its auditory match than when it was presented with a non-matching sound. These effects of learning on rivalry did not correlate with subjects' conscious knowledge of the specific audio-visual pairings, as assessed in a separate recognition test. Our results indicate that prior knowledge—even that which is rapidly and recently acquired—helps resolve ambiguity in the visual world.

E124

EXCITABILITY OF THE MIRROR NEURON SYSTEM IN SINGING PERCEPTION: A TRANSCRANIAL MAGNETIC STIMULATION STUDY

Isabelle Royal[1], Pascale Lidji[1], Frank Russo[2], Isabelle Peretz[1]; [1]University of Montreal, [2]Ryerson University — The perception of movements is associated with increased activity in the human motor cortex. This system may underlie our ability to understand actions, as it is implicated in the recognition, understanding and imitation of actions. Here, we investigated the involvement and lateralization of this "mirror neuron" system (MNS) in the perception of singing. Transcranial magnetic stimulation (TMS) was applied over the mouth representation of the motor cortex in non-musicians while they watched 4-second videos of singers producing a 2-note ascending interval. The task was to decide whether a sung interval matched a given interval. A control task consisted of judging whether abstract visual figures were open or closed. During both tasks, motor evoked potentials (MEPs) were recorded from the mouth muscle and normalized by considering a ratio of the amplitudes obtained in the singing interval task relative to the control task in each cerebral hemisphere. To investigate the time course of the motor activation, TMS pulses were randomly emitted in 7 time windows (ranging from 500 to 3500 milliseconds after stimulus onset). Results show that the MEP amplitudes are higher after stimulation of the right hemisphere in the singing condition. More specifically, TMS applied between 1000 and 1500 milliseconds, before the production of the second note of the interval, over the right hemisphere yielded higher MEPs as compared to the left hemisphere. These results suggest that the right MNS is involved in the anticipation of a singing judgment.

E125

SUPERADDITIVE EFFECTS DURING FLAVOR PERCEPTION ARE MODULATED BY ANTERIOR TEMPORAL CORTEX CONNECTIVITY.

Janina Seubert[1], Kathrin Ohla[2], Yoshiko Yokomukai[3], Johan Lundström[1,4,5]; [1]Monell Chemical Senses Center, Philadelphia, USA, [2]German Institute of Human Nutrition Potsdam-Rehbrücke, USA, [3]Kirin Institute of Food and Lifestyle, Kirin Holdings Co. Ltd., [4]Department of Psychology, University of Pennsylvania, Philadelphia, USA, [5]Department of Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden — The combination of taste and odor found in a flavorful dish creates a more powerful sensation than its odor or taste in isolation. Whereas the neural processing of the individual chemosensory components is well known, the functional connectivity underlying the combined flavor percept is poorly understood. In the present functional magnetic resonance imaging study, subjects were presented with taste only (gustatory presentation of juice, closed soft palate), smell only (orthonasal presentation of juice odor), or a combined flavor (retronasal-gustatory presentation, swallowing juice). As expected, olfactory stimulation alone stimulated olfactory areas while gustatory stimulation alone elicited activation within the gustatory cortex. Overlapping activation within both networks could be observed during flavor presentation, and a convergence zone between all three conditions was observed in the anterior ventral insula and cingulate cortex. Superadditive activity for the flavor condition relative to odor and taste alone was observed in the dorsal insular gyrus, extending into parietal operculum and postcentral gyrus. Finally, to delineate the cerebral networks contributing to the flavor percept, we assessed the functional connectivity between these important nodes responsive to chemosensory overlap during combined odor-taste stimulation. Increases in functional connectivity with both convergence and superadditive areas were observed in an overlapping area in the temporal pole. Taken together, these findings are suggestive of an important relay function of semantic memory circuits in the formation of the flavor experience from crossmodal chemosensory information.

E126

USING CITALOPRAM AND BUSPIRONE TO INVESTIGATE THE EFFECT OF SEROTONIN ON THE DYNAMICS OF PERCEPTUAL RIVALRY

Jody Stanley[1], Suresh Sundram[2], Olivia Carter[1]; [1]The University of Melbourne, Australia, [2]The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia — When sensory input is truly ambiguous, conscious perception tends to switch between two mutually exclusive interpretations in a phenomenon known as perceptual rivalry. Previous research has suggested that the timing of these switches can be altered by a range of sero-

tonergic drugs that selectively or non-selectively activate the serotonin-1A (5-HT1A) receptor. We aimed to investigate whether this change in perceptual rivalry switch rate was due to global levels of serotonin in the brain, or to specific activation of the 5-HT1A receptor. We used two serotonergic drugs in twelve healthy participants: citalopram to increase global levels of serotonin, and buspirone to activate 5-HT1A receptors. Perceptual testing included binocular rivalry and auditory stream segregation. Participants were asked to indicate when their conscious awareness of the stimulus changed between the two possible perceptual states. While several individual participants showed changes in switch rate across conditions, the direction of change was not consistent across participants. Therefore, there were no significant differences in switch rate between citalopram, buspirone, and placebo conditions in visual and auditory paradigms. Unlike previous studies, we did not find evidence that changes in serotonin affect the rate of switch in perceptual rivalry. It is possible that participants' general arousal levels may have been affected by other methodological factors—such as refraining from caffeine and the extended waiting time required for drugs to reach peak plasma levels—and that these factors interacted with the affects of the drugs on rivalry switch rate. Individual differences in reactions to the drugs may also play a role.

E127

GRASPING WITHOUT VISION: HAND PREFERENCE IN SIGHTED AND CONGENITALLY BLIND INDIVIDUALS

Kayla Stone[1], Claudia Gonzalez[1]; [1]University of Lethbridge — Studies have shown that hand preference for grasping is modulated by different factors such as object size and location. For example, people prefer to use their right hands when grasping small as opposed to large objects. A factor that has not been investigated with respect to hand preference for grasping is vision. To what extent does vision modulate this preference? We explored this question in two experiments. In experiment One, sighted individuals were tested in a reaching-to-grasp task with and without vision (i.e. blindfolded). In experiment Two we tested congenitally blind subjects. In both experiments participants were asked to put together 3D models using building blocks. The models were simple, composed of 7-10 blocks of 3 different shapes. A total of 60 blocks were scattered on a tabletop at the beginning of the sighted trials and 30 blocks at the beginning of the blindfolded trials. Starting condition (blindfolded or sighted) was counterbalanced between participants. Results from experiment One showed that right hand preference for grasping decreases when vision is removed but only if participants had started the task using vision. If participants first performed the portion of the task blindfolded and then completed the task with vision, no change in hand use between the two conditions (i.e. sighted and blindfolded) was found. This suggests that a brief haptic experience can modulate hand preference. This suggestion is further supported by the results from experiment Two. Hand preference of the congenitally blind resembled that of the group with the brief haptic experience.

E128

CREATING A SYNAESTHETIC BRAIN? LEARNING SPATIAL ASSOCIATIONS FOR NOVEL SYMBOLS USING BRAIN STIMULATION

Jacqueline Thompson[1], Arwel Pritchard[1], Roi Cohen Kadosh[1]; [1]University of Oxford, UK — Number-space synaesthesia (NSS) is a cognitive phenomenon in which individuals conceive of numbers as occupying specific locations in an explicit mental visuospatial layout. Little, however, is known about how these "number forms" arise and develop, although trends observed across synaesthetes suggest strong influences of cultural learning (e.g. reading direction). To investigate how spatial information during learning may influence spatial-numerical associations, we emulated early number learning by teaching adults sets of novel symbols representing relative magnitudes. We used transcranial random noise stimulation (TRNS), a non-invasive electrical stimulation that has been shown to enhance perceptual learning. NSS synaesthetes and controls received either sham TRNS, parietal TRNS or occipital TRNS, while they undertook a symbol-learning paradigm with stimuli arranged to reflect a number-space association bias. Parietal controls — but not synaesthetes — showed a strong left-to-right spatial orientation bias for symbol pairs in the learning task, as well as marked improvement across 5 days in a spatial "number-line" symbol-mapping task, which reflects an association between numbers and space. Meanwhile, across both synaesthetes and controls, parietal TRNS completely attenuated the typical spatial-numerical association of response codes (SNARC) effect seen in the sham — and to a lesser degree, the occipital — TRNS groups. We conclude that bilateral parietal TRNS improves spatial-numerical learning in both synaesthetes and controls, but for synaesthetes this is only evident in tasks that evoke spatial associations implicitly, rather than explicitly. We suggest this is due to competition from explicit spatial representations created by NSS synaesthetes but not controls.

E129

EATING TOOLS IN HAND ACTIVATE THE BRAIN SYSTEMS FOR EATING ACTION: A TRANSCRANIAL MAGNETIC STIMULATION STUDY

Kaori Yamaguchi[1], Kimihiro Nakamura[2], Tatsuhide Oga[3], Yasoichi Nakajima[1]; [1]Research Institute of National Rehabilitation Center for Persons with Disabilities, [2]Kyoto University Graduate School of Medicine Human Brain Research Center, [3]Toranomon Hospital Kajigaya — There is increasing neuroimaging evidence suggesting that visually presented objects and tools (e.g. letters, pen, scissors) can automatically drive the human visuomotor system encoding the learned motor actions relevant to the visual stimuli. According to this framework, while little is known about the neural mechanism involved in eating action in humans, we predicted that somatosensory signals produced by eating tools in hand can covertly activate the neuromuscular systems involved in eating action. In Experiment 1, using transcranial magnetic stimulation (TMS) with an oddball paradigm, we measured motor evoked response (MEP) of the masseter muscle in normal humans to examine the possible impact of tools in hand (chopsticks and scissors) on the neuromuscular systems during the observation of food and non-food stimuli. We found that food stimuli overall increased MEPs more greatly than non-food stimuli, whereas this category-specific modulation of MEP was greater when participants held chopsticks than when they held scissors in their dominant hand. In Experiments 2&3, we further observed that eating tools (chopsticks) enhanced the masseter MEPs more greatly than other tools (scissors) during the visual recognition of food, whereas this covert change in the neuro-masticatory system was not detectable at the behavioral level. A joint analysis of the three experiments further confirmed a robust impact of eating tools on the masseter MEPs during food recognition. Taken together, we conclude that eating tools in hand exert a category-specific impact on the neuromuscular system for eating.

E130

ENHANCED WHITE MATTER CONNECTIVITY IN COLORED-MUSIC SYNESTHESIA

Anna Zamm[1], Gottfried Schlaug[1], Psyche Loui[1]; [1]Department of Neurology, Beth Israel Deaconess Medical Center and Harvard Medical School — Synesthesia, a condition in which stimuli in one sensory modality consistently and automatically trigger concurrent percepts in another modality, provides a window into the neural correlates of crossmodal associations. While research on grapheme-color synesthesia has provided evidence for both hyperconnectivity and disinhibited feedback as possible underlying mechanisms, less research has explored the neuroanatomical basis of other forms of synesthesia. Here we investigated the neuroanatomical substrates of colored-music synesthesia, with the goal of identifying white matter connectivity differences associated with enhanced audiovisual association. We hypothesized that colored-music synesthetes might show unique patterns of white matter connectivity in pathways connecting areas involved in auditory and visual association. The Inferior Fronto-Occipital Fasciculus (IFOF) connects auditory and visual association areas to frontal regions, and thus serves as a good candidate for exploring possible differences in white matter connectivity between sensory areas in coloured-music synesthetes. We used diffusion tensor imaging (DTI) to trace the IFOF in synesthetes (n=10) and matched controls (n=10). Behavioral results with the synaesthesia battery (Eagleman et al, 2007) confirmed behavioural consistency of sound-color associations among the synesthetes. DTI results showed enhanced white matter integrity in the right IFOF in synesthetes relative to controls. Furthermore, white matter integrity in the right IFOF was significantly correlated with scores on audiovisual subtests of the synaesthesia battery, notably within white matter underlying the fusiform gyrus ($p < 0.05$ FWE). Our findings provide the first evidence of a white matter substrate of colored-music synesthesia, and suggest that enhanced white matter connectivity subserves enhanced cross-modal associations.

E131

HOW WE OPTIMIZE EFFORT ALLOCATION: BEHAVIORAL EVIDENCE FOR AN ACCUMULATION MODEL WITH DISSOCIABLE IMPLICIT AND EXPLICIT COSTS Florent Meyniel[1,2,3,4,5], Lou Safra[1,2,3,4,5], Mathias Pessiglione[1,2,3,4,5]; [1]Motivation Brain & Behavior team, [2]Brain & Spine Institute, [3]University Paris 6, [4]Inserm UMR_S975, [5]CNRS UMR 7225 — A pervasive problem for living creatures is effort allocation, i.e. finding a tradeoff that maximizes benefits while preserving exhaustion. Because task-related costs are difficult to predict, this tradeoff has to be dynamically adjusted online. We suggested an accumulation model where decisions to start and stop effort exertion are triggered by a cost evidence signal reaching lower and upper bounds. In a first set of three experiments (n=45), we tested the main predictions of our model. Participants produced an imposed force on a handgrip, for a payoff proportional to their effort duration. The period preceding behavioral observation was systematically manipulated by imposing various efforts and rests. We observed that effort exertion linearly shortened with preceding effort duration, and prolonged with preceding rest duration, up to a maximum corresponding to full recovery. When subjects were allowed to rest before effort exertion, they waited for a time that was linearly dependent on the preceding effort duration. In a second set of three experiments (n=67), we addressed the question of whether the tradeoff would be different when cost is explicit (visually cued), as opposed to when it remains implicit (only experienced through force production). During each trial, participants freely alternated effort and rest, with the aim of maximizing payoff. We found the following dissociation: implicit cost specifically affects effort duration, whereas explicit cost specifically affects rest duration. These effects could be captured by our cost evidence model, with accumulation slope increasing with implicit cost and dissipation slope decreasing with explicit cost.

E132

INDIVIDUAL DIFFERENCES IN THE FEEDBACK-RELATED NEGATIVITY ARE ASSOCIATED WITH ALTRUISTIC BEHAVIOR Pablo Morales[1], Ulrich Mayr[1]; [1]University of Oregon — Economists have favored models of rational choice and utility maximization to help explain human choice behavior. Several challenges include reconciling rational choice models with altruistic behaviors, as well as obtaining non-choice measures of utility. Previous neuroimaging research has demonstrated a relationship between activity in areas associated with reward processing and subsequent altruistic behavior (Harbaugh, Mayr, & Burghart, 2007). The goal of the current work was to determine to what degree an event-related potential measure related to the processing of negative feedback, the feedback-related negativity (FRN), can be elicited in an altruistic context, and can be used to predict actual altruistic behavior. Subjects performed a version of a gambling task (Gehring & Willoughby, 2002) where they experienced monetary gains and losses for both themselves, and also for a charity. This was then followed by an independent assessment of real-stakes charitable donations. A significant FRN was found in response to self-losses, as well as charity-losses. Overall, FRN amplitudes were significantly larger for self-losses than charity-losses. Furthermore, individuals with larger amplitudes in response to charity-losses than to losses to themselves were more likely to subsequently engage in altruistic behavior. These results suggest that with the FRN we can measure a decision-relevant parameter that either directly or indirectly affects altruistic choices.

E133

CHOOSING UNKNOWN GOODS: FMRI STUDY OF PRODUCT CHOICE Ikuya Nomura[1], Kazuyuki Samejima[2], Kazuhiro Ueda[1,4], Yuichi Washida[3], Hiroyuki Okada[2], Takashi Omori[2]; [1]The University of Tokyo, [2]Tamagawa University, [3]Hitotubashi University, [4]CREST — Choice between known goods and unknown goods is repeated in everyday life as new products go on the market one after another. Although such choice is one of the key factors of consumer behavior, very few experimental studies that reveal the underlying mechanism of the choice have been carried out thereon. In the present study, repetitive choices among known goods and unknown goods are performed by utilizing 48 bottles of mineral water as stimuli and cognitive mechanisms related to the choice are examined. Further, brain activity during product choice was measured with fMRI. As a result, participants who tend to seek for information have a stronger tendency to choose unknown goods and their right frontal pole was activated when unknown goods were chosen. Here, the right frontal pole is known to be activated during exploratory decisions and such activation is further confirmed in the present study with another task. Additionally, functional connectivity between the right frontal pole and inferior frontal gyrus was observed. These results indicate that choosing unknown goods is primary for the purpose of gaining information but also includes a cognitive process of a risk taking decision.

E134

BOOSTING YOUR 'NO'S': THE NEURAL ORIGIN OF SELF-REGULATION IMPROVEMENT Karolien Notebaert[1,2], Sabrina Bruyneel[1], Kinnunen Suna[2], Hahn Tim[2], Anderl Christine[2], Windmann Sabine[2], Dewitte Siegfried[1]; [1]KU Leuven, Belgium, [2]Johann Wolfgang Goethe-Universität, Frankfurt am Main, Germany — Effective self-regulation is crucial to avoid the detrimental effects that can be associated with impulsive choice behavior. Although recent studies have revealed the neural processes underlying a single self-regulation decision, it remains unclear which neural mechanisms are driving the improvement of self-regulation. Here, we shed light on this issue by using functional brain imaging to examine the neural activity in restrained eaters making real decisions regarding snacks to eat. We found that a behavioral improvement of self-regulatory food choices was associated with (i) an increase of activation in the prefrontal cortex, a region previously associated with top-down control processes (ii) a decrease of activation in regions associated with bottom-up impulses, including the ventral striatum and amygdala. In line with this, these neural processes were associated with a simultaneous decrease of experienced response-conflict, as reflected by a decrease of activation in the anterior cingulate cortex throughout the improvement of food choices. These findings provide insight into the neural mechanisms that enable an improvement of self-regulation in repeated decisions, and therefore contribute to our understanding of effective strategies to down-regulate cravings associated with pathologies, such as substance abuse and impulse control disorders.

E135

THE VALUE OF UNCERTAINTY: A REINFORCEMENT LEARNING MODEL OF INCREASED RISK SEEKING DURING GAMBLING WITH NEAR-MISS OUTCOMES Scott Oberg[1], Aaron Gruber[1], Matthew Tata[1]; [1]University of Lethbridge — Electronic gambling machines (EGMs) such as video slot-machines present players with complex contingencies and feedback about their success that may affect decisions. For example, these games often present artificially high rates of "near miss" outcomes. Such manipulations may distort a player's ability to judge risks and rewards. We tested whether near misses affect decision making in a simple two-armed bandit contingent-learning problem. Two bet choices were offered to players on each trial. Players learned to choose the bet with positive rather than negative long-run expected values. Feedback after each bet consisted of three colored squares, which appeared in sequence and indicated either a win (all squares the same), a near miss (first two squares the same), or a full loss (all squares different). We manipulated the rate at which players encountered near misses after advantageous or disadvantageous bets. Players learned more slowly when near-misses were artificially high, regardless of which bet type was manipulated. Several standard reinforcement-learning models failed to predict this distortion in learning rate. We describe a model that better predicts this effect by incorporating uncertainty bonuses. Theoretical considerations indicate that gaining knowledge (reducing uncertainty) has value. If uncertainty is high, outcomes have greater salience for predicting future outcomes then when uncertainty is low. EGMs that incorporate a high occurrence of near misses may be manipulating the normal role of uncertainty by increasing the perception that inherently uninformative feedback is predictive of future reward.

E136

ACUTE STRESS EFFECTS ON MODEL-BASED VERSUS MODEL-FREE REINFORCEMENT LEARNING Ross Otto[1], Candace Raio[1], Elizabeth Phelps[1], Nathaniel Daw[1]; [1]New York University — Contemporary accounts of decision-making posit the operation of separate, competing valuation systems in the control of choice behavior. In particular, model-free reinforcement learning (RL), which learns action preferences in a manner in accord with the "law of effect", is contrasted with the more flexible mod-

el-based RL, which explicitly represents the structure of the environment in order to prospectively evaluate actions. Popular neurocomputational accounts of reward processing emphasize the involvement of the dopaminergic system in model-free choice and putatively prefrontal, executive control systems in model-based choice. Here we hypothesized that the hypothalamic-pituitary-adrenal (HPA) axis stress response—believed to have detrimental effects on prefrontal function—should modulate model-based contributions to choice behavior. Based on previous work detailing how acute stress promotes habitual choice behavior at the expense of goal-directed performance and moreover, impairs working memory capacity, we examined if an acute stressor modulates the usage of model-based RL strategies in a sequential decision-making task that affords disentanglement of the two choice strategies. The cold pressor task was used in half of the subjects to induce a neurophysiological stress response, and following a short delay, participants completed 200 trials of the sequential choice task. Further, baseline Operation Span as well as pre-and post-stressor salivary cortisol levels were taken as measures of working memory capacity and HPA axis reactivity to stress, respectively. We find suggestive evidence that acute stress attenuates the contribution of model-based strategy to behavior, enriching existing accounts of the interplay between acute stress and prefrontal function.

E137

CORRELATION AND CAUSATION: A SYSTEMS APPROACH TO UNDERSTANDING DECISION-MAKING AT THE SINGLE-NEURONAL LEVEL IN THE HUMAN BRAIN

Shaun Patel[1,2], Sameer Sheth[1], Matt Mian[1], Sarah Bourne[3], Alice Flaherty[1], Emad Eskandar[1]; [1]Massachusetts General Hospital, [2]Boston University School of Medicine, [3]Vanderbilt School of Medicine — Single neuronal computations underlying financial decision-making remain unclear. We explored single neuronal activity from the nucleus accumbens (NAc) and subthalamic nucleus (STN) in patients undergoing deep brain stimulation while actively engaged in a financial decision-making task. In a subgroup of the subjects, we explored the effects of intermittent electrical stimulation of the STN on financial decision-making. Subjects are presented with a computerized gambling task modeled as a simplified version of the card game "war". We recorded 25 NAc and 20 STN from 13 patients undergoing deep brain stimulation for neuropsychiatric or movement disorders. We found single neuronal evidence of a behavioral and prediction error signal in the NAc and STN. The behavioral signal predicted–during a discrete 500 ms interval–their upcoming financial decision well before they physically manifested their choice. The prediction error signal–the difference between expectation and outcome– occurred during a discrete 500 ms interval immediately after receiving feedback on the outcome of the current trial. Furthermore, in a subgroup of subjects, we were able to shift their behavior towards risk-seeking by applying 1 s of electrical stimulation in the STN before the trial began; we found no changes when stimulation was delivered at any other task epoch. In conclusion, these findings demonstrate the ubiquitous nature of two reinforcement learning signals during financial-decision making. In addition, we demonstrate a causal relationship by applying intermittent electrical stimulation to bias the decision signal and ultimately alter financial behavior.

Poster Session F

F1

ORIENTING ATTENTION IN PREPARATION TO ENCODING IN VISUAL SHORT-TERM MEMORY AND DURING VISUAL SHORT-TERM MEMORY MAINTENANCE IS ACHIEVED THROUGH DIFFERENT TEMPORAL DYNAMICS OVER DEVELOPMENT

Andria Shimi[1,2], Duncan Astle[1], Anna C Nobre[2], Gaia Scerif[2]; [1]MRC Cognition and Brain Sciences Unit, Cambridge, [2]University of Oxford — In this study, we used event-related potentials to examine developmental changes in the neural mechanisms through which participants orient attention towards perceptually present items or items maintained in visual short-term memory (VSTM). Adults and 10-year-olds saw an array of four differently-colored items followed by a probe item and indicated whether the probe matched one of the four items in color. In pre-cue trials, a cue was presented before the array and guided participants' attention to one of the upcoming items. In retro-cue trials, an informative spatial cue followed the array and guided participants' attention to one of the already encoded items in memory. In neutral trials, uninformative cues were shown before and after the array. Analyses compared accuracy and latency for responding as well as brain activation in pre-cue, retro-cue and neutral trials to determine commonalities and differences in the deployment of attentional processes across the different orienting conditions. Results showed that adults elicited a set of conventional lateralized neural markers (EDAN and ADAN), previously studied in service of perception, which were largely common to prospective and retrospective orienting. Children deployed orienting less efficiently than adults and more so prospectively than retrospectively, thereby revealing a neural dissociation between attentional shifts prior to encoding and during maintenance. Results demonstrate that understanding the neural changes of these mechanisms over development can inform the adult end-state.

F2

VISUAL MISMATCH NEGATIVITY AND EARLY EVOKED POTENTIALS IN MILD COGNITIVE IMPAIRMENT AND ALZHEIMER'S DISEASE

George Stothart[1], Andrea Tales[1], Nina Kazanina[1]; [1]University of Bristol — Visual mismatch negativity (vMMN), a neurophysiological tool allowing the examination of early visual and attentional processing, has been shown to be maintained in healthy ageing (Stothart et al., 2012, Neurobiology of Aging), providing a baseline against which to compare the equivalent processes in pathologically ageing populations. Using 64 channel EEG, we examined the early visual processing of healthy older adults (n=26, mean age=77 yrs), patients with Mild Cognitive Impairment (MCI) (n=26, mean age=77 yrs, mean Mini-Mental State Exam=26) and patients with Alzheimer's disease (AD) (n=18, mean age=80 yrs, mean Mini-Mental State Exam=23) in a vMMN paradigm. All groups displayed a double peaked visual P1 response prior to the vMMN epoch. vMMN was observed in AD patients and was of an equivalent duration (c95ms) and amplitude (0.9μV) to the healthy older adults, suggesting that early sensory processing and visual change detection are maintained in AD. However it was noticeably absent in MCI patients at a group level. Further investigation of the vMMN and preceding visual evoked potentials showed a high degree of absolute variability and group heterogeneity in the evoked potentials of the MCI group compared to both healthy ageing and AD. Using visual evoked potentials to measure early sensory and attentional processing may provide the tools needed to investigate the clinical heterogeneity of MCI patients and their subsequent prognoses.

F3

DISTRACTION IMPAIRS VISUAL ORIENTATION DISCRIMINATION AND CATEGORIZATION ABILITIES IN OLDER ADULTS

Peter Wais[1], Joyce Clanon[1], Daniel Steiner[1], Adam Gazzaley[1]; [1]University of California, San Francisco — The influence of distraction on visual attention negatively impacts memory. It is not known if the influence of irrelevant information impacts visual perception involved in orientation discrimination and categorization abilities. Our study examined the effects of distraction on tests of orientation discrimination and categorization abilities between groups of younger and older adults. Because older adults are more susceptible to visual distraction than younger adults (Gazzaley et al., 2005), we hypothesized that age-related distractibility might have a negative effect on different types of visual perceptual abilities. We used an adaptive staircase method to threshold participants' perceptual abilities in two experiments that differed in demands for top-down control of visual attention to goal-relevant stimuli. Both of the experiments included conditions with and without visual distractors. Results from Experiment 1, an orientation discrimination task with conditions using exogenous or endogenous cues to attend to rotated probes, showed an interaction of cue-type, age and distraction. For endogenous cues, discrimination in the plain condition did not differ between groups, but was impaired in the distractor condition for older adults. Results from Experiment 2, a categorization task that used morphed prototype stimuli, showed an interaction of age and distraction. Older adults, but not younger adults, showed a negative impact of visual distraction on categorization. These results suggest a direct relationship between increased susceptibility to visual distraction in normal aging and impairment in perceptual abilities involved in both orientation discrimination and categorization.

F4

TO BECOME OLDER IS FATIGUING: ON THE INTERACTION BETWEEN HEALTHY AGEING AND MENTAL FATIGUE

Edmund Wascher[1]; [1]IfADo - Leibniz Research Centre for Working Environment and Human Factors — With increasing age, functions of the frontal lobe, so-called executive functions decline as a consequence of structural changes. Prolonged cognitive effort is assumed to exhaust the very same structures temporarily. The present study investigates the interaction of ageing and mental fatigue. We measured inhibition of Return (IOR) in 12 young (18-27) and 12 older (55-65) adults. EEG was recorded from 64 electrodes. Each subject performed 4 blocks of 25 minutes each. Across all blocks, IOR raised later in older adults. In younger adults no effects of mental fatigue were observed. In older adults, however, the initial deficit increased further and led to a substantial reduction and delay of IOR at the end of the experiment. The difference in information processing started already with the handling of the cue. A missing frontal N2 and an increased P3 in older adults can be assigned to reduced control over irrelevant information. Consequently, older adults show prolonged durations of the N1, a delayed slow positive component ispilateral to the cue, and a missing Pd, all indices of impaired inhibition of this irrelevant stimulus. Adjustment of attentional effort with increasing time on task was missing in older adults. The pattern of data indicate that older adults may not only fail control irrelevant information but also fail to evolve automatisms in signal processing when performing for extended time periods. More effort that has to be paid to perform adequately may lead to accelerated exhaustion.

F5

EFFECTS OF AGE AND EXTERNAL NOISE ON SELF-REGULATION OF INTERNAL DISTRACTIONS

David A. Ziegler[1], Adam Gazzaley[1]; [1]UCSF — Interference in goal-directed behavior can arise from distractions in the external environment, as well as from the internal milieu (e.g., intrusive thoughts). The objectives of this study were to test whether internal distractibility is affected the presence of external distractions and by aging. Healthy younger (YA) and older adults (OA) performed an externally-oriented visual target detection task and an internally-oriented mental rotation task. Each task was performed both with and without auditory noise delivered through headphones. After each trial, participants reported if they were distracted by internal thoughts or by some external factor. Total distraction was similar between YA and OA in no-noise conditions, but OA reported more total distractions in the presence of auditory noise ($p = .058$). Both groups showed a significant interaction ($p < .05$) between auditory noise and the type of distraction reported (internal or external), but the pattern of the effect differed between groups. For both groups, internal distractions were more frequent than external distractions in the no-noise conditions. In YA, auditory noise led to an increase in external distractions and a decrease in internal distractions (paired t-tests, $p < .05$), whereas OA

showed an increase in external distractions under the noise conditions ($p < .05$), but without an accompanying decrease in internal distractions. These results suggest that internal and external distractions interact dynamically, with YA exhibiting a trade-off between internal and external distraction. In contrast, OA appear less able to regulate their levels of internal distraction, leading to higher overall distractibility under noisy conditions.

F6

ATTENTIONAL STATE TRAINING IMPROVES EXECUTIVE FUNCTION IN HEALTHY AGING SENIORS Ativ Zomet[1,4], Thomas Van Vleet[1,2], Christina Marini[1], Alana Vernon[1,2], Sawsan Dabit[1], Jose Gallegos[1], Michael Merzenich[1,3]; [1]Brain Plasticity Institute, [2]VA Medical Center, Martinez, [3]University of California, San Francisco, [4]Tel-Aviv University, Israel — A number of recent studies suggest that cognitive training focused on the promotion of a more optimal state of attention can improve higher-order functions such as working memory and executive control. One method (Tonic and Phasic Alertness Training, TAPAT) that targets executive control functions, such as inhibition and sustained attention, has been shown to produce benefits in attention, working memory and executive function in patients with acquired brain injury. Given the decline in these cognitive operations in healthy aging, in the current study we examined whether TAPAT training could also benefit this population. Twenty one healthy aging participants were assessed on standardized and experimental neuropsychological measures of attention, working memory and executive function before completing either 5 hours of TAPAT training or a closely matched active control training condition (9 sessions, ~ 33 min/session). Post-training, changes in performance on the outcome measures revealed significant improvement in attention, working memory and executive function in the TAPAT group vs. the active control training group. The results suggest that training to achieve a more optimal state of attention may benefit higher-order cognitive operations in healthy aging.

F7

EFFECTS OF ALERTNESS AND TEMPORAL PREPARATION ON INHIBITION OF RETURN Dana Hayward[1], Jelena Ristic[1]; [1]McGill University — Recent studies suggest that Inhibition of Return (IOR), a hallmark index of reflexive orienting, might be modulated by top-down changes in voluntary temporal preparation to respond to the target. However, these findings remain difficult to interpret because voluntary temporal preparation was manipulated differently across studies. Specifically, some researchers manipulated voluntary temporal preparation by decreasing the percentage of no target trials, thus also affecting overall tonic alertness (e.g., Tipper & Kingstone, 2005). Others manipulated voluntary temporal preparation by changing the frequency of target occurrence at each cue-target interval (e.g., Gabay & Henik, 2008). We measured the individual and combined effects of alertness and voluntary temporal preparation on the magnitude of IOR elicited by a spatially nonpredictive peripheral cue using a typical cuing task. High tonic alertness was achieved by presenting the target on 94% of trials and low tonic alertness was achieved by presenting the target on 75% of trials. High temporal preparation was achieved by increasing the frequency of target occurrence with the lengthening of cue-target intervals and low temporal preparation was achieved by keeping the frequency of target occurrence constant across all cue-target intervals. Our data indicated that the manipulations of alertness and voluntary temporal preparation produced the expected effects on reaction times. However, the magnitude of IOR remained unchanged across all conditions, suggesting that IOR is a fundamentally reflexive effect.

F8

REWARD GUIDES ATTENTION TO OBJECT CATEGORIES IN REAL-WORLD SCENES Clayton Hickey[1], Marius Peelen[2]; [1]VU University Amsterdam, The Netherlands, [2]University of Trento, Italy — Reward is thought to motivate approach behaviour in part by automatically facilitating the processing of reward-associated visual stimuli. Existing studies of human vision have demonstrated this effect at the level of visual features, showing that objects characterized by reward-associated features become salient and attention-drawing. However, exemplars taken from real-world categories, like 'cars', rarely share more than a few basic features, and the features that characterize individual members are often shared with non-target items. Search for this type of target will benefit little from feature-priming. Here we test the idea that reward primes this kind of visually-heterogeneous, real-world category of natural stimuli. Participants detected the presence of object categories - cars, trees, or people - in briefly presented photographs of natural scenes. Each trial began with a cue indicating target category and each correct response randomly resulted in reward or no-reward. We examined search efficiency as a function of a.) whether a distractor in the display was a member of the target category from the immediately preceding trial, and b.) whether that preceding trial had garnered reward. Behavioural results show that search was disrupted by a reward-associated distractor and that the magnitude of this effect could be predicted from a questionnaire index of trait reward sensitivity. Preliminary fMRI results suggest an increased response in object-selective cortex to previously rewarded distractors. Reward thus appears to potentiate processing of reward-associated categories during visual search through cluttered natural scenes.

F9

EFFCTS OF ACUTE PSYCHOSOCIAL STRESS ON MUTIPLE OBJECT TRACKING Atsuko Iwasaki[1], Cary Feria[1], Cheryl Chancellor-Freeland[1]; [1]San José State University — Multiple object tracking (MOT) is an experimental technique to assess aspects of attention, and requires attentional control, which involves acts of the prefrontal cortex. Cognitive functions related to this brain area are considered to be vulnerable to the stress hormone, cortisol, and these effects may be either beneficial or detrimental depending on the level of cortisol reactivity, task difficulty, and type of a stressor. We assume that when individuals undergo relatively difficult MOT tasks before and following socially-induced stress, an improvement in performance due to the practice effect should vary across cortisol reactivity. Thus, we hypothesized that among three types of cortisol reactivity (low, middle, high), the high-cortisol responders would show the least improvement in MOT performance within the stressed group. Participants in this study were 76 undergraduate students from a culturally diverse university, 49 of whom underwent the two blocks of MOT trials before and following exposure to a psychosocial stressor, whereas 27 control participants viewed a neutral stimulus between the two MOT blocks. Cortisol reactivity was determined by four saliva samples. The results revealed that under stress, low- and high-cortisol responder groups showed a significantly smaller improvement relative to the control and middle-cortisol responder groups that showed an expected change with practice. This suggests that acute psychosocial stress modified cortisol levels, and may have impacted attentional control on MOT. An implication of this work is that high levels of social stress (e.g., a job interview) may affect everyday multiple object tracking tasks, such as that seen while driving.

F10

UNFILLED LINE OBJECTS ARE UNIQUE REGARDING THE MANNER OF SPATIAL SELECTION Tetsuko Kasai[1], Ryuji Takeya[1], Sho Tanaka[3]; [1]Hokkaido Universty — In previous studies, we have found that spatial attention reflected by the visual N1 component of event-related potential (ERP) spreads over perceptually grouped elements or an "object". Furthermore, some later ERP attention effects can also vary with perceptual grouping, while functional significance of them is unclear. The present study examined whether the N1 and later spatial attention effects are modulated by unfilled line objects, which have boundary and shape information but lack surface information. ERPs were recorded from 14 participants during a focal attention task with bilateral line squares that had a gap at the upper or lower part and were connected or unconnected by a line. The task was to detect squares without the gap (easy condition) or with a narrower gap (hard condition) in an attended visual field. ERP attention effects were observed as amplitude enhancement at occipital temporal electrodes contralateral rather than ipsilateral to attended fields. P1 attention effect (100-140 ms post-stimulus) increased in the hard condition, as previously reported. In contrast, N1 attention effect was absent and P2 attention effect (200-250 ms) was clearly observed but decreased for connected objects regardless of task difficulty. These results are in accordance with the view that the object-based N1 attention effect previously found reflects selection of filled highlighted objects, or a sensory enhancement mechanism of object-based attention. The present object-based P2 attention effect may specifically reflect selection of boundary information or higher object representations that are constructed from lines.

F11

NEURAL CORRELATES OF LOCAL VS. GLOBAL ATTENTIONAL SCOPE REVEALED VIA EEG PATTERN CLASSIFICATION Alexandra List[1], Monica Rosenberg[2], Aleksandra Sherman[1], Marcia Grabowecky[1], Satoru Suzuki[1], Michael Esterman[3]; [1]Northwestern University, [2]Yale University, [3]VA Boston Healthcare System — Pattern classification techniques have been widely used to differentiate neural activity of perceptual categories, especially using fMRI. Here, we instead endeavored to predict the scope of attention, local or global, from EEG data. A group of 15 participants were presented with hierarchical stimuli and were asked to indicate which of two target letters (H and S) were presented, irrespective of whether the target appeared at the local or global level. On each trial, the target letter appeared equiprobably at each level, paired with an irrelevant distracter (E or A) at the other level. EEG data were recorded from 64 channels at a sampling rate of 1024 Hz, and were subsequently high-pass filtered at 0.1 Hz. We applied linear support vector machine (SVM) classifiers with a cross-validation procedure at each timepoint (~1 ms). EEG data were reliably differentiated for local vs. global attention, emerging over posterior electrode sites during the 300-700 ms interval after stimulus onset. Whereas the classifiers reliably differentiated the scope of attention, a more traditional event-related potential (ERP) analysis of the same data did not. In sum, multivariate pattern analysis of EEG, which reveals unique spatiotemporal patterns of activity distinguishing between behavioral states on a trial-by-trial basis, is a highly sensitive tool for characterizing the neural correlates of attention.

F12

ERP EVIDENCE OF A GLOBAL INTERFERENCE EFFECT AT EARLY STAGES OF GLOBAL/LOCAL VISUAL PROCESSING Nicolas Poirel[1], Grégory Simon[2], Mathieu Cassotti[2], Arlette Pineau[2], Olivier Houdé[1], Virginie Beaucousin[3]; [1]LaPsyDÉ, Unité CNRS 3521, Université Paris Descartes, Université de Caen, PRES Sorbonne Paris Cité ; Institut universitaire de France (IUF), [2]LaPsyDÉ, Unité CNRS 3521, Université Paris Descartes, Université de Caen, PRES Sorbonne Paris Cité, [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). Behavioral studies evidenced that (1) the detection of global information is faster than the detection of local elements, a phenomenon called the global advantage, and that (2) global information interfere with the processing of local elements. These two effects constitute the so-called 'global precedence effect'. Although the global advantage appears to impact neural processing as early as the first 100 ms post-stimulus, previous studies failed to evidence a global interference effect before 200 ms. Using a rapid display of letter compound stimuli in a global/local task with no-conflict and conflict conditions, the present event-related potential study shows a global interference occurring as early as the time range of the N1 component. This finding completes and reinforces the recent neural models of human visual perception, which suggest that the global information conveyed by rapid magnocellular visual channels allows an initial perceptual analysis of visual inputs and then guides the subsequent analysis of local information conveyed by slow parvocellular visual channels through feedback signals into early visual areas. This fast global processing could be conveyed within the brain ventral pathway and would be able to guide – or interfere with – the subsequent more detailed and slower local processing of the visual scene. In regards to this model, the present study demonstrates for the first time that global information interfere at a very early stage (approximately 150 ms after stimulus presentation) with local information.

F13

NEGLECT DYSLEXIA: A MATTER OF "GOOD LOOKING" Silvia Primativo[1,2], Lisa Saskia Arduino[3,4], Maria De Luca[2], Roberta Daini[5], Marialuisa Martelli[1,2]; [1]University of Rome, La Sapienza, Rome, Italy, [2]Neuropsychology Unit, IRCCS Fondazione Santa Lucia, Rome, Italy, [3]LUMSA University, Rome, Italy, [4]ISTC-CNR, Rome, Italy, [5]Milano-Bicocca University, Milan, Italy — Neglect Dyslexia (ND) is an acquired reading disorder often associated with right-sided brain lesions and Unilateral Spatial Neglect (USN). In reading aloud single words patients with ND produce left-sided errors. The reported dissociations between USN and ND suggest that the latter can be interpreted as a selective reading deficit distinct from USN. We analyzed eye movements in USN patients with and without ND (respectively ND+ and ND-) and in a group of controls (right brain-damaged patients without USN), comparing a reading aloud task and a saccadic task (left-right saccade test). Only ND+ patients did left-sided errors, with a prevalence of omissions, and showed an impaired eye movement behavior both in the reading and in the saccadic tasks. While reading ND+ patients made more fixations than the other two groups, with only few falling accurately on the target. This result parallels the inaccurate fixations during the saccadic task shown by the same group of patients. A third experiment addressed whether left neglect and low fixation accuracy account for reading errors in ND. Using a speeded reading-at-threshold experiment, that didn't allow for eye movements, ND- patients, but not controls, did left-sided errors. We concluded that ND rather being a dissociated disorder is the result of the USN syndrome when the fine eye movements, as those required in reading, are compromised.

F14

THE FIRST BRANCH OF THE SUPERIOR LONGITUDINAL FASCICULUS MEDIATES VISUAL IMPROVEMENTS INDUCED BY RHYTHMIC TMS ON RIGHT PREFRONTAL AREAS Romain Quentin[1,2], Lorena Chanes[1,2], Antoni Valero-Cabre[1,2,3]; [1]Centre de Recherche de l'institut du Cerveau et de la moelle épinière, CR-ICM, CNRS UMR 7225, INSERM UMRS 975, [2]Université Pierre et Marie Curie, Paris, France, [3]Laboratory for cerebral Dynamics Plasticity & Rehabilitation, Boston University, School of Medicine, USA — Transcranial Magnetic Stimulation (TMS) has demonstrated the ability to induce local as well as connectivity-mediated effects on distant brain areas. Moreover, when used at specific frequencies in short bursts, this non-invasive technique can entrain local and distant oscillatory activity and modulate behavior. We hereby used low beta TMS bursts at 30 Hz on a key frontal site of the human visuo-attentional network, the right Frontal Eye Field (FEF) resulting in visual perception ameliorations. Subjects were asked to perform a visual discrimination and a conscious visual detection task involving near threshold Gabors. We specifically addressed the question on to what extent the TMS-modulated perceptual effects derived from such FEF intervention might be influenced by specific white matter pathway connecting the stimulated area with the rest of the attentional network. We used a recent method using spherical deconvolution to model the diffusion signal in each voxel and tracked the whole brain fibers with deterministic tractography. We report a statistically significant inverse correlation between the number of streamlines and the volume of the right and left Superior Longitudinal Fasciculus I (SLF I) and bilateral visual detection sensitivity improvements (d') induced by such frontal stimulation. Our data indicate that a lower SLF I number of streamlines or volume would make individual participants more prone to experience higher visual modulatory effects under frontal rhythmic TMS. It strongly suggests that the architecture of specific white matter pathway has the ability to influence the distributed effect of focally applied rythmic neurostimulation, resulting in different behavioral modulations.

F15

YOUR ATTENTION PLEASE: EFFECTS OF VALENCE ON EMOTION REGULATION WITH FULL- AND DIVIDED-ATTENTION John A. Morris[1], Christina M. Leclerc[2], Elizabeth A. Kensinger[1]; [1]Boston College, [2]State University of New York at Oswego — Numerous studies have investigated the neural substrates supporting cognitive reappraisal, identifying the importance of interactions between prefrontal and medial temporal lobe regions. It is unclear, however, how valence and attention interact to affect the processes used for cognitive reappraisal. The current study investigated this issue by asking participants to regulate their reactions to positive or negative images while undergoing fMRI. Participants viewed images from the International Affective Picture System database and were instructed to use cognitive reappraisal to increase or decrease their emotional response to the images or to view the images without attempts to regulate. For some participants, full attention was devoted to the regulation task. For other participants, an auditory discrimination task was performed concurrently with regulation. When asked to view negative and positive images, results revealed few effects of valence. However, when reappraisal was required, the results revealed a robust effect of valence that interacted with the attention condition. The reappraisal of negative images was associated with more widespread activation than the reappraisal of positive images (including cingulate, hippocampus, insula, and lateral and

medial prefrontal cortex), particularly in the divided attention condition. Contrast analyses revealed that divided attention did not disrupt the processes used to reappraise negative images, whereas the divided attention manipulation reduced activity in regions associated with the reappraisal of positive images. Critically, participants continued to report reappraisal success even during the divided attention condition. These results suggest multiple routes to cognitive reappraisal, depending upon image valence and the availability of attentional resources.

F16

MENTAL INTEGRATION OF EMOTIONAL AND NON-EMOTIONAL VERBAL PAIRS IS SUPPORTED BY DISSOCIABLE NEURAL REGIONS AT ENCODING AND RETRIEVAL

Brendan Murray[1,2], Elizabeth Kensinger[1,2]; [1]Boston College, [2]Center for Brain Science, Harvard University — Integration describes one way to encode discrete pieces of information as a single mental representation (e.g., imagining the verbal pair "surf + degree" as a degree conferred upon completion of a surfing course; Graf & Schacter, 1989; Murray & Kensinger, 2012). Recent neuroimaging investigation has shown that visual processing regions can support the encoding of non-emotional items as a single, integrated representation (Staresina & Davachi, 2010), suggesting that integration may occur before information reaches the medial temporal lobes. In the present study, participants underwent functional MRI while encoding verbal paired associates as single, integrated mental representations (e.g., the surfing degree) and also while performing an associative recognition test. For pairs that participants subsequently identified as "intact" on the recognition task, encoding activity in the cuneus and lingual gyrus increased parametrically with self-reported encoding vividness for emotional pairs while activity in right hippocampus and bilateral dorsolateral and dorsomedial prefrontal cortex increased parametrically with self-reported encoding vividness for non-emotional pairs. During recognition, correct identification of both intact and recombined non-emotional pairs was supported by activity in right parahippocampal gyrus, while correct identification of emotional pairs was supported by activity in right cuneus/precunes, bilateral auditory cortex, and left orbitofrontal cortex. These results suggest that dissociable regions support successful integration of emotional and non-emotional pairs and successful retrieval of those integrated representations. Integration and retrieval of non-emotional pairs is supported disproportionately by medial temporal lobe (i.e., hippocampus and parahippocampal gyrus), while integration and retrieval of emotional pairs is supported disproportionately by visual processing regions.

F17

THE ACTIVE AVOIDANCE OF THREAT ENHANCES NEURAL SENSITIVITY TO EXPECTANCY VIOLATION.

Vishnu Murty[1], Kevin LaBar[2], R. Alison Adcock[2]; [1]New York University, [2]Duke University — Threat avoidance can alter the way individuals interact with their environment. However, relatively little research has investigated how this motivational state changes neural sensitivity to salient events encountered in these environments. To investigate these processes, participants performed a motivated reaction-time task in which they tried to avoid shock punishments, or not, during the simultaneous collection of fMRI and skin conductance levels (SCL). On half of the trials, participants were presented with task-irrelevant, trial-unique expectancy violations: a neutral novel object in a stream of expected objects. Results indicated that the active avoidance of threats increased activations in the amygdala as well as the mesolimbic dopamine system including the nucleus accumbens, and VTA. Further, the active avoidance of threats enhanced neural sensitivity to expectancy violations in regions previously implicated in encoding environmental salience, such as the medial prefrontal cortex (mPFC), dorsal striatum, and parahippocampal cortex. The active avoidance of threat also increased individuals' SCLs. Trial-by-trial variation in dorsolateral prefrontal cortex activation and orbitofrontal cortex deactivation predicted variations in SCLs. Critically, this variation in SCL responses predicted neural sensitivity to expectancy violations on a trial-by-trial basis, such that greater SCLs were associated with greater expectancy violation processing in the mPFC, ventral visual stream, and parietal cortex; thus, SCL is a potentially useful biomarker for neural sensitivity to salient features of the environment. Together these findings demonstrate that the active avoidance of threats recruits neural resources to enhance processing of salient, unexpected features of the environment, even when those features are not inherently threatening.

F18

DON'T SAY IT: SELF-GENERATED EMOTION NAMING IMPEDES EMOTION REGULATION IN SHORT TIMEFRAMES

Erik Nook[1], Ajay Satpute[2], Kevin Ochsner[3]; [1]Stanford University, [2]Northeastern University, [3]Columbia University — Extant psychological research has not investigated the effect of categorizing an emotion by giving it a name on the subsequent regulation of that emotion. The present set of studies used behavioral and psychophysiological techniques to ascertain if emotion naming using self-generated labels is helpful or detrimental to emotion regulation. Participants viewed negative images and reported on their affective responses while heart rate and skin conductance were recorded. While viewing the images a second time, participants either "named" the emotion they felt by generating and verbally reporting an emotion label, regulated their response using a cognitive regulation strategy, both named and regulated their emotions or neither named nor regulated their emotions (passive viewing). In study 1, both self-report and psychophysiological results showed that participants who both named and regulated their emotions felt more negative and less positive than those who just regulated their emotions. This suggests that naming interfered with the regulation of their emotions. Additionally, participants who named their emotions did not report feeling less negative than those who merely saw the images a second time, suggesting that self-generated emotion naming provided no regulatory benefit. Study 2 replicated these results and extended them by finding that emotion naming reduced the effectiveness of both reinterpretation and acceptance regulation strategies. These findings suggest that emotion naming interferes with some emotion regulation strategies, implying that either emotion naming crystalizes emotional experiences (rendering them less amenable to modification) or that emotion naming drains cognitive resources that are otherwise used to carry out regulation.

F19

DID YOU HEAR THAT TOO? EMOTIONS MAKE BRAINS TICK TOGETHER DURING SPOKEN DISCOURSE PROCESSING

Lauri Nummenmaa[1,2,3,4], Heini Heikkilä[1], Athanasios Gotsopoulos[1], Enrico Glerean[1], Iiro P. Jääskeläinen[1], Riitta Hari[2], Mikko Sams[1]; [1]Department of Biomedical Engineering and Computational Science, School of Science, Aalto University, Finland, [2]Brain Research Unit, O.V. Lounasmaa Laboratory, School of Science, Aalto University, Finland, [3]Turku PET Centre, University of Turku, Finland, [4]Advanced Magnetic Imaging Centre, School of Science, Aalto University, Finland — Auditory communication and storytelling provide humans a powerful way for sharing their emotional experiences. Here we show that networks of brain areas "tick together" in participants who are listening to similar emotional events in spoken narratives. Participants' brain activity was measured with functional magnetic resonance imaging (fMRI) while they listened to 45-s spoken narratives describing, unpleasant, neutral, and pleasant events spoken in neutral voice. After scanning, participants listened to the narratives again and rated continuously their experience of pleasantness¬–unpleasantness (i.e. valence) and of arousal–calmness. Instantaneous inter-subject phase synchronization (ISPS) measures were computed to derive both multi-subject voxel-wise similarity measures of hemodynamic activity and inter-area functional connectivity (seed-based phase synchrony, SBPS). Valence and arousal time series were subsequently used to predict the moment-to-moment ISPS and SBPS. While listening to the discourses, participants' brain activity was synchronized mainly in the auditory cortices. However, high emotional arousal increased ISPS in the auditory cortices and in Broca's area, while low valence was associated with enhanced ISPS in thalamus, anterior cingulate and lateral prefrontal and orbitofrontal cortices. SBPS analysis also revealed that emotional valence and arousal modulated connectivity of large-scale brain networks during narrative processing. We propose that high arousal synchronizes different individuals' brain networks involved in auditory information processing and speech comprehension, whereas low valence synchronizes mechanisms supporting self-referential processing as well as regulatory responses. By enhancing the synchrony of brain activity across individuals, emotions may thus promote social interaction and facilitate interpersonal understanding.

F20

NEURAL CORRELATES OF ANXIOUS APPREHENSION AND INTERFERENCE DURING EMOTIONAL AND NON-EMOTIONAL STROOP TASKS

Aminda O'Hare[1], Laura Crocker[2], Wendy Heller[2], Stacie Warren[3], Jeffrey Spielberg[4], Gregory Miller[2,5]; [1]University of Massachusetts Dartmouth, [2]University of Illinois at Urbana-Champaign, [3]St. Louis VA Medical Center, [4]University of California Berkley, [5]University of Delaware — Identifying patterns of brain activity accompanying individual differences in affective traits such as stable anxiety can aid in understanding their cognitive implications. Anxious apprehension is a type of anxiety characterized by worry and verbal rumination. It has been associated with increased activity in left inferior frontal gyrus (LIFG), an area involved in the production and rehearsal of language, both during rest (Nitschke, et al, 1999) and when examining negative vs. neutral words in an emotion-word Stroop task (Engels, et al., 2007). Theoretically, non-emotional tasks that require cognitive effort should also be associated with increased worry and verbal rumination when anxious apprehension is high. The present study examined the relationship between anxious apprehension and both emotional and cognitive interference via functional magnetic resonance imaging (fMRI) during an emotion-word and a color-word Stroop task in a community sample characterized by substantial psychopathology (n = 99). Consistent with theory and previous findings, activity in LIFG increased for both emotional (negative vs. neutral) and cognitive (incongruent vs. congruent) interference as a function of anxious apprehension. In addition, increases in LIFG activation were associated with increases in behavioral interference, as measured by reaction time, in both tasks. These findings are consistent with the prediction that anxious apprehension is associated with increased risk for verbal rehearsal and disrupted performance during tasks that require effortful control, regardless of the nature of the distractors.

F21

IMAGING TRAUMATIC MEMORY: AN FMRI STUDY OF SURVIVORS OF THE AIR TRANSAT DISASTER

Daniela J. Palombo[1,2], Margaret C. McKinnon[3,4], Anthony R. McIntosh[1,2], Adam Anderson[2], Brian Levine[1,2]; [1]The Rotman Research Institute, [2]University of Toronto, [3]McMaster University, [4]St. Joseph's Healthcare Hamilton — While laboratory-based studies demonstrate enhancement of memory by negative emotion, relatively few studies have mapped the behavioral and neural changes associated with real-life trauma. Studies of exceptionally emotional or life-threatening events are particularly challenged by the inherent variability of such events across individuals. We investigated the neural correlates of traumatic memory in passengers from an August, 2001 airline flight that nearly ditched into the Atlantic Ocean, but was then safely landed on an island military base with no serious injury. Survivors were scanned, using fMRI, during recollection of three different events: the airline disaster (AT), the September 11th terrorist attacks (9/11), and a comparatively non-emotional event from the same time period. Passengers showed a robust flashbulb memory for the AT incident. Relative to non-emotional recollection, functional connectivity analyses of fMRI data indicated increased amygdala coupling with the insula, medial prefrontal cortex, lateral and medial temporal cortices, and posterior higher-order visual regions during 9/11 and AT recollection in passengers. This amygdala coupling was highest in individuals whose recollection of 9/11 and AT was most pronounced. Moreover, the PTSD symptom severity was positively correlated with the degree of this neural coupling in all three mnemonic conditions. These findings, which extend laboratory-based studies of emotional memory, suggest that functional alterations in cortical and subcortical areas, via amygdalar influences, underlie the expression of negatively valenced memory traces.

F22

VIOLENT TRAUMA HISTORY DETERMINES THE REACTION TO HUMAN ATTACK PICTURES

Mirtes Pereira[1], Orlando Fernandes Jr[1], Rita de Cassia S Alves[1], Liana C L Portugal[1], Isabel P A David[1], Izabela Mocaiber[1], Eliane Volchan[2], Leticia Oliveira[1]; [1]Federal Fluminense University, [2]Federal University of Rio de Janeiro — Exposure to unpleasant pictures has consistently evoked interference on behavioral tasks. Here we tested if trauma history might influence emotional modulation evoked by violence scenes. We employed a set of pictures of human attack and matched neutral pictures. Each trial (n=30) begun with a fixation cross for 1500 ms followed by a central picture and two peripheral bars (presented for 200 ms). Subjects were instructed to ignore the central images and to respond as fast as possible whether or not the orientation of the bars was the same while his reaction time (RT) was recorded. A questionnaire of life-threating events selected 59 students who experienced at least a traumatic event of violence. The number of types of "violent crime" was added up. We used mean-split to separate respondents in two groups: low trauma and high trauma. We calculated each subject´s median RT for correct threat and neutral trials. Then we created an emotional modulation score by subtracting the RT at neutral trials from those at threat trials. T tests revealed that emotional modulation score was significantly different between groups ($p=0.03$). One sample t test revealed that only the emotional modulation score of high violent trauma subjects (-32 ms) was significantly different from zero ($p<0.01$). Negative values observed in the high trauma group represent that subjects were faster for threat stimuli than for neutral. These results suggest that increasingly number of violent trauma might prompt overt motor preparation, compatible with more active defensive responses, thus reducing reaction time to threat pictures.

F23

PREFFERED INTERPERSONAL DISTANCE: A BEHAVIORAL AND EEG STUDY

Anat Perry[1], Orly Rubinstein[1], Leehe Peled[1], Simone Shamay-Tsoory[1]; [1]University of Haifa — Despite the vast knowledge, both behavioral and neural, of the mechanisms defining space around a singular body, little is known about the neural mechanisms that encode space between bodies. Yet, the space between people creates and defines the social dynamics of our interactions with others. Although different between cultures, within each culture interpersonal distance is implicit but clearly felt, especially if one stands nearer or further than expected. To assess the neural dynamic of interpersonal distance preferences we used a revised version of the Comfortable Interpersonal Distance paradigm, in which participants imagine either a friend or stranger approaching (visualized on a computer screen) and are asked to stop the figure when feeling uncomfortable. Behavioral findings in 100 students indicated that preferred interpersonal distance is correlated with both measures of empathy and of social anxiety. We then used the same paradigm to explore how interpersonal distance modulates EEG suppression in the mu/alpha range, and analyzing the ERPs elicited by the same stimuli, we investigated how early in the perception time-course these factors affect perception. Alpha / Mu suppression (8-12 Hz) was modulated by the type of figure approaching (friend or stranger). ERP differences between conditions were evident as early as 200 ms, as well as differences between socially-anxious verses non-anxious individuals. Individual differences affect how comfortable we feel when being approached by a friend or stranger. These differences are determined early in perception, and modulate early attentional processes.

F24

CUTTING LIKING AT ITS JOINTS: IN SEARCH OF DISSOCIATION BETWEEN SEVERAL TYPES OF OLFACTORY EXPERIENCES IN THE BRAIN

Aline Pichon[1,2], Géraldine Coppin[2,3], Sylvain Delplanque[2,3], Corrado Corradi-Dell'Acqua[1,2], Christian Margot[4], David Sander[2,3], Patrik Vuilleumier[1]; [1]Laboratory for Behavioral Neurology and Imaging of Cognition, University Medical Center, University of Geneva, [2]Swiss Center for Affective Sciences, University of Geneva, [3]Laboratory for the Study of Emotion Elicitation and Expression, Faculty of Psychology and Educational Sciences, University of Geneva, [4]Firmenich S.A. — Odor perception is a complex process merging sensory input with strong emotional components. In addition, odorant quality and structure coding are dissociated in the brain. Here we used fMRI to study how the emotional component of odors is represented neurally. Participants (n = 9, aged 19-37) were presented with 12 prototypical odors divided in 4 different profiles, covering major emotional dimensions as defined by the 6-level Geneva Odor Emotion Scale (GEOS). Odors were delivered with an MRI compatible olfactometer, and participants performed a simple detection task after each trial. They were asked at the end of each session to rate the pleasantness, familiarity, intensity of the odors, as well as the subjective feelings elicited by the olfactory stimulus along GEOS dimensions. Skin conductance, heart and respiratory rate were simultaneously recorded during each session. Our first fMRI results showed activations in major olfactory brain structures, including piriform and orbito frontal (OFC) cortices, amygdala, hippocampus, and parahippocampal cortex. Pleasant

smells elicited activations in the medial OFC, while unpleasant odors activated the OFC more laterally, together with insula, in keeping with past work. Finite Impulse Response analysis was also carried out, revealing how amygdalar activity occurred about about 3 sec after the odor delivery by valve aperture, whereas OFC activity was more delayed. Grouping odors by GEOS emotional profiles already enables some dissociation between several pleasant olfactory experiences. Further analyses based on correlations with self-reported measures on GEOS scale will be necessary for finer distinctions between emotional profiles elicited by odors.

F25

MODULATION OF COGNITIVE CONTROL BY TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS)

Christian Plewnia[1], Monika Zeiller[1], Bastian Zwissler[1], Larissa Wolkenstein[2]; [1]Department of Psychiatry and Psychotherapy, Neurophysiology and Interventional Neuropsychiatry, University of Tübingen, Germany, [2]Department of Clinical Psychology, University of Tübingen, Germany — Cognitive control (CC) is of decisive relevance for adaptive human behavior. Deficient CC is a central characteristic of major depressive disorder (MDD). Insufficient activation of the dorsolateral prefrontal cortex (dlPFC) has been linked with this deficit. The activity of distinctive brain areas can be transiently modulated by transcranial direct current stimulation (tDCS). To further explore the role of the dlPFC in physiological and disturbed CC we modulated dlPFC activity in healthy subjects and MDD patients by tDCS and tested its effects on CC as quantified by emotional distractibility in a delayed working memory task (DWM) and an attentional bias task (ABT). We found that activity enhancing anodal tDCS to the left dlPFC (1mA, 20 min, cathode at right upper arm) during DWM performance enhanced working memory in healthy subjects (n=22) and MDD patients (n=22). Most importantly, it ameliorated emotional distraction prevalent in patients with MDD. Reciprocally, inhibiting, cathodal tDCS to the left dlPFC (1mA, 20 min, anode at right upper arm) impairs CC on the influence of negative stimuli in healthy subjects (n=28) reflected by a decrease of correct responses in the DWM and an increase in reaction time in the following ABT. These findings demonstrate a tDCS-polarity specific plasticity of CC and thus verify the important role of left dlPFC activity for this key feature of human cognition and its disturbance in MDD. Therefore our data point towards new opportunities for the treatment of MDD by a specific combination of brain stimulation techniques and cognitive-behavioral treatment strategies.

F26

BEHAVIORAL ACTIVATION, INHIBITION, AND HYPOMANIC PERSONALITY MODERATE NEUROCOGNITIVE COMPONENTS DURING AN EMOTIONAL GO/NOGO TASK

Narun Pornpattananangkul[1], Xiaoqing Hu[1], Ellen Reynolds[2], Robin Nusslock[1]; [1]Northwestern University, [2]Columbia University — The present study examined the effect of stimuli valence on N2 and P3 event-related potentials (ERP) during an emotional Go/Nogo task. Furthermore, we examined the extent to which individual differences in Behavioral Inhibition, Behavioral Activation (BIS/BAS), and hypomanic personality moderated ERP components to emotional salient stimuli. Nogo stimuli were emotional (i.e., happy and fearful) faces, and Go stimuli were non-emotional faces. Fearful Nogo stimuli elicited higher P3 than happy Nogo stimuli ($F(1,34.07) = 5.67$, $p = .027$, partial $\eta 2 = .21$, G-G corrected); however, we did not find an effect of emotional valence on NoGo N2. Moreover, individual differences in BAS, BIS, and hypomanic personality moderated the Nogo N2 for each emotional valence. Participants who had a more negative Nogo N2 for fearful faces over happy faces had higher BAS ($r(20) = -.47$, $p = .028$) and Hypomania Personality Scale (HPS; $r(20) = -.51$, $p = .003$) scores, but lower BIS scores ($r(20) = .48$, $p = .024$). Taken together, these results indicate elevated BAS and hypomanic personality are associated with reduced response conflict to happy stimuli, whereas elevated BIS is associated with reduced response conflict to fearful stimuli. These results have implications for understanding emotional sensitivity and inhibitory deficits in mood and anxiety-related psychopathology.

F27

THE EFFECT OF FMRI-GUIDED CONTINUOUS THETA BURST STIMULATION (CTBS) ON THE SPONTANEOUS REGULATION OF EMOTION

Ignazio Puzzo[1], Birthe Henne[1], Yanbo Hu[1], Tom Johnstone[1]; [1]School of Psychology and Clinical Language Sciences University of Reading Earley Gate Whiteknights Road Reading RG6 6AL — The present study used fMRI-guided continuous theta burst stimulation (cTBS) to examine the causal role of the right and/or left lateral prefrontal cortex (PFC) in the down-regulation of emotional distraction during cognitive tasks. 16 healthy adult participants first completed an fMRI session with an instructed emotion regulation task. Lateral PFC cTBS targets were identified on the basis of each individual's activation. In two following sessions, each participant received 40s of cTBS to the left and right lateral PFC respectively (counterbalanced). Participants performed a blocked visuo-spatial working memory task containing a threat of shock in 50% of blocks. Participants were significantly slower during "risky" than "safe" blocks following cTBS to the right lateral PFC but there was no significant difference in reaction times between "risky" and "safe" blocks following cTBS to the left lateral PFC. Individuals' reaction time difference between "risky" and "safe" blocks under cTBS were then entered as covariates in a group level analysis of the same contrast (Risky>Safe) in the same WM task performed during fMRI. This accounted for between-subjects variance thus revealing a number of clusters including insula, left ventrolateral PFC, anterior cingulate and precuneus which were more activated during the risky than the safe trials. In summary, participants are slower at performing the visuo-spatial WM task during "risky" compared to "safe" blocks when they received cTBS over the right lateral PFC, and individual differences in RT during right PFC cTBS explain individual differences in fMRI activation during the same task.

F28

VENTRAL ANTERIOR CINGULATE CORTEX FACILITATES AFFECTIVE MNEMONIC INTERFERENCE RESOLUTION

Crystal Reeck[1], Kevin LaBar[1]; [1]Duke University — When memories compete for retrieval, executive control resolves interference by enhancing relevant and dampening irrelevant representations. These control processes impose lasting consequences, such that selected representations are more mnemonically accessible and competing representations are more readily forgotten. Theories of selective retrieval draw parallels to selective attention, positing that prefrontal mechanisms that detect and resolve interference from external stimuli are similarly recruited by mnemonic interference. The present investigation tested this proposition by examining whether neural mechanisms putatively related to affective control also underlie affective mnemonic interference resolution. Twenty-four participants completed a retrieval-induced forgetting paradigm while undergoing fMRI. Participants selectively retrieved items from memory while experiencing mnemonic interference from either neutral or negative associates. A final recall test revealed that both neutral and negative associates experienced similar levels of retrieval-induced forgetting, indicating that control enacted similar consequences regardless of the affective status of mnemonic competitors. Activation in left ventrolateral prefrontal cortex (VLPFC) and dorsal anterior cingulate cortex (ACC) decreased over multiple successful retrieval attempts, reflecting diminished mnemonic interference. Importantly, connectivity analyses indicated that VLPFC showed greater positive correlations with subgenual ACC when mnemonic interference was generated by affective representations. Rostral ACC also exhibited increased activation in individuals that demonstrated greater subsequent forgetting of affective competitors, further implicating this region in affective mnemonic interference resolution. These findings parallel previous research examining control processes driven by external affective distracters, demonstrating that executive control processes in memory, like those mobilized in response to external distracters, recruit distinct prefrontal regions when interference arises from affective sources.

F29

OXYTOCIN INCREASES ANXIETY TO UNPREDICTABLE THREAT

Marissa Krimsky[1], Danielle Charney[1], Katherine Vytal[1], Monique Ernst[1], Brian Cornwell[1], Christian Grillon[1]; [1]National Institute of Mental Health — The nonapeptide oxytocin, dubbed by the media as the 'moral' or 'love' molecule, has a variety of pro-social effects across species. A relatively simple explanation for these complex effects is that oxytocin alleviates anxiety, thereby indirectly promoting trust, cooperation and other affiliative behaviors. Indeed, oxytocin can reduce anxiety-like behavior in animals, via its neuromodulatory influence on the amygdala, a core hub mediating fear and anxiety. Surprisingly, oxytocin also promotes territoriality, aggression, and other defensive behaviors toward out-group members, complicating any straightforward interpretation of oxytocin's socio-emotional effects. We

investigated the effect of oxytocin and vaso pressin during anticipation of predictable and unpredictable shocks in 24 males and 19 females. Each subject was tested under placebo, oxytocin, and vaso pressin. Startle was used as a measure of fear and anxiety. Results showed that oxytocin did not reduce but rather increased startle potentiation during unpredictable threat in humans, suggesting that oxytocin enhances anxiety.

F30

STIMULUS-UNAWARE EMOTIONAL ACTIVATION COLORS FIRST IMPRESSIONS: A REGULATORY ROLE FOR CONSCIOUS ACCESS

Regina C Lapate[1], Bas Rokers[1], Tianyi Li[2], Richard J Davidson[1]; [1]University of Wisconsin-Madison, [2]University of Chicago — Affective stimuli can modulate central and peripheral-physiological systems independent of awareness. It has been proposed however that conscious access benefits emotion regulation by rendering affect less diffuse (e.g., less likely to color preferences for unrelated stimuli). Here, we used an individual-differences approach to examine this proposal by independently indexing the intensity and diffuseness of affective provocation. Sixty-seven individuals were presented with blocks of emotional (fearful faces & spiders) and neutral (flowers) stimuli shown for 1000ms. An interocular suppression technique, continuous flash suppression (CFS), prevented stimulus visibility in half the trials. To quantify the intensity and diffuseness of the affective elicitation, we recorded skin conductance responses (SCRs) to the stimuli and likeability ratings of novel neutral faces presented subsequently. The data from forty-six individuals who were SC responders and whose performance in a 2-alternative-forced-choice stimulus detection paradigm did not significantly differ from chance (P>.1) were used in the analysis. Emotional stimuli elicited larger SCRs than neutral ones, $F(2,44)=6.46$, P=.003; an effect that was not modulated by stimulus-awareness, P>.56. Specifically, regardless of stimulus-awareness, fearful faces elicited significantly larger SCRs than flowers, Ps<.03. Critically, only during stimulus-unawareness did larger SCRs to fearful faces (relative to flowers) predict decreased likeability of novel neutral faces, rho=-.31, P=.03. No such association was found during stimulus awareness, rho=.12, P>.4, and awareness did significantly modulate the strength of the intensity-diffuseness relationship, 95% CI correlation-coefficient difference: .01, .8, P<.05. This study confirms the privileged processing of fearful expressions and underscores a putative role for conscious access on behavioral regulation.

F31

FETAL PROGRAMMING EFFECTS OF TESTOSTERONE ON THE REWARD SYSTEM AND BEHAVIORAL APPROACH TENDENCIES IN HUMANS

Michael Lombardo[1], Emma Ashwin[2], Bonnie Auyeung[1], Bhismadev Chakrabarti[3], Meng-Chuan Lai[1], Kevin Taylor[4], Gerald Hackett[5], Ed Bullmore[1], Simon Baron-Cohen[1]; [1]University of Cambridge, [2]University of Bath, [3]University of Reading, [4]Addenbrooke's Hospital, Cambridge, UK, [5]Rosie Maternity Hospital, Cambridge, UK — Sex differences are present in many neuropsychiatric conditions that affect emotion and approach-avoidance behavior. One potential mechanism underlying such observations is testosterone in early development. Although much is known about the effects of testosterone in adolescence and adulthood, little is known in humans about how testosterone in fetal development influences later neural sensitivity to valenced facial cues and approach-avoidance behavioral tendencies. With functional magnetic resonance imaging we scanned 25 8–11-year-old children while viewing happy, fear, neutral, or scrambled faces. Fetal testosterone (FT) was measured via amniotic fluid sampled between 13 and 20 weeks gestation. Behavioral approach-avoidance tendencies were measured via parental report on the Sensitivity to Punishment and Sensitivity to Rewards questionnaire. Increasing FT predicted enhanced selectivity for positive compared with negatively valenced facial cues in reward-related regions such as caudate, putamen, and nucleus accumbens but not the amygdala. Statistical mediation analyses showed that increasing FT predicts increased behavioral approach tendencies by biasing caudate, putamen, and nucleus accumbens but not amygdala to be more responsive to positive compared with negatively valenced cues. In contrast, FT was not predictive of behavioral avoidance tendencies, either through direct or neurally mediated paths. This work suggests that testosterone in humans acts as a fetal programming mechanism on the reward system and influences behavioral approach tendencies later in life. As a mechanism influencing atypical development, FT might be important across a range of neuropsychiatric conditions that asymmetrically affect the sexes, the reward system, emotion processing, and approach behavior.

F32

BRAIN ACTIVATION DIFFERENCES BETWEEN INFORMATION AND REWARD PROCESSING

Josep Marco-Pallares[1,2], Azadeh Hajihosseini[3], Antoni Rodríguez-Fornells[1,2,4]; [1]University of Barcelona, [2]Bellvitge Biomedical Research Institute, IDIBELL, [3]University of Victoria, [4]Catalan Institution for Research and Advanced Studies, ICREA — Living in changing environments requires constant adaptation of behavior. Having information about upcoming events is not only an advantage, but is often crucial for survival. In a recent study, Bromberg-Martin and Hikosaka found that midbrain and lateral habenula dopaminergic neurons that fired to rewarding outcomes, were also phasically excited to a cue informing that the next signal would indicate the magnitude of the reward (Bromberg-Martin and Hikosaka, 2009, 2011), suggesting that information and reward might activate the same cerebral network. In the present study, 21 healthy subjects participated in a new experimental paradigm in which either an informative or a non-informative pre-cue preceded information about the probability of gaining or losing money (probability cue) or no information (non-probability cue). Functional magnetic resonance imaging revealed that positive monetary feedbacks activated reward-related areas including Ventral Striatum, Posterior Cingulate Cortex and VentroMedial Prefrontal Cortex. In contrast, among all these areas, informative pre-cues only activated the Ventromedial Prefrontal Cortex, as well as the right Hippocampus. Therefore, while there was a certain degree of overlap at the prefrontal cortex between the two contrasts, other key structures in reward processing such as Ventral Striatum were not activated by information processing. In conclusion, present results seem to suggest that from brain's perspective, information and reward are not exchangeable.

F33

PAIN PREDICTABILITY REVERSES VALENCE OF A RELIEF-ASSOCIATED STIMULUS

Andreatta Marta[1], Mühlberger Andreas[1], Glotzbach-Schoon Evelyn[1], Pauli Paul[1]; [1]University of Würzburg — Relief from pain entails reward-like properties and stimuli presented upon pain termination acquire implicit appetitive properties, but explicit aversive properties (Andreatta et al., 2012). Relief pleasantness depends on pain averseness, and pain averseness may be increased by unpredictability. Here, we investigated whether the un-predictability of pain modulates the pleasantness of a relief-associated stimulus. Thirty (Study1) and twenty-eight (Study2) participants underwent a conditioning phase followed by a test phase. During conditioning, a visual stimulus (FORWARDCS+) was presented before a painful electric shock (unconditioned stimulus, US), another stimulus (BACKWARDCS+) was presented after US, and a third stimulus (CS-) was never associated with US. In Study1, FORWARDCS+ predicted half of the USs, the other half was delivered unwarned before the BACKWARDCS+. In Study2, all USs were fully predicted by FORWARDCS+ and always followed by BACKWARDCS+. During test, no US was delivered and an additional stimulus (NEW) was presented as control. Startle reflex, ratings of valence and of arousal were collected as learning indices. No discriminative startle responses were found to the CSs in Study1, but startle potentiation to FORWARDCS+, and startle attenuation to BACKWARDCS+ were found in Study 2. Participants of Study1 reported both FORWARDCS+ and BACKWARDCS+ as associated with US, whereas in Study2 only FORWARDCS+ was indicated. Possibly, such awareness influenced the ratings. Thus, both FORWARDCS+ and BACKWARDCS+ were reported as aversive in Study1, while BACKWARDCS+ was rated with positive valence and low arousal as opposed to FORWARDCS+ in Study2. In summary, predictability of US reverses valence ratings of a relief-associated stimulus.

F34

NEGATIVE MUSIC MODULATES AMYGDALA RESPONSIVITY TO SURPRISED FACES

Alison M. Mattek[1], Amy L. Palmer[1], Paul J. Whalen; [1]Dartmouth College — Functional MRI studies have demonstrated a robust activation of the amygdala to facial expressions of emotion. If the expression is ambiguous (e.g., surprise), amygdala responses are modulated by the perceiver's interpretation of the expression. Previous studies have also shown that music can bias interpretations of ambiguous facial

expressions. This study investigated how differentially valenced musical contexts would bias amygdala responses to surpised facial expressions. During fMRI scans, subjects listened to 16 minutes of valenced (i.e., either positive or negative) music followed by alternating blocks of surprised faces and fixation. Because amygdala signal changes tend to habituate with repeated presentations, blocks of surprised faces were divided into early and late trials within each run. A significant music by time interaction was observed in the right amygdala. Subjects primed with negative music showed a heightened right amygdala signal to surprised faces during early trials that quickly habituated. Conversely, subjects primed with positive music showed moderate right amygdala signal that was sustained through both the early and late trials. This amygdala response pattern to surprised faces preceded by negative music strongly resembles amygdala responses to fearful faces devoid of any musical context (see Whalen et al., 2009). This suggests that negative music biased perceivers to interpret surprised faces as more negative. However, amygdala responses to surprised faces preceded by positive music were typical of those seen to surprise faces devoid of a musical context, suggesting that the positive music did not necessarily bias the interpretation of surprise.

F35

NEUROIMAGING STUDIES OF HUNGER AND IMPULSIVITY Vlad B. Papa[1], Erica M. Orenstein[1], Kevin E. Ruprecht[1], Tyler E. Owens[2], Laura E. Martin[1]; [1]University of Kansas Medical Center, [2]University of Kansas — Impulsive decision-making is associated with enhanced sensitivity to immediate over delayed rewards. The medial prefrontal cortex (MPFC), the anterior cingulate cortex (ACC), and the insula are involved in evaluating rewards and making decisions. The current study used functional magnetic resonance imaging (fMRI) to examine impulsive decision-making when participants reported increasing levels of hunger and no change in hunger over the 2 hours prior to the scan. Scans were performed using a 3 Tesla Siemens Skyra scanner. A mixed group of healthy weight to obese subjects was separated into an increasing hunger group, and a no change in hunger group. Participants performed a delay discounting task during which they chose between a smaller immediately available reward and a larger delayed reward. fMRI data were analyzed using AFNI and focused on brain responses when participants selected the immediately available reward, delayed reward and the difference in brain responses between choosing the immediately available vs. the delayed reward. Preliminary results show differences in brain activations between subjects who reported increases in hunger compared to those who did not report changes in hunger levels, in the insula and MPFC when choosing the delayed reward, but no differential brain activations were found when choosing the immediately available reward. Overall, the MPFC and insula may be activating more to suppress the urge to select an immediate choice when participants are hungry. These results indicate that changes in hunger impact impulsive decision-making and have implications for the development of health interventions.

F36

INDIVIDUAL DIFFERENCES AND NEURAL CORRELATES OF LEARNING FACES WITH CARICATURED INNER OR OUTER FEATURES Stefan R. Schweinberger[1], Jan Plötner[1], Claudia Schulz[1,2], Franz J. Neyer[1], Jürgen M. Kaufmann[1]; [1]Friedrich Schiller University, Jena, Germany, [2]University Hospital, Münster, Germany — Previous findings demonstrated that increasing distinctiveness via spatial caricaturing improves face learning, and causes modulations of event-related-potential (ERP) components associated with processing of typical shape information (P200) and with face learning and recognition (N250). We investigated the extent to which this caricature learning advantage is driven by exaggerated shape of inner or outer facial features. In addition, we tested whether individual differences in face recognition skills are associated with differences in the role of caricatured inner and outer features. In a face learning paradigm, previously unfamiliar faces were presented either 1) as veridical portraits, 2) with only inner features caricatured, 3) with only outer features caricatured, or 4) with both inner and outer features caricatured in shape. In a subsequent recognition test, participants performed a face familiarity task on learned and novel faces. Different image exemplars were used at learning at test. Both accuracy and ERPs suggested that the caricature learning advantage was mainly driven by exaggerated shape of inner features, with little contribution of external features. We also found that while individual differences in face recognition skills were not associated with differential efficiency of inner and outer feature caricatures, individuals with poorer face recognition profited more from caricatured shape information overall. The results suggest that shape caricaturing facilitates the acquisition of new face representations by exaggerating critical idiosyncratic information of inner facial features. Moreover, at least within the normal range of face recognition skills, individual differences in face learning appear unrelated to differences between inner and outer facial features.

F37

EVIDENCE THAT THE EVOKED RESPONSE OF DORSOMEDIAL PREFRONTAL CORTEX TO FIXATION BASELINE PERIODS FACILITATES FUTURE SOCIAL (BUT NOT NONSOCIAL) INFERENTIAL (BUT NOT NON-INFERENTIAL) JUDGMENTS Robert Spunt[1,2], Meghan Meyer[2], Matthew Lieberman[2]; [1]California Institute of Technology, [2]University of California, Los Angeles — People draw inferences about each other with great efficiency. Such inferences are typically executed in order to refer transient observed behaviors (e.g.,"smiling") to relatively more permanent unobservable states (e.g.,"friendly"). A large body of evidence has delineated a set of brain regions that are reliably correlated with the performance of such mental state inferences: the mentalizing system. Intriguingly, this system shows considerable anatomical overlap with the default mode network, so-called because it is exhibits strong, integrated activity when people are at rest, for instance, duration fixation baseline periods. Here, we used fMRI to test the hypothesis that activity of the mentalizing system during these fixation periods prior to social inferential judgments would increase the efficiency of such judgments. 21 healthy adults underwent event-related fMRI while executing three types of judgments: social inferential (evaluating a mental description of a photographed behavior); social non-inferential (evaluating a motor description of a photographed behavior); or non-social (evaluating an arithmetical expression). Social inferential judgments robustly activated the mentalizing system, and many of the same areas were robustly de-activated by the non-social task when compared to the fixation baseline periods in between each trial. A parametric analysis of response time revealed that increased activity during these pre-trial periods in one of these regions, dorsomedial prefrontal cortex, was associated with faster response times to accurate social (but not non-social) inferential (but not non-inferential) judgments. This provides the best support yet for a functional link between default activity of the mentalizing system and the execution of social inferences.

F38

SOMETHING ALWAYS STICKS? - EMOTIONAL MODULATION OF NEUTRAL FACE PERCEPTION IN AN IMPLICIT MEMORY DESIGN Janine Strehlow[1], Johanna M. Kissler[2]; [1]University of Konstanz, Germany, [2]University of Bielefeld, Germany — Emotional stimuli modulate EEG event-related potentials (ERPs) at distinct processing stages. In a previous study we demonstrated that neutral faces associated with negative context elicit larger LPPs during recognition testing than neutral faces associated with neutral context in an explicit memory design. The present study investigates the effect of emotional context on perception and processing of neutral faces in an implicit design. We collected event-related potentials from 24 healthy students (12 male / 12 female). At first participants viewed briefly presented neutral faces. During a second run each face was preceded by a descriptive phrase about the person's occupation or criminal activities that participants were instructed to read attentively. Faces finally were re-presented randomly mixed with new ones. In addition to a surprise old-new recognition test participants performed a nine-step sympathy rating. Recognition performance was similar for faces presented in negative and neutral context. However, sympathy ratings differed significantly: Faces that had been presented in negative context were evaluated more negatively than faces presented in neutral context. Still, follow-up analyses revealed that evaluative changes were driven by the explicitly recognized faces. On a neural level old faces associated with negative information elicited larger left-parietal negativity around 300 ms after stimulus presentation than old faces with neutral context or new stimuli. No context-related modulations were found for N1, EPN and LPP components. Results indicate that evaluative changes due to an affective context rely on explicit mnemonic processes even in implicit designs and specify a neural correlate for this effect.

F39

ACCURATE INTEROCEPTIVE AWARENESS ENHANCES EMOTIONAL SENSIBILITY Yuri Terasawa[1,2], Yoshiya Moriguchi[2,3], Saiko Tochizawa[4], Riko Sato[4], Satoshi Umeda[4]; [1]Japan Society for the Promotion of Science (JSPS), [2]Department of Psychophysiology, National Center of Neurology and Psychiatry, [3]Integrative Brain Imaging Center (IBIC), National Center of Neurology and Psychiatry, [4]Department of Psychology, Keio University — The peripheral theory of emotion suggests that subjective experience of emotion and interoception are essentially related. Some researches showed that the interoceptive sensibility predicts emotional sensibility and anxiety traits. In this study, we examined whether the interoceptive sensibility modulates emotional experience in social context, using with facial expressions. Thirty graduate and undergraduate students participated our study. The interoceptive sensibility was measured by the heartbeat detection task. In this task, participants were required to report number of heartbeats that they could feel over a period of time. Interoceptive sensibility was evaluated by the levels of dissociation between reported and actual heartbeats (interoception error rate). We selected 5 types of facial expression photos, those were happy, sadness, disgust, anger and neutral. We made morphed continua photos between neutral and each facial expression. We prepared eight steps between neutral-100% and each emotion 100%. Each stimulus was presented in random order and participants judged whether they can feel any emotion from the stimulus or not, and chose the most appropriate emotion when they judged the stimulus have emotional valence. Individual's threshold to feel the emotion were obtained from their responses against the facial expression photos. Interoception error rate was significantly correlated with sensibility to happiness and sadness. The results imply that individuals who are sensitive to their own interoceptive information are also sensitive to emotions presented in facial expressions. The results suggest that interoceptive awareness modulates intensity of subjective experience of emotion and affects personality traits concerned with emotion processing.

F40

FMRI EVIDENCE FOR WHETHER MORALS ARE PROCESSED LIKE FACTS OR PREFERENCES Jordan Theriault[1], Adam Waytz[2], Larisa Heiphetz[3], Liane Young[1]; [1]Boston College, [2]Northwestern University, [3]Harvard University — Are statements of moral value more like statements of objective fact or statements of subjective preference? Prior work in philosophy and psychology has examined issues of moral "objectivism" versus "subjectivism". Using fMRI, we measured neural responses to statements of morals, preferences, and facts to determine whether morals are processed more like preferences or more like facts. Statements were designed such that participants would agree with half and disagree with half, within each domain (morals, preferences, facts). Participants reported agreement/disagreement in the scanner. We focused on regions of interest (ROIs) for theory of mind (ToM) using a standard localizer task: right/left temporo-parietal junction (RTPJ/LTPJ), dorsal medial prefrontal cortex (DMPFC). First, we found that the average magnitude of response in ToM ROIs was equally robust for morals and preferences, whereas the response was reduced for facts. Second, we found that within the RTPJ, LTPJ, and DMPFC the increase in activation for morals and preferences relative to facts was driven by disagreeable statements. These findings reveal broad similarities in the neural processing of morals and preferences versus facts. Moreover, people may be especially inclined to consider the "minds" behind morals (or preferences) versus facts in the case of disagreement.

F41

BRAIN REGIONS FOR THEORY OF MIND DISTINGUISH BETWEEN COOPERATIVE AND COMPETITIVE INTERACTIONS IN A "ROCK, PAPER, SCISSORS" GAME Lily Tsoi[1], James Dungan[1], Liane Young[1]; [1]Boston College — Prior work suggests we dehumanize our opponents during intergroup conflict but attribute mental states to close others. Other work suggests that theory of mind (ToM) is essential for strategic, competitive interactions. We investigated whether brain regions for ToM are differentially recruited for competitive versus cooperative interactions and whether this dimension is encoded in these regions. Participants played a variant of "Rock, Paper, Scissors" with one other player (actually the computer), in which they had to pick a shape (circle, square) and also try to guess what shape the other player would pick. In "cooperate" trials, players worked together toward the same goal to both win $1 ("if you both guess the same shape, you'll both win $1"). In "compete" trials, players had opposite goals, and only one person could win $1. In the control trials, the computer generated a shape, and either both players would win or only one would win, mimicking "cooperate" and "compete" trials, respectively. First, region of interest (ROI) analyses revealed greater activation for compete and cooperate over control trials in ToM regions: precuneus, dorsomedial prefrontal cortex (DMPFC), and right temporo-parietal junction (RTPJ). Second, distinct patterns emerged across ROIs when comparing competitive and cooperative interactions: greater precuneus activity for competitive, greater DMPFC activity for cooperative, and equally robust activity in RTPJ. Third, multi-voxel pattern analyses (MVPA) revealed all three regions, including RTPJ, encode whether an interaction is cooperative or competitive. These results suggest that competitive versus cooperative interactions engage different components of ToM with distinct neural substrates.

F42

A TRAIT CODE IS REPRESENTED IN THE MEDIAL PREFRONTAL CORTEX Frank Van Overwalle[1], Ning Ma[1], Kris Baetens[1], Marie Vandekerckhove[1], Jenny Kestemont[1], Wim Fias[2]; [1]Vrije Universiteit Brussel, Belgium, [2]Ghent University, Belgium — The medial Prefrontal Cortex (mPFC) is critically involved in inference about the traits of the self and others. We investigated whether the mPFC also represents the neural code for traits, or trait code. To localize the trait code, we used fMRI-adaptation, which is a rapid suppression of neuronal responses upon repeated presentation of the same underlying stimulus, in this case, the implied trait. Participants had to infer an agent's (social) trait from brief trait-implying behavioral descriptions. In each trial, the critical (target) sentence was preceded by a sentence (prime) that implied the same trait, the opposite trait, or no trait at all. The results revealed robust suppression of activation in the ventral mPFC only. Crucially, this adaptation effect was graded: strongest after being primed with a similar trait, moderate after an opposite trait and negligible after a trait-irrelevant prime. These findings indicate that a trait code is represented in the ventral mPFC.

F43

ANTERIOR TEMPORAL FACE PATCHES: A META-ANALYSIS AND EMPIRICAL STUDY Rebecca J. Von Der Heide[1], Laura M. Skipper[1], Ingrid R. Olson[1]; [1]Temple University — High-resolution fMRI studies of nonhuman primates have reported the existence of face-sensitive patches in the ventral anterior temporal lobes (ATL). Studies in humans have suggested the function of these patches is related to the mnemonic aspects of person processing. First, neurons in these regions have response profiles indicative of mnemonic activity. Second, a face sensitive P350 ERP component has been localized to the ventral ATL in patients undergoing resection surgery. Third, ATL resection or damage causes an associative prosopagnosia in which face perception is intact but face memory is compromised. Although fMRI studies of humans have extended these findings, it remains unclear if activations to novel and familiar faces in humans are similar to those reported in studies of non-human primates. It is also unclear whether regions of the ATL are preferentially sensitive to famous and personally familiar faces and if activations to these stimuli are similar. We present the results of two studies of person memory: a meta-analysis of existing fMRI studies and an empirical fMRI study using optimized imaging parameters. The findings from the empirical study and meta-analysis were remarkably similar showing left-lateralized ATL activations to familiar individuals whereas novel faces activated the right ATL. The only consistent overlap in activations in both studies to faces associated with knowledge was in the polar tip of the ATL. Activations to famous faces were quite ventral, similar to those reported in nonhuman primates. These findings suggest that face memory-sensitive patches in the human ATL are in the ventral/polar ATL.

F44

WALKING IN AND OUT OF VIEW: DIRECTION OF ANIMATE MOTION REVEALS SOCIAL ORIENTING OF ATTENTION Nicole White[1], Adam Anderson[1], Jay Pratt[1]; [1]University of Toronto — Research in humans and non-human animals suggests that attention capture by animate motion is both reflexive and innate. Some authors suggest further that

visual processing of animacy may contribute critically to social cognition, as complex inferences about intentional agents can be drawn from sparse motion cues. The present study explicitly tests the hypothesis that visual processing of animate motion is linked to more complex social cognitive tasks by examining competitive bias of attention in a two-stimulus display. We demonstrate that, when participants are presented with two instances of identical human motion in the left and right visual periphery, attention is biased towards human figures appearing to approach the observer's central field of vision (i.e., figures facing towards the observer's fixation). The time-course of attentional bias was also significantly related to scores on a Theory of Mind task; participants with higher scores showed attentional bias faster, indicating a link between animate motion processing and higher-level social cognitive abilities. Subjective ratings of animacy experience ("aliveness") and agent recognition ("humanness") collected after the experiment also reliably predicted reaction times in the visual task. Participants who rated stimuli as both "highly alive" and "highly human" exhibited the fastest responses, while the slowest responses were observed for participants who rated stimuli as "highly alive" but low in "humanness". These results suggest that visual processing speed is associated with subjective recognition of animacy and agency. Further work using event-related potentials will investigate whether these findings reflect modulation of early visual processes (e.g., the P1 component).

F45

FACES IN CONTEXT: – THE MUTUAL INFLUENCE OF FACIAL EXPRESSIONS, GAZE DIRECTION, AND VISUAL CONTEXT SCENES ON VISUO-CORTICAL PROCESSING

Matthias Wieser[1], Paul Pauli[1], Andreas Keil[2]; [1]University of Würzburg, [2]University of Florida — Perception of facial expressions is typically investigated by presenting isolated face stimuli. In everyday life, however, faces are rarely seen without a surrounding visual context. Conversely, fearful faces may act as a cue, heightening the sensitivity of the visual system to effectively detect potential threat in the environment. In addition, gaze direction may interact with facial expressions leading to differential processing of the face itself but also the surrounding contexts. In the present studies, we used steady-state visual evoked potentials (ssVEP) to examine the mutual effects of facial expressions, gaze direction, and affective visual context. By assigning two different flicker frequencies (12 vs. 15 Hz) to the face and the context scene, cortical activity to the concurrent stimuli was separated, allowing to track the cortical processing of the face and the context independently. Participants viewed flickering faces (angry, fearful, neutral) with averted or direct gaze overlaid on flickering visual scenes, while performing a simple change-detection task at fixation, and high-density EEG was recorded. Analysis of mean ssVEP amplitudes revealed that cortical processing of fearful faces with averted compared to direct gaze was enhanced only when unpleasant context scenes were presented. These findings point at a complex interplay between facial expressions, gaze direction, and context on visual perception, which further challenge the assumption of hardwired categorical emotion extraction mechanisms.

F46

TRAINING EXECUTIVE FUNCTIONS INDUCED NEURAL CHANGES IN READING

Pedro M. Paz-Alonso[1], Maria R. Rueda[2], Sonia Guerra[2], Myriam Oliver[1], Manuel Carreiras[1]; [1]Basque Center on Cognition, Brain and Language (BCBL), Spain, [2]University of Granada, Spain — Cognitive psychologists have begun to devise effective methods for training cognitive abilities. Recent evidence suggests that some of the core ingredients of cognition are susceptible to substantial practice-related improvements. Nevertheless, little is yet known about the neural changes supporting these improvements and to what extent the strengthening of executive functions transfers to other domains, such as reading. The present fMRI study was aimed at investigating the neural changes in cognitive control and reading abilities induced by training executive functions. A total of 56 participants aged 8-9 years took part in the study. Before undergoing training, participants' higher cognitive functions and reading abilities were assessed behaviorally and with functional MRI. Then, participants either received 8 sessions of computer-based games of increasing difficulty intended to train attention and executive control abilities (Experimental Group) or received an equally long control intervention playing the lower levels of difficulty of the same games (Control Group). After training, participants' cognitive functions were again assessed behaviorally and in the scanner. Similar to prior evidence, our results revealed that the experimental intervention improved participants' fluid reasoning and working memory, but it did not influence participants' crystallized intelligence. Training modulated the involvement of fronto-parietal networks in cognitive control, as well as critical regions within the reading network including the left inferior frontal gyrus and the ventral occipitotemporal cortex. Interventions intended to train executive functions might not only produce benefits in the specific functions being trained, but also yield transfer effects in untrained functions, such as fluid reasoning and reading.

F47

NEURAL REACTIONS TO POSITIVE AND NEGATIVE FEEDBACK CHANGE ACROSS CHILD AND ADOLSCENT DEVELOPMENT

Sabine Peters[1,2], Eveline A. Crone[1,2,3]; [1]Brain and Development Lab, Leiden University, The Netherlands, [2]Leiden Institute for Brain and Cognition, The Netherlands, [3]Developmental Psychology, University of Amsterdam, The Netherlands — Learning from feedback is a crucial component of adaptive behavior, which continues to develop across childhood and adolescence. Recently, developmental neuroscientists have started to investigate if feedback learning in adults and children relies on similar neural mechanisms. In one study (Van Duijvenvoorde et al. ,2008), the dorsolateral prefrontal cortex (DLPFC) and parietal cortex were more active in adults after negative feedback, but in children after positive feedback. In this study, we further investigated these neurodevelopmental patterns in a larger sample of participants (n=271, 8-25 years old) in a more complex multiple-trial learning setting. Participants completed a task that was designed to compare feedback learning networks in children and adults, as well as possible valence differences across development, while ensuring that positive and negative feedback were similarly informative for learning. Behaviorally, adolescents and adults demonstrated faster learning than children. The neuroimaging data indicated that adolescents and adults recruited the fronto-parietal network and medial prefrontal cortex to a greater extent. Performance was correlated with neural activity during learning in areas within the feedback learning network, even after age-correction. Crucially, children showed more activation in the DLPFC and superior parietal cortex after positive feedback, whereas adults showed more activation in these areas after negative feedback. The results provide more specific evidence for the hypothesis that during child development, the role of the DLPFC and parietal cortex changes from a focus on positive feedback towards a focus on negative feedback.

F48

EFFECTS OF AGE AND VASCULAR RISK FACTORS ON PERFORMANCE DURING THREE INHIBITORY CONTROL PARADIGMS IN COGNITIVELY NORMAL OLDER ADULTS

Alexandra Roach[1], Samuel Lockhart[1], Charles DeCarli[1]; [1]University of California Davis — In normal, healthy aging, older adults experience cognitive decline across multiple domains. Previous work has shown that aging affects the inhibitory control network, however, no study has simultaneously investigated the affects of age and vascular risk factors on three forms of inhibitory control. Using the Go-NoGo task, we tested basic response inhibition; with the Eriksen Flanker task, we evaluated inhibition of response competition driven by the interference of incompatible arrow directionality; and with the Stroop task, we assessed response competition driven by the interference of incompatible word stimuli. We tested cognitively normal young adults (18-30 years) and cognitively normal older adults (65-90 years) on each of the three inhibitory control paradigms. Our research questions focused on 1) whether there were appreciable differences in interference across these tasks that differed between younger and older adults, and 2) whether these specific performance deficits within the older adults were correlated with neuroimaging biomarkers including severity of white matter injury (as measured by white matter hyperintensities), and white matter integrity (as measured by fractional anisotropy). Results showed a consistent interference effect that was greater in the Stroop than the Flanker for both younger and older adults, however, response inhibition during the Go-NoGo task remained intact. Additionally, performance differences between compatible and incompatible trials were mediated by the presence of white matter

hyperintensities indicating that white matter injury exacerbates age-related cognitive decline in normal aging. Our results demonstrate differences in the affects of aging across the different inhibitory control paradigms.

F49

INCREASED P2 EVENT-RELATED POTENTIAL RESPONSE IN OLDER INDIVIDUALS WITH EXCEPTIONAL MEMORY FUNCTION

Rebecca Shukhman[1], Krishna L. Bharani[1], Katherine D'Aunno[1], Kristen Rose Whitney[2], Robert S. Hurley[2], Sandra Weintraub[2], Emily Rogalski[2], M-Marsel Mesulam[2], Robert G. Morrison[1]; [1]Loyola University Chicago, [2]Northwestern University Feinberg School of Medicine — The Northwestern SuperAging Project recruits individuals over the age of 80 with exceptional memory function to explore potential causes for their cognitive resilience. An initial cohort of SuperAgers, have significantly thicker cortices than their healthy age-matched peers and thicker left anterior cingulate cortices (ACC) than much younger individuals with age-typical memory function (Harrison et al., 2012). While ACC thickness did not correlate with memory function, it is possible that SuperAgers's different ACC morphology contributes to their memory resilience. In the present study 10 SuperAgers (M = 85.1 years-old, M=14.8 years-education) and 10 older adult controls (OAs, M = 76.1 years-old, M=17.1 years-education) performed 300 trials of a visual Go-NoGo task while we recorded scalp electroencephalography (EEG). While there were no reliable differences in accuracy or RT between groups, SuperAgers showed dramatically different event-related potentials (ERPs) in both Go and NoGo conditions. For example, SuperAgers showed greater fronto-central P2 (200-300ms) ERPs (p=.01) than controls, as well as a greater difference between the NoGo and Go centro-parietal P3 ERP (450-650ms; p =.04). The P2 topography was consistent with a dorsal ACC source. Mean P2 amplitude was highly correlated with individual RAVLT memory performance (r=.70) suggesting early engagement of cognitive control resources may enhance subsequent memory processes. Understanding how unusually successful older adults' enhanced cognitive control contributes to better memory performance may provide insight into how to improve cognitive aging trajectories for both those showing normal decline as well as those exhibiting the severe decline typical in Alzheimer's disease.

F50

EFFECTS OF REAL-TIME STRATEGY VIDEO GAME TRAINING ON WHITE MATTER INTEGRITY IN INTERHEMISPHERIC POSTERIOR CALLOSAL CONNECTIONS OF THE PRECUNEUS IN HEALTHY AGING

Maren Strenziok[1], Ellen Clarke[1], Sophia A. Santa Cruz[1], James C. Thompson[1], Raja Parasuraman[1], Pamela M. Greenwood; [1]George Mason University, Fairfax, VA, USA — Although good cognitive functioning in old age appears to depend on white matter integrity, the ability of cognitive training to heighten white matter integrity has been largely unexplored. Previous studies reported that memory training increased integrity of prefrontal white matter and anterior corpus callosum (CC) compared to no-contact control groups. Such effects may reflect different performance expectations of trained and non-trained groups, so that it remains unknown whether white matter changes can be detected between cognitive training tasks that may vary in effectiveness. Adults over age 60 were randomly assigned to real-time strategy (Rise of Nations, RON) or auditory perception (Brain Fitness, BF) training. RON was previously shown to improve cognitive control, and BF was shown to improve memory in older people. Fractional anisotropy (FA) from diffusion-weighted images (12 gradient directions; b=1000s/mm2; TE=75ms; TR=1000ms; 50 slices, 3mm thick, 4 repetitions), processed with longitudinal tract-based spatial statistics (FSL), were measured before and after training. Group (RON, BF) by time (pre-training, post-training) whole brain ANOVA interaction effects analyses revealed lower FA in the CC splenium after RON training ($p<0.05$, tfce-corrected). No change was found after BF training. Probabilistic tractography seeded from the peak intensity area in the splenium revealed interhemispheric pathways connecting the bilateral precuneus. We conclude that in aging, strategy training specifically decreases reliance on interhemispheric parietal connections involved in spatially-guided behavior and attention. Even though decreased FA is thought to reflect lower white matter integrity, trajectories are likely a more complex result of regional changes with age, disease, and interventions.

F51

DIFFERENTIAL EFFECTS OF GAIN VS. LOSS ANTICIPATION ON ELECTROPHYSIOLOGICAL CORRELATES OF ERROR AND FEEDBACK PROCESSING IN CHILDREN AND ADOLESCENTS

Kerstin Unger[1], Kray Jutta[1]; [1]Saarland University, Saarbruecken, Germany — Previous research suggests that adolescents are characterized by stronger reward sensitivity compared to children and younger adults. However, less is known so far about the extent to which developmental differences in incentive processing affect behavioral adaptation during feedback-based learning. In this study, we examined the influence of appetitive and aversive cues on error and feedback processing – as reflected in the error-negativity (Ne/ERN) and feedback-related negativity (FRN) in 10- to 11-year-old children and 13- to 14-year-old adolescents. We applied a specific variant of a reinforcement task in which errors resulted in losing money (loss condition), failure to gain money (gain condition), or neither of both (neutral condition). Incentive value was varied trial-by-trial and was indicated by 'loss', 'gain', and 'neutral' cues prior to each imperative stimulus. Although learning performance did not differ significantly between loss, gain, and neutral conditions in children and adolescents, gain anticipation differentially affected error and feedback processing. Children showed a larger Ne/ERN on gain trials relative to loss and neutral trials, suggesting that gain expectation was associated with an increased reactivity of a rapid internal error detection mechanism. While incentive value did not modulate the Ne/ERN in adolescents, gain anticipation resulted in more differentiated processing of positive and negative feedback, mainly due to reduced (i.e. more positive) FRN amplitudes on correct trials. Our data suggest that the transition from childhood to adolescence is accompanied by a shift in a relatively greater sensitivity to the motivational value of feedback stimuli, particularly if prior cues signal higher rewards.

F52

MODULATING YOUNGER AND OLDER ADULTS' PERFORMANCE IN IGNORING PICTORIAL INFORMATION DURING A WORD MATCHING TASK

Andrea J. Wilkinson[1], Lixia Yang[1], Ben Dyson[1]; [1]Ryerson University — The current study sought to examine the extent to which distracting pictorial information affects semantic word matching performance in younger and older adults. This was tested in the context of semantic relations between task-relevant word pairs, a task-irrelevant picture and resultant N400 differences. During EEG monitoring, younger and older adults were shown a prime word superimposed on a to-be-ignored picture, followed by a test word. Their task was to determine whether the prime and test word were semantically related. The to-be-ignored pictures were interfering (for 'No' trials), facilitating (for 'Yes' trials), or neutral (for both 'Yes' and 'No' trials) to the expected responses. The relationship between inhibitory and facilitatory effects of a to-be-ignored picture was assessed during a more automatic and a more controlled condition by manipulating the context-test ISI as 50 ms and 1000 ms, respectively. Test display analysis of the N400 at centro-parietal sites revealed similar N400 amplitudes for the 'No' response trials at either ISI, revealing that younger and older adults showed an equivalent effect from interfering pictures. In contrast, younger adults showed greater reductions in the N400, as compared to older adults, for 'Yes' facilitation trials - but only in the long ISI condition. These results suggest that younger adults utilize irrelevant but facilitating pictorial information in a semantic word matching task, specifically during controlled retrieval.

F53

ALTERED N400 CONGRUITY EFFECTS IN PARKINSON'S DISEASE WITHOUT DEMENTIA

Marta Kutas[1,2], Vicente Iragui[1], Yu-Qiong Niu[3,4], Tanya D'Avanzo[5], Jin-Chen Yang[3,4], David Salmon[1], Lin Zhang[3], John Olichney[3,4]; [1]Department of Cognitive Science, University of California San Diego, [2]Department of Neurosciences, University of California San Diego, [3]Department of Neurology, University of California Davis, [4]Center for Mind and Brain, University of California Davis, [5]Department of Psychology, Rehabilitation Hospital of the Pacific, Honolulu, Hawaii — The N400 congruity effect (ERP 300-500 ms post stimulus onset to contextually incongruent minus congruent words) generally shows a linear amplitude decrease with normal aging, and an even greater decrease in Alzheimer's dementia. As little is known about N400 effects in Parkinson's disease (PD), we recorded ERPs in 11

elderly medicated patients with PD (without dementia, mean age = 66.4 yrs, mean duration of illness = 10.8 yrs) during antonymic and category verification. Eleven (11) healthy elderly controls (mean age = 65.7 yrs) also participated in the study. Non-demented PD patients exhibited substantially larger N400 congruity effects (~2 μV) than the age-matched controls for both the opposites ($F(1, 10) = 21.8$, $p < .001$) and categories ($F(1, 10) = 5.5$, $p < .05$) conditions, consistent with reports of behavioral hyper-priming and possibly insufficient inhibition of irrelevant semantic information and/or greater target activation. It is also consistent with abnormally heavy reliance in PD on external cues. These findings implicate abnormal dopaminergic signaling (e.g., frontostriatal and/or mesocortical circuits) in PD, despite L-dopa therapy.

F54

NEURAL CORRELATES OF COGNITIVE INHIBITION FOR EMOTIONAL CONTENT IN ADOLESCENTS

Laura Quiñones-Camacho[1], Coral Rosado-Santiago[1], Cybelle M. López-Valentín[1], Lydia C. Rodríguez-Corcelles[1], Ángel A. Nuñez-Méndez[1], Nicole M. Ryan-Nolla[1], Antonio Algaze-Beato[2,3], Giovanni Tirado-Santiago[1]; [1]University of Puerto Rico, Río Piedras Campus, [2]University of Puerto Rico, Medical Sciences Campus, [3]University of Puerto Rico, Bayamón Campus — Cognitive inhibition (CI), the ability to ignore non-relevant information, has been studied extensively in adults. However, there are few studies of CI in adolescents. The aim of this study was to assess in adolescents the neural correlates of CI for emotional information using BOLD fMRI at 3T during a Prose Distraction Task (PDT). The task consisted of four 85 word-long stories that remained on-screen for 66s, followed by a 15s fixation point. Interspersed within each story, arbitrary words printed in italics served as distractors of either neutral or negative emotional valence (a total of two stories of each type were shown). Recent studies have shown increased activation of the inferior frontal gyrus (IFG) when the demand of attention grows and inhibition of emotional stimuli is necessary. We hypothesized that CI for emotional stimuli in this task would require areas related to inhibition and emotional processing such as the IFG and the amygdala. We also hypothesized that participants would take longer to read stories with negative emotional distractors than with neutral distractors. Seven participants (3 females; mean age 14.28 years, SD=1.17) were assessed to rule out any serious behavioral or psychological disorder. Afterwards, participants completed the PDT during an fMRI session. A fixed-effects analysis in FSL demonstrated that, in our sample, the left IFG demonstrated a significantly higher BOLD response when reading stories with negative vs. neutral distractors. These data show a trend similar to previous studies where IFG showed higher activation in tasks with emotional stimuli and larger attentional demands.

F55

MUSIC TRAINING IS LINKED TO ENHANCED EXECUTIVE FUNCTIONS IN CHILDREN: EVIDENCE FROM ERPS AND NEUROPSYCHOLOGICAL TESTS

Katri Saarikivi[1,2], Vesa Putkinen[1,2], Mari Tervaniemi[1,2], Minna Huotilainen[1,2,3]; [1]University of Helsinki, [2]University of Jyväskylä, [3]Institute of Occupational Health — The transfer effects of music training are broad, ranging from enhancement of verbal auditory memory and attention to better intellectual ability as measured with cognitive ability tests. Improved executive functions are one candidate mechanism for explaining the extent of this cognitive enhancement. In this study, we combined the search for an underlying mechanism to a developmental perspective. We investigated the differences in executive functions between children aged 9-15 engaged in music training since the age of 7 and their not musically trained but active peers. The investigations took place two years apart (Time 1 and Time 2), enabling a follow-up of the development of brain responses and their connection to neurocognitive test performance. We found that the P3a response measured at Time1 predicts test performance at Time 2, irrespective of musical training or age-related maturation. In addition, musically trained children showed greater P3a responses at both measurement times and better overall test performance at Time 2. These results point towards the role of the P3a as an index of executive functions and provide support for the role of music training in developing these neurocognitive skills.

F56

INTRA-INDIVIDUAL RESPONSE TIME VARIABILITY IN CHRONIC METHAMPHETAMINE ABUSERS WITH AND WITHOUT METH-INDUCED PSYCHOSIS

Catherine Fassbender[1], Stefan Ursu[1], Ruth Salo[1]; [1]UC Davis Imaging Research Center — Intra-individual variability (IIV) in an individual's response times (RT) has been used successfully as an index of inattention in disorders such as ADHD and schizophrenia. IIV has also been linked to functional brain activity. To our knowledge an examination of RT IIV and its relation to brain activity on a cognitive paradigm has never been carried out in methamphetamine (MA) abuse. We examined RT IIV using a Stroop paradigm and how this IIV related to brain activity in 30 currently drug abstinent (3 mos to 2 yrs) MA abusers compared to 27 non substance-abusing controls. We calculated IIV for congruent and incongruent stimuli separately. Repeated Measures ANOVA with group (MA, control) as a between-subjects factor and stimulus (congruent, incongruent) as a within-subjects factor revealed a main effect of stimulus with higher IIV in incongruent compared to congruent stimuli ($p=0.001$). Although the MA group was more variable than the controls, this difference did not reach significance ($p=0.14$). However, when the MA group was divided into those subjects who had experienced MA-induced psychosis (MAP+; n=20) and those who had not (MAP-; n=10), group differences emerged ($p=0.01$). The MAP+ group had higher IIV compared to the other groups (post-hoc test $p<0.02$). Elevated IIV was associated with an inability to effectively activate right prefrontal cortex (BA10) during incongruent stimuli in all subjects. Greater IIV did not correlate with severity of use or months MA abstinent. Results suggest impaired attention control in MA-dependent subjects who had experienced MA-induced paranoia in the Stroop paradigm. DA021847; NARSAD

F57

TEST-RETEST RELIABILITY AND CONVERGENT VALIDITY OF MEASURES OF EXECUTIVE PROCESSING: EVIDENCE FROM THE SIMON, FLANKER, SWITCHING, AND ANTISACCADE TASKS

Oliver Sawi[1], Kenneth Paap[1]; [1]San Francisco State University — Executive processing is often studied with the Simon, flanker, antisaccade, and switching tasks. The Simon, flanker, and antisaccade effect have all been assumed to measure the inhibitory control component of executive processing. The switching task has been assumed to provide measures of the monitoring (mixing costs) and switching (switch costs) components of executive processing. The test-retest reliability of these various measures was analyzed. Participants completed all four tasks in two sessions and Pearson r's were computed. The flanker effect shows moderate reliability as a measure of inhibitory control. However, both the Simon effect and the antisaccade effect show low reliability. Switching costs show good reliability while mixing costs show moderate reliability. A related question is whether the magnitude of flanker and Simon interference decreases with practice. A 2x2 ANOVA on the Simon data shows main effects of condition and session, but no ConditionxSession interaction. Similarly, the flanker data also show main effects of condition and session, but also shows a ConditionxSession interaction reflecting a slightly reduced flanker effect in Session 2. Both mixing costs and switching costs decreased with practice. In addition, when the participants were partitioned into groups of bilinguals and monolinguals, ANOVAs were conducted on all of the measures described above. There were no main effects of group nor were there any GroupxCondition or GroupxConditionxSession interactions. Lastly, in order to examine the convergent validity of these tasks, Pearson r's were computed between tasks confirming previous reports that measures of inhibitory control are not correlated

F58

NEURAL CORRELATES OF INTENTIONAL AND STIMULUS-DRIVEN INHIBITION: A COMPARISON

Margot Schel[1,2], Eveline Crone[1,2,3]; [1]Leiden University, the Netherlands, [2]Leiden Institute for Brain and Cognition (LIBC), the Netherlands, [3]Amsterdam University, the Netherlands — People can inhibit an action because of an instruction by an external stimulus, or because of their own internal decision. The similarities and differences between these two forms of inhibition are not well understood. Therefore, the present study directly compared the neural correlates of intentional and stimulus-driven inhibition. Participants (18-26 year-olds, M = 21.49, N =24) performed two

inhibition tasks while lying in the scanner: the marble task in which they had to choose for themselves between intentionally acting on, or inhibiting a prepotent response to measure intentional inhibition, and the classical stop signal task in which an external signal triggered the inhibition process. Results showed that both intentional and stimulus-driven inhibition decision processes rely on a neural network including bilateral parietal and lateral prefrontal cortex and presupplementary motor area (preSMA). We also found additional activation in dorsal fronto median cortex (dFMC) and left inferior frontal gyrus (left IFG) during intentional inhibition that depended on the history of previous choices. Together, these results indicate that intentional inhibition and stimulus-driven inhibition have commonalities at the neural level, but intentional inhibition is also characterized by additional context-dependent neural activation in medial prefrontal cortex. Currently, we are analyzing data from children aged 10 to 12 (M = 11.05, N =19) to examine the development of the neural correlates underlying intentional and stimulus-driven inhibition.

F59

THE NEURAL MECHANISMS OF CONTEXT-SPECIFIC CONTROL Nathalie Schouppe[1], Jelle Demanet[1], C. Nico Boehler[1], Wim Notebaert[1]; [1]Ghent University — Goal-directed behavior requires constant adjustments to changing environmental demands. This context-sensitive recruitment of cognitive control is evidenced by behavioral studies reporting reduced interference effects in contexts with a high proportion of incongruent trials, compared to contexts with a low proportion of incongruent trials (i.e., context-specific proportion congruency effect, CSPC effect). Recently, King et al. (2012) demonstrated the involvement of the medial superior parietal lobule in bringing about this effect. Our study extends these findings by investigating the neural mechanisms involved in contextual control, not only when the context is imposed, but also when the context is freely selected. If the CSPC effect is an instance of proactive control, we would predict larger behavioral and neural effects for freely chosen contexts than for imposed contexts. In contrast to this prediction, behavioral results showed a similar CSPC effect in the voluntary and the imposed condition. Imaging data showed typical conflict-related activation (incongruent > congruent) in the anterior cingulate cortex, the presupplementary motor area, and the inferior parietal lobule. Additional analyses in these regions of interest revealed a significant context x congruency interaction in the left inferior parietal lobule and also this neural CSPC effect was not modulated by how the context was selected. These results indicate that different areas in the parietal lobe play a role in contextual control and that the mechanisms underlying this adaptation do not depend on whether the context is chosen freely or not.

F60

ACTION VIDEO GAME EXPERIENCE HURTS COGNITIVE CONTROL: A LONGITUDINAL EXPERIMENT Daiqing Shi[1], Zude Zhu[1], Weiyan Huang[1], Shuangju Zhen[1], Wei Zhang[1]; [1]South China Normal University — To investigate the causal role of the video game experience in cognitive control change, we performed a longitudinal experiment by recruiting 24 subjects who had very little video game experience to complete 30 hours non-action video game training (control group, CG) or first-character action video game (experimental group, EG) training within 5 weeks. The participants' cognitive control ability was measured with Stroop task in three time slots: before training (Time 1, T1), immediately after training (Time 2, T2) and three weeks after training (Time 3, T3). In T1 and T2, EEG was recorded when the participants performing the Stroop task. Following the dual mechanism of cognitive control theory, the Stroop task was presented with a mixed design to distinguish reactive and proactive control as well as varied response-to-stimulus interval (RSI, 750 ms or 3000 ms) to distinguish recruitment and maintenance of proactive control. Behaviorally, the maintenance of proactive control of the EG was significantly declined in T2 than T1 in EG, while rebounding in T3. Additionally, the proactive control related frontal slow wave showed lower magnitude in the EG than the CG in T2, suggesting declined proactive control in the EG after video game training. Furthermore, we also found the reactive control related slow potentials difference between congruent and incongruent trials disappeared in the EG in T2, suggesting declined reactive control in the EG participants. Taken together, the present study taken a longitudinal approach found that action video game experience hurts both proactive and reactive cognitive control.

F61

DOPAMINERGIC MODULATION OF WORKING MEMORY IN PARKINSON'S DISEASE PATIENTS Kathleen Poston[1], Fadi Tayim[1], Sophie YorkWilliams[1], Jennie Lambert[1], Vinod Menon[1]; [1]Stanford University — Parkinson's disease patients can exhibit working memory deficits early in the disease. Because dopamine is well-known to play an important role in working memory, dopamine deficiency in the mesocortical circuits has been hypothesized as one etiology for this deficit. However, the relationship between dopamine and cognitive performance in Parkinson's disease is complex, and both impairments and improvements have been observed after dopamine replacement, depending on the task performed. The present study directly compares working memory performance and concurrent cortical activity associated with dopamine replacement during a modified Sternberg task. We recorded behavioral and Blood-oxygen level dependent (BOLD) functional magnetic resonance imaging (fMRI) data from non-demented Parkinson's disease patients (n=13) and Control subjects (n=15). In this task, participants encoded either 5 unique or identical numbers (High or Low load, respectively), maintained them during a delay, and then responded whether a single probe matched an item from the memory set. The Parkinson's disease patients were assessed both OFF and ON Parkinson's dopaminergic medications, counterbalanced at least two weeks apart. Behavioral results revealed no difference in accuracy or reaction time between the Control and Parkinson's disease OFF participants. By contrast, Parkinson's disease ON were less accurate and slower than both Parkinson's disease OFF and Control participants. fMRI results revealed Parkinson's disease OFF showed more prefrontal cortex activity than Parkinson's disease ON. Taken together, these data indicate a link between working memory deficits and dopaminergic medications in Parkinson's disease patients, which may be associated with reduced prefrontal cortex activity.

F62

THE BENEFITS OF STIMULUS-DRIVEN ATTENTION FOR WORKING MEMORY ENCODING: REDUCTION OF THE PHONOLOGICAL SIMILARITY EFFECT Susan Ravizza[1], Eliot Hazeline[2]; [1]Michigan State University, [2]University of Iowa — Lesions of the temporal-parietal junction (TPJ) are associated with low verbal working memory span (Koenigs et al., 2011; Shallice & Vallar, 1990). In a previous study, we demonstrated that activity of this region was inconsistent with the TPJ acting as a verbal store and, instead, we suggested that this region may be involved in stimulus-driven attention that could be important for encoding information into working memory (Ravizza et al., 2011). The present study investigates whether stimulus-driven attention to relevant information affects working memory performance. In two experiments, we examine whether stimulus-driven attention to similar items can improve retention of these items in working memory. Lists of phonologically-similar and dissimilar items were presented at expected or unexpected locations in Experiment 1. Stimulus-driven attention to similar items presented at unexpected locations reduced the phonological similarity effect so that these items were better remembered than similar items that appeared at expected locations. These results were replicated in Experiment 2 using contingent capture to boost stimulus-driven attention to similar items. Together, these experiments demonstrate that stimulus-driven attention to relevant information is one mechanism by which encoding can be facilitated and suggests that patients with lesions to the TPJ may have lower verbal spans because of a loss of attention to incoming information.

F63

THE RELATIONSHIP BETWEEN EXECUTIVE FUNCTION AND FRONTAL CORTEX CONNECTIVITY AT REST Andrew Reineberg[1], Jessica Andrews-Hanna[1], Harry Smolker[1], Amy Turner[1], Marie Banich[1]; [1]University of Colorado Boulder — Studies of group differences in resting state functional connectivity (rs-fcMRI) are pervasive throughout the fields of cognitive neuroscience and clinical neuropsychology. However, the relationship between the resting brain and individual differences in executive control in a normal population remains unexplored. Ninety-one college-aged participants completed a six minute resting state fMRI scan and a battery of tasks measuring important constructs of executive function (see Miyake & Friedman, 2012): inhibition of a prepotent response (antisaccade task), task set shifting (category switching task), and working memory updat-

ing (keep track task). Using Independent Components Analysis (ICA), we found distinct brain networks associated with improved goal maintenance (z-score average of the three tasks), shifting-specific performance, and updating-specific performance. The networks identified consisted of typical sources of executive control (right inferior frontal gyrus, frontal pole, anterior medial prefrontal cortex) and typical targets of executive control (parietal lobe, superior temporal lobe, and hippocampus). Using the frontal regions from these ICA-identified networks as regions of interest in a functional connectivity analysis, we found that increased connectivity of right inferior frontal gyrus (particularly connectivity to the hippocampus and other subcortical regions) was predictive of individual differences in updating-specific performance but not shifting-specific performance or goal maintenance. Whole brain connectivity of other frontal regions of interest was not predictive of individual differences in executive function. The results of the current study have important implications for our understanding of individual differences in the brain at rest, particularly the relationship between sources vs. targets of control and executive function.

F64

ENHANCING TRAINING AND TRANSFER EFFECTS BY APPLYING NON-INVASIVE BRAIN STIMULATION DURING WORKING MEMORY TRAINING

Lauren Richmond[1], David Wolk[2], Ingrid Olson[1]; [1]Temple University, [2]University of Pennsylvania — An emerging body of research shows that working memory (WM) can be enhanced via focused practice. However, whether these effects transfer to other tasks is more controversial. Moreover, research on this topic has accrued slowly because running these tasks is costly, subjects find training tedious, and the effects are not as robust and long-lived as hoped. We hypothesized that transcranial direct current stimulation (tDCS) could serve as an adjuvant for some types of cognitive training including WM training. Previously tDCS was shown to influence performance on two different WM tasks: n-back (e.g. Fregni, et al., 2005) and a variant of the Sternberg task (Marshall, et al., 2005). However, the degree to which tDCS might influence WM training and transfer has yet to be explored. To this end, young adult participants completed a battery of tests tapping WM, sustained attention, and inhibition. Next, active or sham tDCS was applied to dorsolateral prefrontal cortex while participants performed an adaptive complex WM task (see Chein & Morrison, 2010; Richmond et al., 2011) over 10 daily testing sessions. A post-test battery was administered at completion. Preliminary results indicate that participants receiving active tDCS show large improvements on the training task compared to sham. In addition, the active participants exhibited improved transfer to other WM tasks compared to sham. These data represent the first demonstration that tDCS can enhance training effects in the domain of working memory.

F65

HOW DISTRIBUTED ARE SHORT-TERM MEMORY REPRESENTATIONS OF VISUAL MOTION?

Adam Riggall[1], Bradley Postle[1]; [1]University of Wisconsin-Madison — We recently demonstrated the successful time-point-by-time-point decoding, with multivoxel pattern classification (MVPC), of remembered directions of motion during a short-term delayed-recognition task (Riggall & Postle, 2012). Critically, this item-level decoding was only possible within medial and lateral occipital cortex despite the presence of robust, elevated delay-period signal in frontal and parietal cortex. Here, we address the seemingly paradoxical fact that, in the same data, 'importance maps' from whole brain decoding--the specific voxel weights used by the trained classifier--revealed a number of important voxels located in frontal and parietal regions. A comparison of ROI importance maps (frontal, parietal, lateral occipital (including MT+)), medial occipital) with the whole brain importance maps reveals a marked difference between occipital vs. frontoparietal regions: Whereas in posterior regions the same voxels tended to be assigned large importance values by both analyses (mean 62% overlap of top 25% important voxels across subjects), in frontal and parietal cortex, the overlap was much lower (mean overlap of 7%). This suggests that, whereas frontal and parietal regions may participate in broadly distributed representations of trial-specific information, these regions cannot be construed as storing "independent" mnemonic representations. In a second analysis we assessed the neural stability of delay-period representations by comparing the 25% most important voxels across time points. Here we found that only a small percentage of these (mean of 5% across subjects) were important throughout the delay. This suggests, in line with recent multiunit electrophysiological studies, that seemingly stable mental representations may be underlain by highly dynamic neural representations.

F66

SIMILARITIES AND DIFFERENCES IN THE COGNITIVE PROCESSES AND NEURAL SUBSTRATES THAT SUPPORT WORKING MEMORY AND LONG-TERM MEMORY

Nathan Rose[1], Fergus Craik[1], Bradley Buchsbaum[1]; [1]Rotman Research Institute, University of Toronto — The extent to which recall on working memory (WM) tasks involves retrieving items from long-term memory (LTM) largely depends on the amount of disruption to active maintenance processes (Rose & Craik, 2012). In this study, participants were to make a deep or shallow judgment on a word and recall the word after a 10 s delay on each trial. During the delay, participants either rehearsed the word or performed an easy or hard math task. Immediate recall was best following rehearsal-filled delays and for deeply processed items, but only when followed by difficult, math-filled delays. In contrast, LTM for items initially recalled following rehearsal-filled delays was worst, and better for deeply processed items regardless of the delay. We repeated the experiment in an fMRI study. Activation was greater for deep than shallow processing in left inferior frontal and anterior temporal cortex and the hippocampus during both encoding and immediate recall, particularly when retrieval occurred following a math- vs. rehearsal-filled delay. Whereas shallow processing and rehearsal-related areas can support active maintenance in WM, deeper processing benefits recall on WM tasks when the conditions invoke the neural substrates that support LTM.

F67

STILL SEARCHING FOR THE PHONOLOGICAL STORE: EEG CORRELATES IMPLICATING MOTOR AND PERCEPTUAL REGIONS

Jason Samaha[1], Margaret T. Lynn[3], Tiffany K. Jantz[1], Ezequiel Morsella[1,2], Mark W. Geisler[1]; [1]San Francisco State University, [2]University of California, San Francisco, [3]Ghent University — Isolating the neural correlates of the phonological store (i.e., the imagery-related component of verbal working memory [WM]) has proven to be more challenging than originally anticipated (Buchsbaum & D'Esposito, 2008). Contrary to classic models of WM (e.g., Baddeley, 1986), in which the phonological store is well circumscribed and modularized, studies examining the neural underpinnings of this component have implicated both perceptual and what have historically been classified as motor regions, along with frontal regions employed in cognitive control (Koenigs et al., 2011; McNorgan, 2012). Building on these findings, we examined the degree of involvement of motor and perceptual processing in verbal WM. In Study 1, subvocalizing a word (traditionally associated with articulatory rehearsal) or holding verbal auditory imagery in mind (traditionally associated with perceptual processing) led to comparable behavioral effects (e.g., priming), $t(45) < 1$, $p > .30$. This equivalence is, consistent with the hypothesis that auditory imagery and subvocalization may recruit the same neural network, and echoes 'common-code' proposals (e.g., Hommel, 2009) in which motor-related and perceptual-related processes are inextricably linked. Study 2 provides additional evidence for this hypothesis using electroencephalography coherence (sites F3, F7, and TP3). While participants (n = 20) experienced auditory imagery of words, we measured co-activation of motor-speech areas (F7, TP3) and prefrontal areas (F3) involved in foregrounding representations in WM (Johnson & Johnson, 2009). Taken together, these data provide evidence that the phonological store may rely on both perceptual and motor processes.

F68

RECITATION-RELATED STRUCTURAL CHANGES IN THE BRAINS OF VEDIC SANSKRIT PANDITS

James Hartzell[1], Ben Davis[1], David Melcher[1], Gabriele Miceli[1], Tanmay Nath[2], Jorge Jovicich[1], Nandini Chatterjee Singh[2], Uri Hasson[1]; [1]Center for Mind/Brain Sciences (CIMeC), University of Trento, Italy, [2]National Brain Research Centre, Manesar, India — Intensive training of specialized expertise can lead to structural brain changes in the human brain (Maguire et al., 2000). India's Vedic pandits maintain a 3500+ year-old tradition of memorizing and reciting several large Sanskrit texts (Vedas) that can exceed 20,000 lines. Training is based on oral recitation extending from early adolescence to adulthood. To examine the neural systems allowing this memorization we used MRI to compare the brain

structure of Indian Vedic pandits (N=18) to that of matched Indian control participants (N=18) using voxel based morphometry. The two groups were matched for gender, age, multilingualism, education, and hand-eye dominance. Two structural MRI scans (3T system) were obtained per participant within session and averaged to increase signal-to-noise (MPRAGE, 1mm3 isotropic voxels). Brain masks were manually edited to ensure accuracy of grey-matter inclusion. We constructed a group template from all participants, segmented the grey matter, and conducted a voxel-wise analysis to compare grey matter density of the two groups. Higher grey matter density was found for the pandit group in several areas (a reverse contrast revealed no effects). These included a very large cluster covering bilateral anterior cingulate cortex extending from its most rostral extent to the central part of the cingulate gyrus, and several left hemisphere regions: the insula, posterior middle temporal gyrus, paraphippocampal gyrus, and fusiform gyrus. The findings support recent theoretical models in which the anterior cingulate cortex plays an important role in enabling long-term storage of memories and their retrieval (e.g., Weible et al., 2012).

F69

DOES THE CORPUS CALLOSUM CONTRIBUTE TO LEFT HEMISPHERE LANGUAGE DOMINANCE?

Leighton Hinkley[1], Elysa Marco[2,3], Ethan Brown[2], Anne Findlay[1], Polina Bukshpun[2], Rita Jeremy[3], Mari Wakahiro[2], A. James Barkovich[1,2,3], Pratik Mukherjee[1], Elliott Sherr[2,3], Srikantan Nagarajan[1]; [1]Department of Radiology and Biomedical Imaging, UCSF, [2]Department of Neurology, UCSF, [3]Department of Pediatrics, UCSF — Speech production is a dynamic process, involving the recruitment of multiple brain structures in a temporal pattern that typically relies on left-lateralized hemispheric dominance. Individuals with agenesis of the corpus callosum (AgCC) offer a unique opportunity to examine the role of corpus callosum development on language processing dynamics. We use time-frequency MEG imaging to quantify changes in neural oscillations during language tasks in AgCC patients with partial (pAgCC) and complete (cAgCC) agenesis and matched healthy controls (HC). MEG data were collected using a 275-channel whole-head biomagnetometer (MISL). Subjects participated in an auditory verb (AV) generation task and Boston picture naming (BPN) test during MEG recording. Data were analyzed in the time-frequency domain using an adaptive spatial filtering technique (NUTMEG). Changes in beta oscillatory power (12-30Hz) were used to compute a language laterality index (LI, a ratio of power change between the left and right hemispheres). While we found the expected HC leftward language lateralization only 20% of cAgCC individuals showed left hemisphere language dominance. The pAgCC group demonstrated an intermediate left lateralization at 47%. In the group comparison, an increase in beta power suppression ($p<0.01$ FWE) was identified in the AgCC group over the right medial frontal and pre-central gyrus ~450ms prior to the vocal response. In the left hemisphere, significantly reduced beta suppression in the AgCC group was identified over the angular and the superior occipital gyrus ($p<0.01$ FWE). This report demonstrates a direct relationship between abnormal callosal development and impairments in cortical recruitment during language production.

F70

TOPOLOGICAL EFFICIENCY OF RESTING-STATE NETWORKS AND PRAGMATIC PROCESSING IN SENTENCE COMPREHENSION

Jie Hu[1], Xiaoming Jiang[1], Yong He[2], Xiaolin Zhou[1,3]; [1]Center for Brain and Cognitive Sciences and Department of Psychology, Peking University, Beijing, China, [2]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, China, [3]Key Laboratory of Machine Perception and Key Laboratory of Computational Linguistics (Ministry of Education), Peking University, Beijing, China — Recent studies have shown that functional brain networks derived from resting-state fMRI exhibit robust small-world properties. The topological efficiency of such brain network organization is proved to be useful in identifying atypical neural functions in autistic patients, who show severe deficits in their pragmatic ability. Here, we investigated the relationship between the topological architecture of the resting-state brain networks in healthy participants and the individual ability to derive pragmatic implicature during sentence comprehension. The participants rated the comprehensibility of Chinese sentences with a lian … dou… construction (similar to the English construction of even + a low likelihood event). By embedding an event with low likelihood, high likelihood or an event with unspecified likelihood in the lian…dou… construction, we created pragmatically congruent, incongruent, and underspecified conditions□respectively. Graph-theoretical analysis evidenced a strong positive correlation between the comprehensibility rating of the underspecified sentences and the global efficiency of the resting-state brain network, suggesting that the global efficiency of the whole brain network affects the individual's ability to derive pragmatic implicature for ambiguous sentences. Moreover, individual's comprehensibility rating of incongruent sentences negatively correlated with the regional nodal efficiency in subcortical regions responsible for detection of linguistic violations, including left thalamus and putamen, but positively correlated with the efficiency in cortical areas responsible for resolution of linguistic conflict, including the right middle frontal and medial superior frontal gyrus, indicating that the resting state efficiency of regions related with executive control can affect individuals' ability to deal with pragmatic failure during sentence comprehension.

F71

ASYMMETRIC PHYSIOLOGY OF THE PERISYLVIAN LANGUAGE NETWORK: EVIDENCE FROM RESTING STATE FMRI

Robert Hurley[1], Xue Wang[1], Marsel Mesulam[1]; [1]Northwestern University — It is widely accepted that the language network is asymmetrically distributed in the brain, with left perisylvian regions being more critical for language function. Subtle structural differences between the hemispheres have been documented, but the physiological mechanisms of asymmetry remain unknown. In order to address this issue, functional magnetic resonance imaging (fMRI) was acquired from 29 healthy adults at rest, and functional connectivity between perisylvian regions was examined in each hemisphere. Seed regions of interest were placed in each subdivision of Broca's area: pars orbitalis (pOr), pars triangularis (pTr), and pars opercularis (pOp). pTr showed a reciprocal pattern of functional connectivity with the middle temporal gyrus (MTG) in the left hemisphere, but there was no appreciable connectivity between their right hemispheric counterparts. Both pTr and MTG have been strongly linked to lexical processing in prior fMRI and lesion mapping studies, and each may function as important epicenters within the perisylvian language network. In contrast, neither pOr or pOp showed appreciable patterns of temporal connectivity in either hemisphere. These findings suggest left hemispheric dominance for language is facilitated by greater intrinsic connectivity between left perisylvian epicenters.

F72

PREDICTIVE PROCESSING IS INFLUENCED BY THE SPECIFICITY OF SPEECH SOUND REPRESENTATIONS

William Idsardi[1], Mathias Scharinger[1,2], Philip Monahan[3]; [1]University of Maryland, College Park, USA, [2]Max-Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [3]Basque Center on Cognition, Brain and Language, Donostia-San Sebastián, Spain — Recent research provides converging evidence for predictive processing in audition. Perceived regularities allow auditory cortex to generate predictions about when the next stimulus will occur and what the stimulus will be. As such, what predictions should be modulated by prior expectations, particularly for familiar auditory categories, e.g., speech. Here, we tested whether the predictability of speech sounds is modulated by prior knowledge regarding the precise nature of long-term memory representations. To that end, we considered American English low-, mid-, and high- front vowels ([æ], [ɛ], [I], respectively). Mid-vowels have less specific phonological representations than either low or high vowels (termed underspecification). We presented all vowels in a passive oddball paradigm, contrasting high- and low-, as well as high- and mid-vowels in standard and deviant position. The prediction error generated by a high-vowel deviant (reflected by the Mismatch Negativity, MMN) should be greater after more specific low-vowel standard than after a less specific mid-vowel standard. MEG responses (n=12) were recorded by a 157 channel whole-head axial gradiometer MEG system (KIT, Japan). High-vowel deviants elicited larger MMNs after more specific (low) than after less specific (mid) vowels. We conclude that vowels with more specific representations generated stronger predictions regarding future occurrences than vowels with less specific representations.

F73

THE PRESENCE OF "METAPHOR BLINDNESS" IN THE GENERAL POPULATION Baland Jalal[1], VS Ramachandran[1]; [1]Center for Brain and Cognition, University of California at San Diego — Previous research from our group suggests that patients with lesions in the left inferior parietal lobule (IPL)—which is concerned with abstract numerical cognition and cross-modal association (which is consistent with its strategic location at the crossroads between the temporal, parietal and occipital lobes) have difficulty with metaphors. In the current study we report "metaphor blindness" among normal adults in the general population; that is, either the complete inability or difficulty for otherwise intellectually non-challenged individuals to comprehend metaphors compared to the rest of the population. Participants (N = 205) read 12 metaphorical (The detective jumped at the clue) and 12 literal (The accident was a fall) sentences and had to decide whether the sentences had a metaphorical or literal meaning. The mean accuracy for these metaphorical sentences was 10.98 (SD = 2.41); the mean accuracy for literal sentences was 7.30 (SD = 1.84). We found that 5% of participants (11/205) were unable or had difficulty understanding metaphors (were statistical outliers; i.e., scored three or more standard deviations below the mean), while their score for literal sentences felt within a normal statistical range (i.e., less than two standard deviations below the mean). In a follow-up study, a verbal IQ test (WASI; verbal subscale) was administered to 9 out of these 11 participants with low metaphor scores; results suggested that the inability of these individuals to accurately detect metaphors is not due to low verbal IQ.

F74

WHEN SPOKEN AND WRITTEN WORDS MEET IN THE BRAIN: A DEVELOPMENTAL ERP STUDY Lea B. Jost[1,2], Aleksandra K. Moscicka[1,2], Christine Frisch[1], Volker Dellwo[3], Urs Maurer[1,2]; [1]Department of Psychology, University of Zurich, Switzerland, [2]Neuroscience Center Zurich, University of Zurich and ETH Zurich, Switzerland, [3]Phonetics Laboratory, English Department, University of Zurich, Switzerland — Integrating visual and auditory language information is critical for reading. Suppression and congruency effects in audiovisual paradigms with letters and speech sounds provided information about low-level mechanisms of grapheme-phoneme integration during reading. However, the central question about how such processes relate to reading entire words remains unexplored. Using ERPs, we investigate (1) when audiovisual integration occurs for entire words and pseudowords, (2) whether this integration is reflected by differences in map strength or differences in map topography, and (3) whether this integration is influenced by reading fluency. A 128-channel EEG was recorded while 69 monolingual (Swiss)-German speaking first-graders performed an oddball detection task. Word and pseudoword stimuli were presented in blocks either auditorily (A), visually (V) or audiovisually (matching: AVM; nonmatching: AVN). Corresponding ERPs were computed, and unimodal ERPs were summated (sumAV). We applied TANOVAs to identify time windows with significant integration effects: suppression (sumAV-AVM) and congruency (AVN-AVM). These integration effects were further characterized using GFP and 3D-centroid analyses. If significant, these analyses were recomputed adding reading fluency as covariate. Significant audiovisual suppression effects were observed for words and pseudowords in similar time windows, in agreement with previous studies on letters and speech sounds. Significant congruency effects were found only for words, but not for pseudowords, suggesting early integration processes specific for words. Suppression effects tended to be characterized by differences in map strength, whereas congruency effects tended to be characterized by differences in map topography. Among all audiovisual integration effects, reading fluency modulated the word suppression effect around 300ms.

F75

INVESTIGATING THE…ER… COMMUNICATIVE ROLE OF DISFLUENCY Jennifer Lines[1], Martin Corley[2], David I. Donaldson[1]; [1]University of Stirling, [2]University of Edinburgh — Disfluency in speech ("um", "uh") has been shown to affect listeners' expectations about upcoming words and the likelihood of their later recognising those words. A linguistic account of these disfluency effects states that disfluency marks speaker difficulty, and listeners adjust their linguistic expectations accordingly (e.g., Arnold et al., 2004). Alternatively, disfluency effects may not be caused by changes in linguistic processing, but may reflect the introduction of a delay in the speech stream, with attendant changes in attention (e.g., Corley & Hartsuiker, 2011). To investigate whether disfluency effects depend on perceived speaker difficulty, we contrasted listeners' expectations about words following disfluencies with those following artificial interruptions. We used Event-Related Potentials (ERPs), focussing on the N400 effect as an index of semantic integration difficulty, comparing ERPs to predictable and unpredictable words within fluent, disfluent, and interrupted sentences. We found that the difference in expectation between predictable and unpredictable words was reduced in disfluent compared to fluent sentences (as indexed by the size of the N400 effect). Expectations about words in artificially interrupted sentences lay between those for fluent and disfluent sentences, suggesting that expectations are modulated by a combination of delay and information about speaker state. Participants later remembered unpredictable words more accurately than predictable words, and were more likely to remember words occurring in disfluent or interrupted than fluent sentences. Importantly, however, memory performance did not differ between words from disfluent and interrupted sentences, indicating that improved subsequent memory does not depend on listeners responding sympathetically to perceived speaker difficulty.

F76

PREDICTING THE FORESEEABLE FUTURE: MEG EVIDENCE FOR PREACTIVATION OF PREDICTED WORDS Tal Linzen[1], Joseph Fruchter[1], Masha Westerlund[1], Alec Marantz[1]; [1]New York University — There is mounting evidence that the brain processes information by generating predictions and testing them against incoming stimuli. However, little is known about how these predictions are encoded. The focus of the present study was to determine whether a specific representation of the predicted item is pre-activated prior to presentation of that item. Prediction is often argued to be informed by the statistics of the environment. Language processing offers a particularly appealing testing ground for this claim, since these statistics can be easily estimated from texts. We selected adjective-noun pairs that varied in transition probability, ranging from cases in which the adjective is highly predictive of a specific noun ("stainless steel") to cases in which the adjective is not predictive of any particular noun ("important clue"). The adjective was presented for 600 ms, and was then replaced with the noun. Participants performed a lexical decision on the noun. We obtained cortically-constrained minimum norm source estimates for MEG data from 16 subjects. Using the lexical frequency of the predicted noun as an index of pre-activation, we found that activity in the left temporal lobe was modulated by the noun most likely to follow the adjective, starting at around 100 ms before the noun was even presented. This effect held only for predictive adjectives, and could not be attributed to other variables such as adjective frequency or transition probability. This result presents direct neural evidence for the pre-activation of word-specific predictions driven by the distribution of words in the language.

F77

EASY AS PIE: COGNITIVE EFFORT DURING READING IN LATE BILINGUALS. Evguenia Malaia[1], Sharlene Newman[2]; [1]University of Texas at Arlington, [2]Indiana University Bloomington — This EEG study investigated the effect of the late acquisition of Spanish (L2) on reading native English words. Two groups of native English participants – one with very limited Spanish experience and one with extensive experience performed two lexical decision tasks: an English lexical decision task (ELD), where participants indicated whether a letter string was an English word; and a General lexical decision task (GLD), where participants indicated whether a letter string was a word in either English or Spanish. We conducted a frequency domain analysis of the EEG collected during the task in the higher α band (9.7-12.8 Hz) across electrode clusters of interest. The left posterior and anterior, right posterior and anterior regions of interest, comprised of 16 channels each demonstrated significantly higher α power in the monolingual group. However, while the bilingual group exhibited higher α power amplitude for Spanish stimuli, bilingual group demonstrated higher α power for English stimuli. The high α power in EEG of monolinguals exposed to Spanish stimuli likely indicates the lack of binding across ROIs, as they cannot use visual information for linguistic processing in an unfamiliar language. Higher coefficient of variation (ratio of standard deviation to the mean) in the α band power amplitude across electrode clusters of interest corresponded to faster response times in both groups, except for GLD task

responses on English stimuli. The overall results confirm that orthographic representations of visually presented words are activated simultaneously for both known languages even in late bilinguals.

F78

RAPID AND AUTOMATIC PROCESSES OF MOTOR SYSTEM ACTIVATION AND INHIBITION IN SPOKEN WORD COMPREHENSION

Yury Shtyrov[1], Anna Butorina[2], Anastasia Nikolaeva[2], Tatyana Stroganova[2]; [1]MRC Cognition & Brain Sciences Unit, Cambridge, UK, [2]Moscow State University of Psychology & Education, Moscow, Russia — Perception and action are functionally linked in the brain, but a hotly debated question is whether and to what extent cortical motor circuits are immediately involved in the perception and comprehension of external information, or whether their activation in perceptual tasks is a secondary post-comprehension phenomenon. To address this, we used MEG in combination with individual MR images to investigate the time course and neuroanatomical substrates of activations elicited in the human brain by action-related verbs and nouns, which were presented auditorily outside the focus of attention under a non-linguistic visual distractor task. We found that very early on in the course of perception – starting from about 80 ms after the information was available in the auditory input – both verbs and nouns produced characteristic somatotopic activations in cortical motor areas, with words related to different body parts activating the corresponding body representations (confirmed through a motor localiser task), which was most pronounced in the left pre-motor cortex. Moreover, near-simultaneously with this category-specific activation we observed suppression of motor-cortex activation by competitor words with incompatible action semantics, for the first time documenting operation of the neurophysiological lateral inhibition principle in neural word processing. The extremely rapid speed of these activations and deactivations, their emergence in the absence of attention and their similar presence for words of different lexical classes testify, in our view, to automatic involvement of motor-specific circuits in the perception of action-related language.

F79

CONNECTIVITY OF CORTICAL NETWORKS SUPPORTING SOCIAL AND NONSOCIAL, ABSTRACT AND CONCRETE CONCEPTUAL KNOWLEDGE

Laura Skipper[1], Ingrid Olson[1]; [1]Temple University — Concreteness is a critical organizing factor in semantic memory. While many neuroimaging studies have been carried out that contrast activations for abstract versus concrete concepts, there is little consistency in findings. Neuroimaging has relied on subtraction analyses to search for individual sites of activation responding to abstract/concrete concepts. In this study, we instead chose to explore the functional networks supporting abstract and concrete concepts via Psychophysical Interaction (PPI) analysis. Subjects engaged in a semantic task while undergoing functional MRI. Word stimuli varied on two factors: concreteness (abstract, concrete) and social content (social, nonsocial). Nonword trials made up the baseline trials. In each block, subjects viewed three words consecutively, all belonging to the same concreteness and social content condition. The task was to answer a meaningful question about the words. The left inferior frontal gyrus as the seed region. Results show a left-lateralized network for abstract and concrete concepts that were differentiated along an axis oriented on the superior temporal sulcus. Abstract concepts were part of a superior network including the angular gyrus, while concrete concepts were part of an inferior lobe network including the temporal pole and middle temporal gyrus (MTG). Further analyses revealed that some regions within these networks preferred social stimuli, such as the temporal pole, while other regions showed no preference, such as the posterior MTG. These results suggest that abstract and concrete concepts may be differentiated in the brain through the connectivity of distinct networks, and specific regions in these networks support knowledge of social content.

F80

AN EVENT-RELATED POTENTIAL STUDY OF AUTOMATIC SEMANTIC ACTIVATION OF EMBEDDED BILINGUAL WRITTEN WORDS

Jenna Todd Jones[1], Jeffrey Bowers[1], Nina Kazanina[1]; [1]University of Bristol — A recent study of semantic categorisation in monolinguals (Bowers, Davis & Hanley, 2004) demonstrated semantic interference to meaning related words embedded within larger non-related written words (e.g. "hat" within "that"). The present study examines whether the same effect of semantic interference could be elicited in a bilingual population using mixed linguistic stimuli, while maintaining a single language context. For example, would a cross-language embedded word in an equivalent task, such as the French "sel" meaning "salt" in the English "tinsel", instigate semantic interference in bilinguals similarly to monolinguals. Examination of the event-related potential (ERP) N400 index of semantic congruity was used as an indicator of automatic retrieval of native language word-forms, despite having participants operate solely in their second-language. We examined RTs and the N400 ERP in 24 French-English late bilinguals and a preliminary dataset of 15 English monolinguals. Participants rated semantic relationships between a common target (bird) and four primes: related (wings), English-embedded (reggae, including 'egg'), French-embedded (snide, including 'nid' meaning 'nest'), and unrelated (tourist). Bilinguals revealed a typical N400 disassociation for the related and unrelated conditions, and similarly for both the French-embedded and English-embedded conditions relative to the unrelated condition. Data from the monolingual sample again revealed an N400 disassociation for related and unrelated conditions, and similarly for English-embedded words but not French-embedded words. Results confirm that the interference elicited by embedded words in monolinguals occurs at the semantic level, and that this extends to a subtle bilingual inter-word context (despite previous evidence of context constraint on semantics).

F81

THE NEURAL CORRELATES OF COMPREHENDING AMERICAN SIGN LANGUAGE-ENGLISH CODE-BLENDS

jill weisberg[1], Stephen McCullough[1], Jennifer Petrich[1], Karen Emmorey[2]; [1]San Diego State University Research Foundation, [2]San Diego State University — Bimodal bilinguals fluent in English and American Sign Language (ASL) often "code-blend", producing signs and words simultaneously. We have recently shown that code-blending facilitates comprehension in both languages (Emmorey et al., 2012). We investigated the neural basis of this facilitation using fMRI to examine cortical recruitment during bimodal bilingual perception of code-blends. Fourteen hearing native ASL-English bilingual adults made semantic decisions ('Is it edible?') to audiovisual clips of a native hearing signer producing a) an ASL sign; b) a spoken English word; or c) a sign and spoken word simultaneously. Three imaging runs (3T, TR = 2s, 30 sagittal slices with voxel size = 3.75 x 3.75 x 4.5) each presented two 30s blocks per condition (10 trials/block) and control blocks displaying the model at rest. Individuals' fMRI responses were estimated using multiple regression, and parameter estimates for each condition were entered into a group-level mixed effects ANOVA. Code-blending recruited a combination of brain regions active for each language alone, with increased activation for simultaneous perception of sign and speech in relevant modality-specific regions. Moreover, we found reduced activation during code-blend comprehension, compared to ASL alone, in bilateral occipitotemporal cortex (area MT/V5), left precentral gyrus, and right anterior insula. These decreases may be a neural reflection of the behavioral facilitation previously observed for code-blend comprehension. Increased activity during ASL comprehension may also reflect greater effort during ASL processing in the absence of redundant cues from spoken English.

F82

THE ROLE OF THE LEFT ANTERIOR TEMPORAL LOBE IN SEMANTIC MEMORY VS. SENTENCE PROCESSING

Masha Westerlund[1], Doug Bemis[2], Liina Pylkkänen[1]; [1]New York University, [2]CEA-INSERM Neurospin — The left anterior temporal lobe (LATL) is robustly implicated in semantic processing by a growing body of literature. However, these results have emerged from two distinct bodies of work. On the one hand, the LATL has been characterized as a 'semantic hub' that binds features of distributed concepts, based on results from semantic dementia. On the other, the LATL has been implicated in combinatorial operations in language, as shown by increased activity in this region associated with the processing of sentences and of basic phrases. The present work aimed to reconcile these two literatures by independently manipulating combination and concept specificity within a minimal MEG paradigm. We used a task from the literature on specificity (Rogers et al., 2006) in which subjects had to match images to either less specific ('boat) or more specific nouns ('canoe'), during MEG recordings. Crucially, the nouns were either presented alone (preceded by a consonant string, e.g. 'xhsl boat'/'canoe'), or in a combinatory

context (preceded by an adjective, e.g. 'blue boat'/'canoe'). Neural activity was measured from the onset of the target noun in all conditions, such that the activity elicited by combinatory and non-combinatory operations was measured at the same lexical items. We identified significantly greater composition-related activity in the LATL for the less specific nouns ('blue boat' v. 'xhls boat') as compared to the more specific nouns ('blue canoe' v. 'xhls canoe') between 222-254 ms. These results suggest that we can modulate combinatorial activity simply by modifying the properties of the noun being composed.

F83

INFLUENCE OF SELECTIVE ATTENTION ON STORY COMPREHENSION Steven Small[1], Jie Yang[1], Uri Hasson[2], Emily Cooper[3]; [1]Brain Circuits Laboratory, Department of Neurology, University of California Irvine, USA, [2]Center for Mind/Brain Sciences, The University of Trento, Italy, [3]Helen Wills Neuroscience Institute, University of California Berkeley, USA — When people comprehend a story, their prior knowledge and intrinsic motivation influence how they make inferences and develop interpretations about the story content. The current fMRI study applies a new method to data acquired in previous investigation (Cooper et al, Neuroimage, 2011) of the role of selective attention in modulating the functional neuroanatomy of story comprehension. Twelve participants were asked to focus on action- (e.g., run, eat), space- (e.g., in the zoo), or time-related information (e.g., yesterday) when they listened to identical stories. In each condition, group independent component analysis (ICA) and simple correlation analysis were conducted to identify components correlated with story listening. Subsequently, Granger Causality (GC) analysis was used to test causal influences among the components. All three conditions produced strong ICs in both superior temporal gyri (STG) and anterior temporal lobes, reflecting speech processing and semantic integration during story comprehension. The space condition selectively produced an IC in both insulae, presumably related to spatial processing. The time condition strongly engaged ICs in both insulae, left posterior MTG, and left middle frontal gyrus (MFG), suggesting that comprehending temporal features requires extra resources for lexical semantic processing and working memory. The action condition strongly engaged one IC in the left middle MTG, presumably reflecting action feature processing. GC analysis indicated different patterns of causal influences among the ICs in each condition. These results indicate a previously unrecognized role in how selective attention can modulate the biological processes for story comprehension, with integration of linguistic and semantic feature information.

F84

NPI LICENSING IN TURKISH: AN ERP STUDY Aydogan Yanilmaz[1], John Drury[1]; [1]Stony Brook University — Negative polarity items (NPIs) include words like "any/ever" which must co-occur with a licensor (e.g., negation) in order to be well-formed (e.g., "…has *ever left" versus "…has NOT ever left"). Further, licensor/NPI-dependencies must realize a particular syntactic/hierarchical relationship (e.g., in "[A man with NO beard] has *ever left" negation is a structurally ineligible licensor since it is nested inside a preceding relative clause). NPIs represent a type of logical-semantic/pragmatic deviance which has attracted increasing attention in the ERP literature. A common finding is that unlicensed NPIs elicit P600-type effects (Steinhauer et al. 2010). However, NPI-licensing has typically been investigated in languages where licensor/NPI-dependencies are retrospective (i.e., negation does not predict the occurrence of NPIs). In these languages (e.g., English/German) "intrusion-effects" have been found where NPIs seem to be "attracted" by preceding but structurally ineligible licensors (despite their ungrammaticality), resulting in attenuation of on-line violation ERP effects. However, it is unknown whether such intrusion-effects are conditioned by the nature of the memory/retrieval mechanisms supporting these retrospective dependencies. We conducted an ERP reading study (N=10) in Turkish, where NPIs typically precede licensors (prospective/predictive dependency), testing sentences with embedded clauses and NPI-subjects (e.g., [NPI[…embedded-Verb]main-Verb]) and manipulating the presence/absence of negation on the embedded/main-verbs. Only main-verb negation licenses Turkish main clause subject-NPIs; embedded-verb negation could result in an intrusion-effect. Among other findings, our results showed that, like other languages, unlicensed NPIs in Turkish yield P600-like responses. Further, similar to findings from English/German, violation effects were attenuated by the presence of "intrusive" (embedded-negation) licensors.

F85

CONTEXT INFLUENCES THE ELECTROPHYSIOLOGICAL CORRELATES OF SEMANTICALLY ENRICHED COMPOSITION Megan Zirnstein[1], Matthew J. Traxler[2], Tamara Y. Swaab[2]; [1]Pennsylvania State University, [2]University of California, Davis — The current study utilized ERP methods to test the degree to which enriched composition is affected by prior context. Complement coercion, a form of enriched composition, occurs when two syntactically compatible, but semantically mismatching elements are combined in an expression (e.g., started the book). The semantic mismatch triggers the coercion of one element from an entity into an event sense (e.g., read the book), resulting in processing costs when compared to control expressions. Whether enriched composition is primarily driven by semantic or syntactic operations is currently under debate. Previous ERP work has shown that coerced nouns elicit an N400 response similar to that of semantically anomalous nouns (e.g., astonished the book; Baggio et al., 2009; Kuperberg et al., 2010). Coercion costs, then, should be sensitive to semantic manipulations inter- and intra-sententially. However, some behavioral research has shown that this may not be the case (Frisson & McElree, 2008; Traxler et al., 2005). In the current study, participants read sentence pairs while having their EEG recorded. The sentence pairs included context sentences that either fully specified or underspecified the activity implied by the coercing expression in the paired target sentence (e.g., "reading" for "started the book"). Contrary to previous findings, context modulated the ERP response to the word following the coerced noun, with the fully specified and underspecified contexts eliciting N400 and P600 effects, respectively. These results demonstrate that event information in prior context can change the nature of the cost associated with coercion, but does not attenuate said cost.

F86

PREFRONTAL CONTRIBUTIONS TO RELATIONAL ENCODING IN HEALTHY AGING AND MILD COGNITIVE IMPAIRMENT Chris Foster[1], Donna Addis[2], Jaclyn Ford[1], Daniel Kaufer[1], Jeffrey Browndyke[3], Kathleen Welsh-Bohmer[3], Kelly Giovanello[1]; [1]University of North Carolina at Chapel Hill, [2]The University of Auckland, New Zealand, [3]Duke University — Relational encoding relies on two distinct mnemonic mechanisms, binding and generation. Patients with mild cognitive impairment (MCI), a transitional period between normal aging and very early Alzheimer's disease, show deficits in hippocampal-mediated binding mechanisms, but the status of frontal-based generation processes remains unclear. The current study utilized functional magnetic resonance imaging during encoding to investigate the parametric responses of frontal and hippocampal regions to varying amounts of generative processing in MCI and healthy older adults. Participants made judgments about the relatedness, or number of links, between three word triads and were given an incidental memory test at retrieval. Triads consisted of a category name and two exemplars and semantic relatedness was manipulated across three levels. At encoding, control participants and MCI patients showed equivalent accuracy for relatedness judgments when triads consisted of two related exemplars, but MCI patients were impaired as the number of related links decreased. During the two alternative forced-choice test, patients showed an overall decrement in recognition performance compared to the control group. At the neural level, both groups recruited lateral temporal and parietal cortices as semantic relatedness decreased; however, middle frontal and inferior frontal gyri were recruited significantly more by MCI patients relative to controls as relatedness decreased. In the early stages of cognitive decline, an over recruitment of frontal neural regions appears to aid in the performance of generative processing involved in relational memory. Such findings extend past research and show that over recruitment occurs for both binding and generation in MCI.

F87

PREFRONTAL GRAY MATTER VOLUME MEDIATES AGE EFFECTS ON STRATEGIC PROCESSING Brenda A. Kirchhoff[1], Brian A. Gordon[2], Denise Head[2]; [1]University of Missouri - St. Louis, [2]Washington University in St. Louis — Episodic memory is one of the domains of cognition most sus-

ceptible to decline with age. Prior research suggests that age differences in the strategies that individuals spontaneously use to learn new information contribute to age differences in episodic memory. Currently, relatively little is known regarding what factors drive age differences in self-initiated memory strategies. This study investigated the role of prefrontal structure in age differences in self-initiated memory strategies. Specifically, we explored whether the brain regions that support self-initiated memory strategies change with age, and whether regional prefrontal gray matter volumes mediate age effects on self-initiated memory strategies. The relationships among age, regional prefrontal gray matter volume, and semantic and serial clustering on the California Verbal Learning Test were examined across the adult lifespan (ages 18 – 91). Age was negatively correlated with both serial and semantic clustering. Serial clustering was not significantly correlated with gray matter volumes. Semantic clustering was positively correlated with grey matter volume in left caudal middle, left inferior, and right rostral middle regions of prefrontal cortex. Age did not moderate the relationships between serial and semantic clustering and gray matter volumes. Importantly, grey matter volume in left caudal middle, left inferior, and right rostral middle regions of prefrontal cortex mediated age effects on semantic clustering. These results suggest that the same regions of prefrontal cortex support self-initiated semantic memory strategies across the lifespan. They also suggest that prefrontal gray matter volume mediates the effects of age on self-initiated memory strategies.

F88

RECOLLECTION AND FAMILIARITY DECLINES IN HEALTHY AGING, AMCI, AND AD

Joshua Koen[1], Andrew Yonelinas[1]; [1]University of California, Davis — Many cognitive abilities show marked deficits in the elderly, including the ability to recognize specific details about previous events. Recognition memory is supported by recollection of specific details associated with a prior episode or by assessments of an event's familiarity. There is strong evidence that recollection declines with healthy aging, but the fate or familiarity is less clear. A quantitative review of 54 published studies examining age-related declines in recollection and familiarity showed large age-related declines in recollection and small, yet detectable declines in familiarity. One factor that appeared to mediate familiarity declines was the use of different estimation methods across studies. To further probe this possibility, we examined recognition memory in 40 adults between the age of 40 and 81using the process-dissociation, remember/know, and receiver-operating characteristic procedures. Age-related declines were evident recollection, but not familiarity, and the pattern did not differ across the estimation methods. A second factor that may underlie age-related familiarity declines is the inclusion of individuals with preclinical dementia. In line with this possibility, a review of 10 additional studies revealed that patients with amnestic mild cognitive impairment (aMCI) and Alzheimer's disease (AD) have large declines in both recollection and familiarity. In conclusion, both healthy and pathological aging leads to large declines in recollection. However, familiarity deficits are large in individuals with aMCI and AD but are much smaller (and sometimes nonexistent) in healthy aging individuals. These data suggest that measures of familiarity may be useful in the identification of individuals who will develop memory impairments.

F89

HOW FLUENCY SUPPORTS SOURCE MEMORY FOR FAMILIAR NAMES IN YOUNGER AND OLDER ADULTS: EVIDENCE FROM EVENT-RELATED POTENTIALS

Jessica Komes[1], Stefan R. Schweinberger[1], Holger Wiese[1]; [1]DFG Research Unit Person Perception & Department of General Psychology and Cognitive Neuroscience, Friedrich Schiller University of Jena — It is a matter of current debate whether and how the access to source information may rely not only on recollection, but on fluency-based processes as well. By means of behavioral measures and event-related potentials (ERPs), the present experiments examined potential influences of fluency on source memory for famous names. In Experiment 1, with visual presentation at test, source judgments were more accurate for repeated visually learned versus non-repeated visually learned names, whereas no such beneficial effect was apparent for repeated auditorily learned versus non-repeated auditorily learned names. Additionally, visually presented items at test elicited an N400-like ERP effect (300-600 ms), differentiating between visually and auditorily learned names, for correct source memory decisions only. We interpret this effect as indexing a decision-relevant fluency mechanism arising from within-modality priming of visually learned names. This idea was further supported in Experiment 2, in which the pattern of behavioral and ERP effects for older adults was found to be analogous to the one in younger adults, in line with the assumption of spared fluency processes in older adults. In sum, the experiments suggest that fluency assists person-related source memory via within-modality priming in both younger and older adults.

F90

WHITE-MATTER INTEGRITY IN UNCINATE FASCICULUS AND FORNIX IS ASSOCIATED WITH AGE-RELATED DIFFERENCES IN HIPPOCAMPAL BOLD ACTIVITY DURING EPISODIC RETRIEVAL

Joshua Lee[1,2], Carter Wendelken[3], Julia Ross[2], Jacqueline Pospisil[2], Marcos Sastre[2], Silvia Bunge[3,4], Simona Ghetti[1,2]; [1]University of California, Davis, Department of Psychology, [2]University of California, Davis, Center for Mind and Brain, [3]University of California, Berkely, Helen Wills Neuroscience Institute, [4]University of California, Berkely, Department of Psychology — Recent evidence indicates that the contribution of hippocampus to episodic memory changes during childhood, but mechanisms underlying this change are largely unknown. In the present study, we tested the hypothesis that the integrity of white-matter tracts projecting from the hippocampus to prefrontal cortex (uncinate fasciculus) and/or to subcortical structures (fornix) influences functional activity in the hippocampus during childhood. We have collected fMRI and DTI data for 49 children ages 8-11 as part of a larger study. Fractional anisotropy (FA) values were obtained for regions of interest in the uncinate and fornix. The fMRI task involved memory for the association between images of objects and the specific scene with which they had appeared. Hippocampal BOLD activation was measured from the contrast of accurately remembered vs. inaccurately remembered object-scene associations. In the younger but not older children (from a median split), there was a positive correlation between uncinate FA and the contrast in hippocampal activation, $r(25) = .43$, $p < .05$. By contrast, in the older but not younger children, there was a negative correlation between fornix FA and the contrast in hippocampal activation, $r(24) = -.55$, $p < .01$. These preliminary results suggest that age-related differences in hippocampal function are influenced by the relative strength of anatomical connections with prefrontal and subcortical projections.

F91

INDIVIDUAL DIFFERENCES IN CRITERION SHIFTING DURING RECOGNITION MEMORY ACROSS THE LIFESPAN

Brian Lopez[1], Tyler Santander[1], Misty Schubert[1], Justin Kantner[1], Craig Bennett[1], Michael Miller[1]; [1]University of California, Santa Barbara — A critical aspect of recognition memory is the integration of available memory evidence and a decision criterion. Previous work has shown that several cognitive and personality factors can affect the placement of a decision criterion. Furthermore, episodic retrieval and criterion shifting involve distinct brain regions that are engaged differentially across individuals depending on unique characteristics and strategies. In this study we attempted to quantify how development and aging interact with such factors in their influence on criterion placement during recognition memory. Recognition behavior and regional brain activity were examined in late adolescents, young adults, and elderly adults during an fMRI task involving criterion shifting. The degree of shifting between a liberal and conservative criterion in high- and low-target-probability conditions was quite variable across participants. However, on average there were not significant differences in discriminability or criterion placement between groups. Analysis of task-related brain activity revealed that groups similarly recruited frontoparietal regions typically associated with memory retrieval. Despite overall similarities, significant differences in inter-subject variability between groups was observed with elderly adults being the most variable, followed by late adolescents, then young adults. We examined how personality and cognitive characteristics, brain connectivity, task performance, strategy, and other factors explained this variability, with different factors emerging as significant predictors for each group. These results provide a comprehensive examination of the underlying factors that account for individual variability in criterion shifting during recognition memory across the lifespan. Supported by the Institute for Collaborative Biotechnologies through grant W911NF-09-0001 from the U.S. Army Research Office.

F92

EMOTIONAL MEMORY AND PSYCHOPHYSIOLOGICAL REACTIVITY FOLLOWING A NIGHT OF SLEEP Jessica Payne[1]; [1]University of Notre Dame, Department of Psychology — 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 suggest 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.

F93

A NETWORK FOR NAVIGATION: CROSS-HEMISPHERIC HIPPOCAMPAL CONNECTIVITY PREDICTS WATER MAZE PERFORMANCE Jonas Persson[1], Eva Stening[1], Johan Wikström[1], Hedvig Söderlund[1]; [1]Uppsala University, Sweden — Extensive research has shown that the hippocampus is crucial for flexible navigation and spatial memory, but given the complexity of such cognitive abilities, hippocampal activity alone is likely insufficient to fully account for successful performance. Earlier findings have identified other brain structures subserving relevant cognitive processes, though few studies have directly investigated hippocampal connectivity with these areas during navigation and to what extent connectivity is related to performance. To answer this question, we had twenty participants (25.3±3.2 years of age) perform a virtual Water Maze task. During performance, the right posterior hippocampus showed increased activity for hidden versus visible platforms. Using this area as a seed, a psychophysiological interaction analysis was performed. This revealed task-modulated functional connectivity with the right precuneus, possibly reflecting a translation between egocentric and allocentric representations during encoding of the platform location. When considering performance, faster platform finding was associated with greater connectivity with the left anterior hippocampus. Given earlier evidence of hemispheric specialization, this may reflect an integration of verbal and spatial mnemonic processes that is beneficial for performance. When considering activation only, no correlation was found between performance and hippocampal activation in corresponding areas. This study reveals hippocampal connectivity during Water Maze performance and shows that it is cross-hemispheric connectivity within the hippocampus, not hippocampal activation in these regions per se, that predicts navigation ability.

F94

THE EFFECTS OF ITEM FAMILIARITY ON THE NEURAL CORRELATES OF SUCCESSFUL RELATIONAL MEMORY ENCODING Kristina M. Peterson[1], Christina E. Johnson[1], Nancy A. Dennis[1]; [1]The Pennsylvania State University — Relational memory is resource demanding in that participants are required not only to learn individual items, but also the specific relationships between individual items. Previous research has shown that prior study of individual items aids in relational memory for pairs composed of those same items compared to pairs of items that were not pre-learned (Kilb & Naveh-Benjamin, 2011). The current study sought to elucidate the neural correlates mediating this memory facilitation. After being trained on, or familiarized with individual faces and scenes, participants were scanned while encoding face-scene pairs composed of items from the pre-trained phase (familiarized-item pairs) and pairs whose items had not previously been learned (unfamiliarized-item pairs). Overall subsequent recollection showed engagement of bilateral parahippocampal gyrus (PHG) and hippocampus when compared to subsequent familiarity – a finding consistent with previous literature. However, a comparison between familiarized and unfamiliarized-item pairs showed that subsequently recollected unfamiliarized-item pairs were associated with increased activity across the encoding network including bilateral PHG, hippocampus and right medial prefrontal cortex (PFC); whereas no region exhibited greater activity for encoding of familiarized-item pairs. Results suggest simultaneous encoding of both items and the relationship between items leads to increased recruitment of encoding resources in the PHG and PFC, whereas familiarized-item pairs may utilize the preexisting trace of individual items when encoding pairs of items. These results highlight the demands of relational memory on medial temporal lobe processing and suggest a means by which such demands can be alleviated with prior exposure to individual items.

F95

DISSOCIATION OF ITEM-SPECIFIC AND RELATIONAL MEMORY IN SCHIZOPHRENIA USING SIMULTANEOUS EYE-TRACKING AND FMRI METHODS Joshua Phillips[1], Deborah Hannula[2], Jeremy Le Veque[2], Cameron Carter[1], Charan Ranganath[1], J. Daniel Ragland[1]; [1]University of California, Davis, [2]University of Wisconsin, Milwaukee — In a previous study that combined behavioral and eye tracking measures our group examined whether or not relational memory was impaired in patients with schizophrenia. We predicted that memory for items would remain intact, while memory for spatial relationships among items would be disrupted. While behavioral results showed that patients had an overall performance deficit, eye movement data pointed to a specific impairment on the test of relational memory. To investigate the neural correlates of this impairment we adapted the task used in our earlier work for fMRI, which is the focus of the current presentation. Simultaneous eye-tracking and fMRI data were obtained from 20 schizophrenia patients and 18 controls and fMRI data were examined for task and group effects using behavioral and eye-tracking covariates. As reported previously, patients showed a generalized memory deficit, but eye-movement-based memory effects were more specific, and replicated the results described above. Preliminary fMRI results are congruent with the eye tracking results and failed to show any group differences in whole-brain activation in the item memory condition. In contrast, patients showed reduced activation in the left DLPFC, left middle temporal gyrus, and several subcortical regions (amygdala and caudate) during the relational memory condition. These results confirm previous behavioral and fMRI results indicating that item-specific memory is relatively intact, whereas DLPFC control of relational memory processes is specifically impaired. Eye-tracking procedures were well tolerated by patients and played a key role in dissociating memory processes.

F96

RELATIONSHIP BETWEEN BEHAVIORAL AND ELECTROPHYSIOLOGICAL MEASURES OF PROSPECTIVE MEMORY IN HEALTHY ADULTS AND ADULTS WITH TRAUMATIC BRAIN INJURY Sarah Raskin[1], Navneet Kaur[1], Conseulo Pedro[1]; [1]Trinity College — Prospective memory (PM) is remembering to do something in the future and involves the ability to form and later realize intentions that are delayed over time (Einstein & McDaniel, 1990). The purpose of this experiment was to examine the underlying brain activity related to PM using event-related potentials (West & Ross-Munroe, 2002) and to determine the relationship between the electrophysiological measures and behavioral performance, as measured by the Memory for Intentions Screening Test (MIST) (Raskin, Buckheit, & Sherrod, 2011) in both healthy individuals (HA) and individuals with traumatic brain injury (TBI). Results showed that individuals with TBI performed worse than HA on all variables of both the MIST and the computerized behavioral test. They also showed smaller amplitudes on all ERPs of interest when compared to HA. Lastly, when comparing the MIST and the computerized behavioral data, the MIST correlated more strongly with reaction time of the computerized behavioral test than with any other variables. Overall, these findings suggest that individuals with TBI have deficits in PM compared to HA and that the MIST and the computerized-behavioral tests are measuring similar PM-related processes.

F97

AUTOBIOGRAPHICALLY SIGNIFICANT CONCEPTS: MORE EPISODIC THAN SEMANTIC IN NATURE? AN ELECTROPHYSIOLOGICAL INVESTIGATION OF OVERLAPPING TYPES OF MEMORY

Louis Renoult[1,2], Patrick Davidson[2], Erika Schmitz[2], Lillian Park[3], Kenneth Campbell[2], Morris Moscovitch[1], Brian Levine[1]; [1]Rotman Research Institute, Baycrest, Toronto, Ontario, Canada, [2]University of Ottawa, Ontario, Canada, [3]SUNY College at Old Westbury, NY, USA — A common conception is that semantic memory emerges from episodic memory, shedding the distinctive contexts associated with episodes. Some semantic concepts, such as names of people, however, may retain their episodic origins or acquire episodic information during life experiences. The current study examined this hypothesis by investigating the event-related potential (ERP) correlates of autobiographically significant (AS) concepts, that is, semantic concepts that are associated with vivid episodic memories. We compared famous names that easily brought to mind episodic memories (high AS names) against equally famous names that did not bring such recollections to mind (low AS names), on a semantic task (fame judgment) and an episodic task (recognition memory). We inferred the contribution of semantic and episodic memory to AS concepts, using the amplitude of the N400 and LPC event-related potentials (ERPs), respectively. Compared to low AS names, high AS names were associated with increased amplitude of the LPC in both tasks. Moreover, in the recognition task, the LPC effect of AS was highly correlated with that of recognition confidence. In contrast, the N400 did not differentiate the two kinds of names in any of the tasks, but instead was related to the amount of general knowledge participants had of each person. These results thus supported our hypothesis that semantic concepts high in AS also appear to have an episodic component, and are associated with the same neural correlates that are engaged by episodic memory. Studying these AS concepts may provide insights into how episodic and semantic memory interact.

F98

THE EFFECTS OF IMMEDIATE TESTING ON NEURAL CORRELATES OF RECOLLECTION

Timm Rosburg[1], Axel Mecklinger[1], Michael Weigl[1], Mikael Johansson[2]; [1]Saarland University, [2]Lund University — The testing effect is conceptualized as the benefit for remembering items that were studied and tested rather than just studied. Yet, little is known about its neural correlates. In an event-related potential (ERP) study, we investigated how testing affects subsequent recollection processes. During an initial study phase, 32 participants encountered object names together with pictures of the denoted object ('perceived items') or with the instruction to mentally visualize them ('imagined items'). In two consecutive source memory tests, participants had to differentiate between perceived, imagined, and newly presented items. Half of the studied items were presented in the first run and all items in the second. Behaviorally, repeated testing led to improved item and source memory, as well as faster reaction times, as compared to items that were only tested once. In accordance with these behavioral changes, the left-parietal old/new effect (500-700 ms) as putative correlate of recollection was strongly enhanced by previous testing. An enhancement after testing was also observed for the early portion of the late right frontal old/new effect (700-900 ms). This old/new effect was, however, also modulated by memory source, with larger effects for imagined items than for perceived items. Such a modulation by memory source was also revealed for the late posterior negativity (LPN, 900-1500 ms), that was largely unaffected by repeated testing. Our study shows that immediate repeated testing has an impact on retrieval related old/new effects, while later occurring old/new effects related to post-retrieval processes are clearly less modulated by repeated testing.

F99

THE ROLE OF CONSCIOUS AWARENESS IN MTL AND CORTICAL PROCESSING OF SCENE CONFIGURAL SIMILARITY

Anthony Ryals[1], Joel Voss[1]; [1]Northwestern University Feinberg School of Medicine — MTL structures are involved in memory for relationships among items even when conscious awareness for these relationships is lacking. However, less is known regarding neural processing that supports memory for and awareness of the stable configurations of features that define complex scenes. Memory for feature configurations could depend on MTL processing and be expressed without an individual's awareness, whereas awareness could depend on co-involvement of MTL and prefrontal cortical structures. To test these possibilities, we measured awareness and brain activity during a memory paradigm that involved manipulation of scene configural similarity (SCS). Participants studied scenes and then were tested using scenes that were high in SCS to studied scenes, in that objects and features had the same configuration despite being comprised of different objects, colors, textures, etc. They then rated familiarity for high SCS scenes and for new non-SCS scenes, and also reported recollection of corresponding studied scenes. Familiarity ratings were significantly associated with SCS even when subjects did not recollect, indicating that SCS memory may not require recollection. Furthermore, judgments of learning during study were unrelated to SCS memory, but strongly predicted high-accuracy recognition of studied scenes, indicating that subjects were relatively unaware of processing that supported SCS memory. In a pilot version of this task (N=13), MTL activity distinguished familiarity and recollection for SCS. MTL and cortical activity in the current paradigm will be discussed with respect to SCS memory expressed with awareness versus expressed through eye-movement measures of unaware memory that were obtained throughout the experiment.

F100

THE ROLE OF PREDICTION ERRORS IN CONTROL OF RECOGNITION MEMORY DECISIONS

Jason M. Scimeca[1], Perri L. Katzman[1], David Badre[1]; [1]Brown University — An outstanding question regarding cognitive control of memory is how we evaluate and update memory strategies and mnemonic control representations. Previous research in recognition memory has demonstrated that external feedback does not typically guide participants to establish a more appropriate recognition criterion. However, recent work has shown that false feedback can induce dramatic shifts in recognition criteria. We hypothesized that prediction errors (PEs) are the critical learning signal for updating recognition criteria. In a recognition memory task, we provided false positive feedback to differentially reinforce "old" or "new" responses and found that participants gradually become more likely to make the reinforced memory decision. Critically, we manipulated how much this feedback deviated from participants' expectations by providing the false positive feedback either on trials when participants gave high or low confidence ratings. If participants' confidence ratings reflect their expectation of making a correct response, then false positive feedback following low confidence ratings should lead to a large deviation from their expected outcome. We found that participants who received false positive feedback primarily on low confidence responses showed greater shifts in their response criterion. This is consistent with a learning process mediated by PEs, and with recent theories positing an important role for frontal-striatal circuits in the cognitive control of declarative memory (Scimeca & Badre, 2012). The striatum is known to represent PEs in the reinforcement learning domain, and the present results provide a basis for future neuroimaging work to test whether similar striatal PEs support the updating of recognition memory criteria.

F101

COMMON AND DISTINCT NEURAL STRUCTURES SUPPORT AUTOBIOGRAPHICAL MEMORY, SEMANTIC AND IMAGERY-BASED RETRIEVAL.

Signy Sheldon[1,2], Brian Levine[1,2]; [1]Rotman Research Institute, Baycrest Centre for Geriatric Care, [2]University of Toronto — There is a growing interest in the neural overlap between autobiographical memory retrieval and other forms of retrieval. In this study, we explore the commonalities and distinctions between the neural substrates that support autobiographical memory retrieval, semantic retrieval and imagery. Participants were cued with pictured objects and asked to recall a past personal event (autobiographical), think of a location for the object and list other objects that may also be located there (semantic) or imagine object-based sensory details (imagery) during fMRI scanning. We identified a network common to autobiographical, semantic and imagery retrieval that included inferior frontal, temporal and parietal activity. A follow-up exploratory analysis identified patterns of brain activity that distinguished between the autobiographical, semantic and imagery conditions. This analysis also revealed a separate pattern that related to commonalities between the autobiographical and imagery condition, but not the semantic condition, that included regions such as the inferior frontal gyrus and superior and inferior parietal lobule.

Altogether, these findings indicate that while there is a common network for retrieval regardless of content, distinctions are evident between the three tasks. The association between the autobiographical and imagery condition suggest that there is a strong link between detail retrieval associated with imagery and autobiographical memory.

F102

THEORY OF MEMORY: NEURAL CORRELATES OF SUCCESSFUL DIFFERENTIATION OF SHARED VERSUS NON-SHARED MEMORY

Yeonsoon Shin[1], Sehjung Yi[1], Sanghoon Han[1]; [1]Yonsei University, Seoul, Korea — A crux of social relationship lies at both sharing experiences with others and remembering the experiences appropriately. Especially, it is crucial to have Theory of Memory and differentiate others' memory status from our own. In an fMRI study, we aimed to find brain regions that consistently represent socially shared/non-shared memory, using Representational Similarity Analysis (RSA). Specifically, we focused on the role of temporo-parietal junction (TPJ), which is an important region for Theory of Mind, during social memory. Participants were scanned while performing memory tasks in three conditions: other-shared (OS), other-non-shared (ON), and self-alone (SA). During encoding phase, subjects encoded word stimuli presented with video clips where other person either attended the word (OS) or did not (ON), resulting in shared and non-shared memory respectively. While watching the clip, they were asked to make a meta-memory judgment of other. In test phase, they retrieved word with old/new recognition memory paradigm in their own perspective (SA) or in other's perspective (OS, ON). GLM analysis revealed that OS/ON encoding elicited greater TPJ involvement than SA. Moreover, this region was more involved in OS than ON, differentiating shared memory from non-shared memory. While GLM analysis did not reveal any difference between OS and ON at retrieval, RSA more sensitively discerned consistent pattern representations in TPJ for successful memory of shared versus non-shared episodes. Our data provide evidence that TPJ is mainly involved in encoding other's memory status and represents a pattern for shared memory more consistently.

F103

POSTERIOR CINGULATE SHOWS GREATER ACTIVATION DURING SCENE PROCESSING IN YOUNG ADULT CARRIERS OF THE APOE-4 ALLELE

Jonathan Shine[1,2], Carl Hodgetts[1], Andrew Lawrence[1], Julie Williams[3], Paul Hollingworth[3], Rebecca Sims[3], Toby Lloyd-Jones[4], Richard Wise[2], Kim Graham[1]; [1]Wales Institute of Cognitive Neuroscience, School of Psychology, Cardiff University, [2]Cardiff University Brain Research Imaging Centre, School of Psychology, Cardiff University, [3]MRC Centre for Neuropsychiatric Genetics and Genomics, Cardiff University, [4]Wales Institute of Cognitive Neuroscience, School of Psychology, Swansea University — Presence of the APOE-4 allele is associated with an increased risk of developing Alzheimer's disease (AD). Recent imaging studies have reported differences in brain activity between carriers and non-carriers of the APOE-4 allele, but findings have been inconsistent over the direction and location of these effects (Trachtenberg et al., 2010). In one seminal study, healthy young carriers of APOE-4, relative to non-carriers, showed increased activity in the "default mode network" during resting state fMRI, and increased activity in hippocampus (HC) during memory encoding (Filippini et al., 2009). Here, we asked whether these group differences would be affected by the type of stimuli to be remembered, based on evidence that patients with AD and Mild Cognitive Impairment (MCI) show particular difficulties with scene, but not face, processing (Lee et al., 2007). Thirty healthy young adults, half of whom carried the APOE-4 allele, performed a 1-back matching task with objects, faces, scenes and scrambled objects during fMRI. Group-level differences in BOLD signal were evident in posterior cingulate; these reflected a between-group difference in scene, but not face or object, processing. Specifically, APOE-4 carriers showed significantly greater BOLD response associated with scene processing. These findings support previous studies highlighting differences in the BOLD response in young participants who are carriers of the APOE-4 allele, but in addition show that these can be extended beyond long-term memory to working memory, and may be particularly prominent during spatial processing (consistent with the earliest cognitive deficits seen in AD and MCI, Pengas et al., 2010).

F104

ROLE OF HIPPOCAMPAL SUBREGIONS IN DISAMBIGUATING ELEMENTS OF TEMPORAL VS. SPATIAL CONTEXT IN EPISODIC MEMORY

Dana Smuda[1], Colin Kyle[1], Jared Stokes[1], Arne Ekstrom[1]; [1]University of California, Davis — Despite widespread agreement that the hippocampus is critical for representation of spatial and temporal context of remembered episodes, the nature and mechanisms of underlying processes remain debated. One proposal is that spatial and temporal information are handled differentially by CA3 and CA1, respectively (Rolls and Kesner, 2006). An alternative idea suggests both subregions are involved in processing spatial and temporal context, but differ in terms of processing the underlying representations. Ten participants played a virtual taxi-driver game in which they searched for stores in a specific order, learning both the temporal order of deliveries and the spatial layout of the stores. Participants then judged the relative serial position (temporal context) and the relative distance (spatial context) of these while undergoing high-resolution fMRI (structural: .4X.4X2mm; functional: 1.5x1.5x2mm) targeting the hippocampus. Reaction time (RT) data showed that judgments of temporal order were faster (t-test, $p < .001$) for nearby stores ($M = 3.1221$ seconds, $SE = 0.3021$) than distant stores ($M = 3.6623$, $SE = 0.0444$) while spatial layout RTs showed no such difference ($M = 2.1554$, $SE = 0.0444$, $M = 0.3047$, $SE = 0.0440$, respectively. Representational similarity (RS) analyses of fMRI data showed that temporal context retrieval resulted in significantly lower RS compared to spatial layout retrieval (t-test, $p< .001$); RS varied as a function of distance for temporal but not spatial context. Our behavioral and neuroimaging are consistent with a more coherent representation of spatial layout, compared to a distinct representation of elements in a temporal order.

F105

EXPLORING THE FOUNDATION OF RESTING STATE CONNECTIVITY IN THE HIPPOCAMPUS USING DIFFUSION WEIGHTED IMAGING (DWI) BASED PARCELLATION

Areeba Adnan[1], Massieh Moayedi[1,2], Cornelia McCormick[1,2], Mary Pat McAndrews[1,3]; [1]Toronto Western Research Institute, [2]Institute of Medical Sciences, University of Toronto, [3]Department of Psychology, University of Toronto — Introduction: The hippocampus is well known to be a critical structure supporting recollection. Recent evidence based on functional connectivity in fMRI suggests that the anterior and posterior segments of the hippocampus may play different roles in this process (Poppenk & Moscovitch, 2011). In the present study, we investigated the possibility that the functional heterogeneity of the hippocampus arises from the distinct structural sub-regions that can be distinguished on the basis of their connectivity. Methods: We used DWI tractography based parcellation to divide the hippocampus into distinct sub-regions on the basis of differences in estimated structural connections to the rest of the brain. Then, we used resting-state functional connectivity to determine the different connectivity profiles of these regions. Results: Our methods revealed that parcellation based on intrinsic structural connectivity reliably segmented the hippocampus into distinct anterior and posterior segments bilaterally. We then used these bilateral DTI parcellated anterior and posterior segments as seeds in a functional connectivity analysis using the Conn toolbox in SPM8. Using a contrast looking at anterior > posterior, we found connections to the frontal and temporal regions including the temporal pole. Using a posterior > anterior contrast, there was evidence of connectivity to more posterior regions including the precuneus ($p<0.001$, uncorrected). Conclusions: Tractography based parcellation suggests a division in the hippocampus along the anterior-posterior axis. This structural division also predicts functional connectivity profiles for these regions. This could have important implications for understanding how different aspects of memory may be subserved by distinct patterns of hippocampal-neocortical interactions.

F106

TRENDS IN NEUROIMAGING METHODS: LARGE-SCALE AUTOMATED ANALYSIS OF THE FMRI LITERATURE.

Joshua Carp[1]; [1]University of Michigan — How do researchers design and analyze neuroimaging experiments? How should they? And how likely are their results to be reproducible? To investigate these questions, the present study created a comprehensive database of nearly all published articles that used fMRI

to study human cognition (as of October 2012, the corpus contains 14,953 articles). Methodological details (including software packages, imaging parameters, and analysis procedures) were automatically extracted from each article and validated against a hand-coded database. Overall, methodological details were extracted accurately, with a mean d' value of 3.53 (range: 1.12 to 6.18). Results revealed both variability and stability in methodological practices over time, with some tools increasing in prevalence (e.g. temporal filtering), others decreasing (e.g. global mean scaling), and others remaining stable (e.g. spatial normalization). Thus, the results of early fMRI studies may not be directly comparable to the results of more recent studies. Results also showed that design and analysis pipelines were highly variable across studies and have grown more variable over time. In 1998, we observed 133 unique pipelines among 172 articles (0.77 pipelines per article); in 2011, we observed 492 pipelines among 517 articles (0.95 pipelines per article). Because flexible research methods are associated with elevated rates of false positive results, these results point to a serious risk of false positives among fMRI studies. Altogether, the present investigation highlights the utility of large-scale methodological surveys and suggests that methodological flexibility poses a particular challenge to the integrity of research findings in the fMRI literature.

F107

EEG FEATURE ANALYSIS IN A WORKING MEMORY TASK: MAKING SENSE OF MACHINE LEARNING

Matthew Caywood[1], Daniel Roberts[1,2], Jeffrey Colombe, Hal Greenwald, Monica Weiland; [1]The MITRE Corporation, [2]George Mason University — As a step towards implementing a real-time brain-computer interface (BCI) monitoring neural signatures of continuous human workload, multivariate pattern analysis methods were used to quantitatively measure the contribution of different EEG features to task load in a working memory task. Sixteen participants performed three variants of a working memory task as well as a related visuospatial memory task. Information present in EEG features about task level, task modality, and subject-reported workload was analyzed using a continuum of methods ranging from easily interpretable statistical methods (correlation, ANOVA) to maximally informative for prediction (linear regression, GPR). A BCI was trained using Gaussian Process Regression (GPR) to predict task level and subject-reported workload in real time. Predictive accuracy for both variables was high (task level Pearson's correlation $\rho = 0.90 \pm 0.01$, mean and SEM across subjects). The EEG features identified by statistical methods (ANOVA) as significant were only loosely correlated with the features identified by automated feature selection techniques as most relevant for prediction of task level. However, this subset of ANOVA features still captured over 90% of the full model's predictive ability; there was considerable predictive redundancy between EEG features, and only the top 20% of the features were necessary for asymptotic prediction. Thus, features consistent with cognitive neuroscience models, when sufficient for prediction, can be preferred on account of their interpretability and generalization potential.

F108

DETECTING FUNCTIONAL CONNECTIVITY CHANGE POINTS IN FMRI DATA

Ivor Cribben[1], Lauren Y. Atlas[2], Tor D. Wager[3], Martin A. Lindquist[4]; [1]University of Alberta School of Business, [2]New York University, [3]University of Colorado, Boulder, [4]Johns Hopkins University — Recently in functional magnetic resonance imaging (fMRI) studies there has been an increased interest in understanding the dynamic manner in which brain regions communicate with one another, as subjects perform a set of experimental tasks or as their psychological state changes. In this work, we extend Dynamic Connectivity Regression (DCR), a technique used for detecting temporal change points in functional connectivity between brain regions where the number and location of the change points are unknown. DCR also estimates a graph or set of relationships between the brain regions for data that falls between pairs of change points. We firstly introduce a new algorithm for detecting the changes in functional connectivity for single-subject data as well as new bootstrap techniques for inference on the change points and the graphical structures. Secondly, we discuss methods that combine information across subjects for multi-subject fMRI studies as variability between subjects makes the use of these data sets challenging. The DCR methodology is motivated in part by the fact that often it is hard to specify the nature, timing and duration of psychological processes being studied a priori. The new methods are applied to various simulated data sets as well as to fMRI data sets including data from a study (n=26) of a state anxiety induction using a socially evaluative threat challenge. The results illustrate the method's ability to observe how the networks between different brain regions changes with subjects' emotional state.

F109

AMPLITUDE VARIANCE ASYMMETRY: IDENTIFYING NONLINEAR SIGNATURES IN THE BOLD RESTING STATE SIGNAL

Ben Davis[1], Jorge Jovicich[1], Vittorio Iacovella[1], Uri Hasson[1]; [1]University of Trento — Since Biswal et al.'s (1995) pioneering work documenting connectivity between the left and right motor cortex during rest, numerous studies have identified large, functional networks where low frequency BOLD signals similarly correlate in the absence of an explicit task, and connectivity has become the major descriptive principle for understanding the brain's resting state. However, recent work has shown that resting state activity (RSA) also consists of high-frequency and non-random non-oscillatory properties that are functionally relevant. Extending this work, we propose a novel method for identifying BOLD time series that show nonlinear, non-oscillatory signatures during rest. This method quantifies the relative variance of the amplitude of local maxima and local minima in the BOLD time series (amplitude variance asymmetry; AVA). This simple, easily implemented method reveals new properties of RSA activity without relying on connectivity as a descriptive tool. After an initial validation of AVA on phantom data, we performed AVA analysis on data from 2 participant groups (n=25, n=31) collected in 2 different centers (NYU, UNITN). We find that AVA is remarkably stable across participants, that the regions showing AVA do not form a single functional network and that group-level results replicate across scanning sites (3T,4T). AVA values departed from chance in bilateral lateral temporal cortices, bilateral pre-motor regions extending to the post-central sulcus, and bilateral occipital regions that largely excluded primary visual cortex and extended dorsally towards the medial intraparietal sulcus. These findings indicate that AVA is a robust metric that may reflect important and novel properties of RSA.

F110

MRS CORRELATES OF WORKING MEMORY AND ANXIETY IN ALS

Katherine Denny[1], M. Agustina Rossetti[1], Heather Katzen[2], K. R. Sharma[2], Kristopher Arheart[2], Andrew Maudsley[2], Bonnie Levin[2], Varan Govind[2]; [1]University of Miami, [2]University of Miami Miller School of Medicine — Objective: Amyotrophic Lateral Sclerosis (ALS) is fatal neurodegenerative disease associated with alterations in select cognitive and behavioral domains. Proton magnetic resonance spectroscopy (MRS) offers an opportunity to link brain metabolites with neurobehavioral change. This study examined the distribution of observed brain metabolites in the frontal lobes and their association with mood and neuropsychological test performance in ALS. Participants and Methods: 44 ALS patients (mean age: 54.8, symptom duration: 7.2 months) and 43 age-matched controls (mean age: 48.1) were evaluated with a comprehensive neuropsychological battery that included working memory (e.g., Digit Span-Backwards), and mood (Beck Anxiety Inventory). All participants underwent MRI and volumetric MR Spectroscopic Imaging (MRSI). Average values of signal normalized metabolites in the frontal lobes were calculated for N-acetyl-aspartate (NAA), total-choline (Cho), and total-creatine (Cre) and their ratios. Results: For the ALS group, partial correlations adjusting for symptom duration and severity revealed bilateral Cho/NAA in frontal white matter was negatively associated with working memory ($p<.01$), and Cho/NAA in left frontal grey matter was positively associated with anxiety ($p<.02$). These correlations were not observed in controls. Conclusion: In ALS patients, increased Cho/NAA in bilateral frontal lobe white matter is associated with deficits in working memory, and increased Cho/NAA in left frontal lobe grey matter is associated with increased anxiety symptoms. This study (1) highlights the role of frontal systems in the expression of select cognitive and affective changes documented in ALS and (2) demonstrates that MRS has the capacity to capture neuronal degeneration, a potentially important biomarker of ALS.

F111

GRAY MATTER VOLUME DIFFERENCES BETWEEN SPANISH-ENGLISH AND HINDI-ENGLISH BILINGUALS

Teresa Gray[1], Peter Glynn[1], Gigi Luk[2], Swathi Kiran[1]; [1]Boston University, [2]Harvard University — Previous research has documented structural brain differences between monolingual and bilingual young adults. However, little is known about the structural brain difference between bilinguals who are biliterate in different scripts. In this study, we compared gray matter volume in Spanish-English bilingual (n = 9) and Hindi-English bilingual (n = 10) young adults (Mean age = 25 years). Spanish and English share the same script, both languages are represented by Roman alphabets. In contrary, Hindi and English are represented by Devanāgarī and Roman alphabets, respectively. The two groups of young adults were comparable in chronological age, second language age of acquisition (English for both groups) and English proficiency (using Boston Naming Test and self-reported). T1-weighted images were collected from the participants and the data were analyzed using voxel-based morphometry (VBM) analysis in FSL. A priori Regions-of-interests (ROIs) were determined: bilateral inferior and middle frontal gyri, middle temporal gyri (MTG), angular gyri, supramarginal gyri, and anterior cingulate. Previous research has reported activity in these regions during bilingual processing. We hypothesized the bilingual groups would differ in gray matter volume in word processing regions because of their biliteracy experience. Results showed that the Hindi-English bilinguals had higher gray matter volume in part of the left MTG (BA 21) compared to the Spanish-English bilinguals (corrected $p < .05$). The Spanish-English bilinguals did not show higher gray matter volume in any area within the ROIs. Results suggested that brain structures responsible for word processing may be influenced by reading experience using different written representations.

F112

NEURAL CORRELATES OF DIFFERENT HIERARCHIES OF PREDICTIONS

Christiane Ahlheim[1], Anne-Marike Schiffer[2], Ricarda I. Schubotz[1]; [1]Westfaelische Wilhelms-University Muenster, [2]University of Oxford — Studies on perception emphasize how much perception is guided by predictions. Valid predictions can be acquired through statistical learning. Statistical regularities in our environment span different levels, from simple frequencies to more complex conditional probabilities of first- to nth-order. Using higher-order probabilities may constrain expectations on lower levels, thus limiting uncertainty about upcoming perceptions. It has been proposed that processing more abstract information draws on more anterior brain regions than processing more concrete information. We therefore tested the hypothesis that using higher-order probabilities for the formation of expectations draws on more anterior frontal sites than using lower-order probabilities. We employed an action-observation paradigm involving statistically structured artificial action sequences, which encompassed first- and second-order conditional probabilities between successive action steps. The probability of each upcoming action step n was modified by its history such that n-1, provided that n-2, modified n's probability differently than n-1 alone. Two posttests provided behavioral evidence for participants´ implicit learning after three training sessions. We found an effect of transition probability on reaction times in a serial reaction time task. Furthermore, participants showed an effect of the employed transition probabilities when they declared which object they expected next in a sequence. In the functional data, the extent to which expectations were modulated by the first-order structure correlated positively with the BOLD response in the ventromesial prefrontal cortex. We take this to reflect biased expectations. In contrast, modulation by the second-order structure drew on the ventrolateral prefronal cortex, showing the expected anterior extent.

F113

A CRITICAL ROLE FOR THE HIPPOCAMPUS IN ASSESSING THE STRENGTH OF PERCEPTION

Mariam Aly[1], Andrew P Yonelinas[1], Charan Ranganath[1]; [1]University of California, Davis — The hippocampus is essential for episodic memory, but its role in visual perception is controversial. We hypothesized that inconsistencies in the literature may arise because the hippocampus is only necessary for some types of perceptual decisions. In previous work, we found that perception can be based on discrete, high-confidence states associated with conscious access to specific details, or on continuously-graded, lower-confidence strength signals associated with a sense of match/mismatch. In the current study, we used receiver-operating characteristics to measure perceptual sensitivity as well as the state and strength components underlying perception in patients with selective hippocampal damage or more widespread medial temporal lobe damage. The patients exhibited significant reductions in perceptual sensitivity. Importantly, both the hippocampal patients and the more extensive MTL lesion patients showed a selective impairment in the graded, lower-confidence strength process, and were completely spared on high-confidence, state-based perception. Similar methods were then used to examine the neural underpinnings of perceptual decisions in healthy individuals. Activation in the posterior hippocampus was related to accurate perceptual discriminations, and this activation linearly tracked the strength of graded, lower confidence responses. As in the patient study, there was no evidence that the hippocampus was involved in high-confidence, state-like judgments of conscious change detection. The results demonstrate that the hippocampus is critical for scene perception based on assessments of the graded strength of sensory information.

F114

A BIOPHYSICAL PERSPECTIVE ON CORTICAL COMPARATORS IN MISMATCH NEGATIVITY

Stefan Berteau[1], Ennio Mingolla[2], Daniel Bullock[1]; [1]Boston University, [2]Northeastern University, Boston, MA — The Mismatch Negativity (MMN) is an EEG "component" computed by subtracting the ERP (event-related potential) evoked by a frequent standard stimulus from the ERP evoked by an infrequent stimulus (Naatanen et al., 1978). Most models of MMN genesis posit a neural "comparator". Neural comparators for computing mismatches are common, e.g., those for computing reward prediction errors (Tan & Bullock, 2008), motor performance errors (Yamazaki & Tanaka, 2007) and reafference prediction errors (Sawtell et al., 2005). Four types of comparators have been proposed for MMN, with formal modeling of three (Wacongne et al., 2012; Banquet & Grossberg, 1987; and May & Tiitinen, 2010). All have shortcomings relative to theoretical criteria or experimental data. We here introduce a biophysical model of neuronal computations that provides a novel basis for a comparator. Our model extends Prescott et al. (2006)'s study of membrane dynamical modes enabled by M-currents (potassium currents affected by muscarinic acetylcholine receptors). We simulate pyramidal neurons with distinct apical and basal poles, to illustrate neuron-level contributions to comparator operations. When "primed" by modulatory top-down input to the apical pole, the neuron fires a burst only at the onset of bottom-up input to the basal pole. Thus, priming enables a regular-spiking neuron to switch from a rate-based code to a binary confirmation at onsets of expected features. This provides robust comparison while reconciling seemingly conflicting neuronal modes (Poisson randomness versus deterministic timing; Ballard & Jehee, 2011). It also reduces metabolic costs and speeds processing of anticipated stimuli (cf., Johnston & Hawley, 1994).

F115

NEGLECT BEYOND THE BRAIN-DAMAGED: LEFT EXTRA-PERSONAL SPACE NEGLECT IN HEALTHY PARTICIPANTS DURING A VISUALLY GUIDED GRASPING TASK.

Devon. C. Bryant[1], Claudia. L. R. Gonzalez[2]; [1]University of Lethbridge — In the current study we documented space use during a visually-guided grasping task. Participants reached out and grasped Lego blocks in ipsilateral, contralateral, peripersonal and extrapersonal space. Previous results have shown that each hand prefers to act in its respective ipsilateral space but hand preference in peripersonal/extrapersonal space has not been documented in a controlled setting. Two separate sets of four different models each (four built with big- and four built with small-Lego blocks) were used for the experiment. Each model contained ten unique pieces but the same ten pieces were used to build the four different models (of each size). So collectively, there were 40 blocks (4 identical pieces of each block) scattered on a tabletop. One of each repeating block was placed in one of the four quadrants of the table: right-peripersonal, right-extrapersonal, left-peripersonal and left-extrapersonal space. Right- and left-handed participants were instructed to build replicas of each model. Results showed that grasps directed towards the left-extrapersonal space were executed last, when most other blocks had been removed from the table (i.e. incorporated into the earlier models). Crucially, this result was also present in left-handers and therefore is not linked to handedness. This study demonstrates that healthy individuals exhibit 'quadrispatial' neglect specific to the left extrapersonal space. This suggests that left

extrapersonal space might be coded by different neural mechanisms than peripersonal or right extrapersonal space. Ultimately, this finding could have important implications for understanding visuospatial functions and deficits such as those seen in patients with hemispatial neglect.

F116

BELIEVING AND PERCEIVING: AUTHORSHIP BELIEF MODULATES SENSORY ATTENUATION Andrea Desantis[1,2], Carmen Weiss[3], Simone Schütz-Bosbach[3], Florian Waszak[1]; [1]Laboratoire Psychologie de la Perception, CNRS UMR 8158, Université Paris Descartes, Paris, France, [2]Institut Jean Nicod CNRS UMR 8129, Ecole Normale Supérieure, Paris, France, [3]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Sensory attenuation refers to the observation that self-generated stimuli are attenuated, both in terms of their phenomenology and their cortical response compared to the same stimuli when generated externally. Accordingly, it has been assumed that sensory attenuation might help individuals to determine whether a sensory event was caused by themselves or not. In the present study, we investigated whether this dependency is reciprocal, namely whether sensory attenuation is modulated by prior beliefs of causality. Participants had to judge the loudness of auditory effects that they believed were either self-generated or triggered by another person. However, in reality, the sounds were always triggered by the participants' actions. Participants perceived the tones' loudness attenuated when they believed that the sounds were self-generated compared to when they believed that they were generated by another person. Sensory attenuation is considered to contribute to the emergence of people's belief of causality. Our results suggest that sensory attenuation is also a consequence of prior belief about the causal link between an action and a sensory change in the environment. Our findings are of importance for several reasons. Firstly, they shed further light on the understanding of the processes underlying sensory attenuation. Moreover, they provide useful insights on the understanding of delusion of control in schizophrenia.

F117

NEUROPSYCHOLOGICAL REGULATION OF ACUTE PAIN: A META-ANALYSIS OF FUNCTIONAL BRAIN IMAGING STUDIES Audrey-Anne Dube[1,2,3], Simon B. Eickhoff[4,5], Stephanie Simard[1,3], Duncan Gary[1,3,6], Rainville Pierre[1,2,3,6]; [1]Universite de Montreal, [2]Centre de recherche en neuropsychologie et cognition (CERNEC), [3]Centre de recherche de l'Institut universitaire de geriatrie de Montreal (CRIUGM), [4]Institute of Clinical Neuroscience and Medical Psychology, Heinrich-Heine University Düsseldorf, [5]Institute for Neuroscience and Medicine (INM-1), Research Center Juelich, [6]Groupe de recherche sur le systeme nerveux central (GRSNC) — Cerebral and cerebro-spinal regulatory processes are thought to subserve the now widely demonstrated analgesic effects of psychological interventions (Price and Bushnell, 2004). A quantitative meta-analysis, based on foci of brain activity, surveyed nearly 15 years of published papers (1997-2011) reporting an increase in BOLD signal or rCBF during psychological procedures intended to produce analgesia. Eighteen papers were categorized according to their psychological approach: placebo, hypnosis, distraction, emotion, controllability of stimuli, meditation, and the induction of emotion. Only statistically significant activation foci, reported in a standard stereotaxic space, were considered. Further, this brain activity had to be associated with a significant reduction of pain subsequent to the experimental procedure. Thus, data for our analyses included 217 foci, 263 healthy subjects and 34 contrasts. Results revealed that psychologically mediated analgesia involves several prefrontal regions (including peaks in the medial, dorsolateral and orbitofrontal sectors) and to a lesser extent some insular, parietal, temporal, and subcortical structures. This may reflect self-awareness as well as the affective, motivational, and cognitive processes associated with the different interventions. Detailed analyses further suggest some anatomo-functional specificity associated with the different interventions. For instance, significant peaks found in the anterior cingulate cortex (ACC) and adjacent areas of the medial-prefrontal cortex can be further segregated based on the specific intervention used. This supports the notion of an integrative role of the ACC as an "adaptive control" center (Shackman et al., 2011), but further suggests some anatomo-functional specificity dependent upon the means through which adaptation is achieved. Fundings: CIHR and FRQS.

F118

DISTRIBUTED CODING OF SYMBOLIC AND NONSYMBOLIC NUMBERS IN THE HUMAN BRAIN Lyons Ian[1,2], Ansari Daniel[2], Beilock Sian[1]; [1]University of Chicago, [2]Western University — Are symbolic (Indo-Arabic-numerals) and nonsymbolic (dot-arrays) numbers coded differently in the brain? We present the first direct neural evidence in humans supporting the summation-coding hypothesis for representation of approximate, nonsymbolic-numbers – but not exact, symbolic-numbers. In the bilateral intraparietal sulci (IPS), both nonsymbolic-numbers and symbolic-numbers showed a linear increase in activation as the number being processed increased (from 1-9). Linear model-fit was high (nonsymbolic: R^2=.860; symbolic: R^2=.626). However, different neural-coding hypotheses predict this result. To differentiate coding-hypotheses, we used representational similarity analysis (RSA) to quantify the distributed, voxelwise correlations between numbers in IPS activity-patterns. In summation-coding, activity for a given quantity (e.g., 9) subsumes all lesser numbers' activity patterns (1-8). This predicts strong dependence across numbers, which increases with size and ratio. In place-coding, activity patterns for different numbers scale independently of one another. Only nonsymbolic-numbers showed an increase in voxelwise correlations as numerical-size increased [nonsymbolic: r(34)=.772; symbolic: r=–.386; correlation-difference: p<.001], and as numerical-ratio between numbers approached 1 [nonsymbolic: r=.838; symbolic: r=–.149; correlation-difference: p<.001]. Our RSA analyses suggest that nonsymbolic-numbers are represented in humans via summation coding and symbolic-numbers are not. We also addressed whether voxelwise activity-patterns were related across symbolic and nonsymbolic number-systems. IPS showed significant cross-system correlations only for numbers in the subitizing-range (1-4): the mapping between number-systems in the IPS is endemic only to numbers within the limits of visual-attention. Only in prefrontal regions did we find significant cross-system correlations for all numbers (1-9), suggesting that a general mapping-mechanism between number-systems relies on domain-general working-memory mechanisms.

F119

CHANGES IN THE CHROMATIC VISUAL EVOKED POTENTIAL (VEP) INDUCED BY HYPNOTIC SUGGESTION Chad Duncan[1], Chris Jones[1], Molly Finnegan[1], William Danton[1], Michael Crognale[1]; [1]University of Nevada,Reno — Past research has demonstrated that the chromatic visual evoked potential is robust to the effects of attentional manipulations such as similar and non-similar distraction. This suggests that the chromatic VEP may be a low level response that is generally unaffected by cortical feedback. Recently, there have been reports of selective achromatic VEP signal loss in a case of Associative Identity Disorder. In this report, brain responses were suppressed for blind personalities but not for sighted personalities within the same subject (Waldvogel, Ullrich & Strasburger, 2007). This result suggests feedback mechanisms from higher cortical areas can influence neural responses in primary visual cortex. The current study attempted to elicit neural inhibition on chromatic responses from putative feedback mechanisms via hypnotic suggestion. Baseline VEPs were recorded before hypnotic induction, after which subjects were read a standardized induction. Experimental VEPs were recorded following instructions designed to induce either positive or negative hallucinations. Results indicate selective signal changes following hypnotic suggestion. We conclude that the chromatic visual evoked potential may be influenced by feedback from higher cortical areas through hypnosis, and that hypnotic suggestion may be a useful tool to probe higher cortical influence on human vision.

F120

CAN YOU TELL WHAT IT IS YET? PERCEPTUAL AND SEMANTIC PROCESSES IN RESOLVING AMBIGUOUS IMAGES Ben Dyson[1]; [1]Ryerson University, Canada — In contrast to many common cognitive paradigms, a common feature of real-world perception is the ability to repeated sample subtly different views of the same object. To study the consequences of repeated environmental sampling, participants were presented with series of drawings generated by iterative copying. Shown in reverse order, representations of single objects or animals began as complex abstract images but lead to semantic resolution as the images became more concrete. During EEG monitoring, participants were presented with consecutive pairs of images and at each trial were asked to both judge the

perceptual similarity of the pair and to indicate whether they had resolved the identity of the current image set. Behavioral data showed that as participants progressed through individual sets, consecutive comparisons remained stable in terms of perceptual similarity but increased in terms of semantic identification. Neural data showed that semantically unresolved and perceptually dissimilar images produced greater neural activity than semantically resolved or perceptually similar images. The time course of the neural effects suggested that markers of semantic distinction were available earlier than markers of perceptual distinction. Under conditions of repeated sampling, the outcome of previous semantic analyses may hold the key to subsequent perceptual investment, thereby underscoring how modeling based on continuous sensory processing may differ from discrete sensory processing.

F121

THE EFFECT OF NEUROFEEDBACK-INDUCED CHANGES IN HIGH ORDER VISUAL AREAS ON BINOCULAR RIVALRY

Jinendra Ekanayake[1], Ged Ridgway[1], Frank Scharnowski[1], Yury Koush[1], Spas Getov[1], Nikolaus Wesikopf[1], Geraint Rees[1]; [1]University College London — The application of online neurofeedback through the use of real-time fMRI opens the possibility of gaining voluntary control of a target brain region. Through repeated training of this modulation we hypothesized that a persisting change in behaviour could be elicited. Subjects first underwent a binocular rivalry (BR) paradigm with rivalrous face and house stimuli; switch frequency and duration of stable percepts were measured. Subjects were then split into two groups and underwent real-time fMRI neurofeedback training up-regulating regions of interest (ROIs) These were individually defined fusiform face area or parahippocampal place area, using a localiser session with stimuli identical to the BR session. Up-regulation of the target ROIs was achieved using real-time neurofeedback through a visual interface driven by the level of BOLD activation in the ROI. At the end of training subjects performed BR again, this time with no up-regulation as before, or with simultaneous up-regulation of one of the target brain regions. A significant decrease in duration and switch rate of the untrained percept was observed. There was no significant change in the perception of the stimulus linked to training. The BR measures during up-regulation were in the same direction as following training i.e. a reduction in the duration of the percept not linked to the up-regulated brain region, regardless of the previous training the subject underwent. Neurofeedback from predefined brain regions results in a top-down perturbation of rivalry dynamics, with training of these regions resulting in a more pronounced effect than up-regulation of a brain region alone.

F122

WHERE YOU READ IS NOT WHERE I READ: HOW INDIVIDUAL VARIABILITY IN LOCATION IMPACTS ORTHOGRAPHIC SELECTIVITY IN THE "VISUAL WORD FORM AREA"

Laurie S. Glezer[1], Maximilian Riesenhuber[1]; [1]Georgetown University Medical Center — Strong evidence exists for a key role of ventral occipitotemporal cortex (vOT) in reading yet there have been conflicting reports about the specificity of this area in orthographic vs. nonorthographic processing. We suggest that the inconsistencies in the literature can be explained by the method used to identify regions that respond to words. Specifically, we provide evidence that the "visual word form area" (VWFA) shows word selectivity when identified at the individual subject level, but that inter-subject variability in the location and size of the VWFA causes this selectivity to be washed out when defining the VWFA at the group level or based on coordinates from the literature. Using fMRI, we scanned 53 subjects while they viewed blocks of words, faces, objects, scrambled objects and scrambled words. We then defined VWFA ROIs (as in Glezer et al., 2009, using response contrasts of words vs. scrambled words and fixation) at the individual and group levels and based on coordinates from the literature, as in previous studies. We found that indeed when defining the VWFA using a group based analysis or using coordinates from the literature, there were no significant response differences between words and faces or objects. However, when identifying the VWFA on an individual subject basis we found that words activated the individually-defined VWFA significantly more than the other stimulus groups. Our findings confirm the existence of a word-selective region in vOT while providing an explanation for why other studies have found a lack of word specificity in vOT.

F123

THE FUSIFORM GYRUS REPRESENTS THE AGE OF FACES.

Golijeh Golarai[1], Alina Liberman[1], Kalanit Grill-Spector[1]; [1]Stanford University — Behavioral studies suggest that adults better remember faces of their own-age cohorts than of children. However, the neural substrates of this own-age preference are not known. We asked if responses across the Fusiform gyrus (FG) varied for own- vs. other-age faces, using functional magnetic resonance imaging (fMRI) in children (ages 7 – 11, n = 14) and adults (ages 18 – 40, n = 12). Subjects underwent fMRI (3T scanner) while viewing images of faces of boys and men, objects, scenes and scrambled images in four blocks per category across two runs, and performed a 1-back task. For each subject we drew the anatomical boundaries of the right FG, partitioning a posterior and a middle region. Age groups were matched for BOLD related signal-to-noise ratio in each anatomical partition of FG. In an independent analysis of percent signal change among face-selective voxels (man and boy faces > objects, $p < 10\text{-}3$) we found significantly higher responses to faces in adults than children and a significant interaction between age of the face stimuli and age of subject in the mid-FG, where own-age faces elicited higher responses than other-age faces. Similarly, in a multivoxel pattern analysis (MVPA) across the mid-FG partition, we found a significant interaction of age of face and age of subject in the reproducibility of MVPAs across run 1 and 2 and better classification of own-age faces in adults. Our results are first to show differential responses to own- vs. other-age faces in the FG of children and adults.

F124

INTERNAL REPRESENTATIONS OF REAL-WORLD SCENE CATEGORIES

Michelle Greene[1], Abraham Botros[1], Diane Beck[2], Li Fei-Fei[1]; [1]Stanford University, [2]University of Illinois Urbana Champaign — Human observers rapidly categorize natural images, but the mechanism behind this ability is unknown. Some models posit that categorization is aided through the use of internal category representations, deployed in a top-down manner to constrain visual input. What is the content of these representations? Although internal representations have been obtained for simple stimuli using reverse correlation, these techniques are not generally scalable to the complexity of real-world scenes. Here, we introduce a novel type of visual noise, that when used with reverse correlation, can reveal internal representations of scene categories. Visual noise was created by sampling from real-world scene features: an 8800-scene database was represented using multi-scale Gabor wavelets. Principal components analysis was performed on this representation, and noise patterns were created by reconstructing random values for the first 2500 principal components. This low-dimensional noise contains extended structures found in natural images, making it more amenable to reverse correlation than Gaussian white noise. We presented this visual noise to four observers, and asked them to classify the noise patterns as members of a particular scene category (e.g. street, mountain, forest). As no scene information was present in these images, observers had to use their internal knowledge of the category, matching it with the visual features in the noise. The reconstructed images were found to be more similar to scene images from the target category than images of other categories, and most similar to the category average, suggesting internal category representations may reflect a composite of experienced exemplars.

F125

NATURAL STIMULI ACQUIRE BASIC-LEVEL ADVANTAGE IN OBJECT-SELECTIVE CORTEX

Marius Catalin Iordan[1], Michelle R. Greene[1], Diane M. Beck[2], Li Fei-Fei[1]; [1]Stanford University, [2]University of Illinois at Urbana-Champaign — With the exception of a few important categories (e.g. faces), it is thought that most object categories elicit a distributed representation throughout visual cortex, yet little is known about the principles behind this distribution. In her seminal work, Eleanor Rosch argued that although objects can be categorized at varying levels of specificity ranging from the very broad ("natural object") to the very distinct ("Mr. Whiskers, my orange tabby"), a mid-level of generality (i.e. "cat") maximizes within-category similarity and minimizes between-category similarity in a cognitively useful way. We used this basic- or entry-level perceptual advantage to guide our search for a fine-grained organizational principle for object categories in the brain: we asked whether patterns of activity across visual cortex adhere to this very powerful cognitive principle of maximizing within-group similarity and minimizing between-group similarity, and

if so at what level of the object taxonomy is this organization predominant. We conducted an fMRI experiment in which participants were shown 1,024 images from 32 subordinate categories (i.e. "chihuahua") grouped into 4 basic categories (i.e. "dog") and 2 superordinate categories (i.e. "natural object"). Using several multi-voxel pattern analyses, we provide evidence that activity patterns in visual cortex simultaneously maximize within-basic-level similarity and between-basic-level dissimilarity, which is most consistent with behavioral judgments. This effect is strongest in object-selective cortex, but is also shared by scene- and face-selective areas. Furthermore, the basic-level advantage emerges gradually as we move up the visual cortical hierarchy, suggesting that successive levels in the visual system may be optimizing basic-level categorizations.

F126

DYNAMIC SCENES AS AN EXPERIMENTAL TOOL TO INVESTIGATE THE NEURAL SUBSTRATES OF COARSE-TO-FINE PROCESSING IN SCENE PERCEPTION

Louise Kauffmann[1], Benoit Musel[1], Alan Chauvin[1], Nathalie Guyader[2], Cédric Pichat[2], Stephen Ramanoël[1,3], Jean-François Le Bas[3], Carole Peyrin[1]; [1]LPNC, CNRS UMR5105, [2]GIPSA-lab, CNRS UMR5216, [3]GIN, ISERM U836 — Influential theories of visual perception suggest that scene recognition follows a predominant coarse-to-fine processing sequence: Low spatial frequencies (LSF) may rapidly reach high-order cortical areas to allow an initial coarse parsing of the visual scene, which could then be "retroinjected" through feedback connections into lower level visual areas to guide the subsequent finer analysis of high spatial frequencies (HSF). In a previous fMRI study, we investigated the neural substrates of the coarse-to-fine categorization using sequences of two spatial-frequency-filtered scenes (LSF followed by HSF or vice versa) with a long inter-scene interval (400 msec) and participants performed a scene-matching task (Peyrin et al., 2010, JOCN, 22). In the present fMRI study, we investigated these neural substrates using dynamic scene stimuli and participants performed an explicit categorization task (outdoors vs. indoors). Dynamic stimuli were composed of six spatial frequency-filtered versions of the same natural scene, from LSF to HSF or from HSF to LSF, in order to experimentally impose a coarse-to-fine (CtF) or the reverse fine-to-coarse (FtC) processing. Consistent with previous psychophysical studies, CtF sequences were categorized faster than FtC sequences. At the neurobiological level, the contrast between CtF and FtC processing revealed significant activation within the orbitofrontal cortex (evidenced to be involved in LSF-based categorical inferences) and the primary visual cortex (on which the first LSF computation could be "retro-injected" back). No significant activation was obtained by contrasting FtC and CtF. These dynamic scenes seem therefore well appropriated to investigate the coarse-to-fine categorization within scene-selective regions.

F127

PHOSPHENE OR SCOTOMA? IT'S A MATTER OF DEFINITION.

Ramisha Knight[1], Chiara Mazzi[1], Silvia Savazzi[1]; [1]University of Verona and National Institute of Neuroscience — Phosphenes induced by transcranial magnetic stimulation (TMS) have been described as sensations of light and a missing region from a visual pattern induced by TMS is referred to as a scotoma. It is believed that phosphenes are caused by neural excitation while scotomas are due to neural inhibition. Alternatively, we propose that this interpretation derives from the specific conditions under which the two precepts have been studied: uniform backgrounds for phosphenes and pattern backgrounds for scotomas. As a consequence, the presence of something over a uniform background (phosphene) has been interpreted as neural excitation while the absence of a pattern (scotoma) has been interpreted as neural inhibition. However, we believe that both kinds of percepts are productive phenomena: the presence of something brighter for phosphenes and the presence of something darker for scotomas. Here, we tested the hypothesis that the two phenomena reflect the same mechanism: neural excitation. TMS was applied over the left occipital cortex under two background conditions: a uniform gray and a pattern background. After detection of a percept, participants reported its luminance, size and location. Reaction times were also recorded. Of the 13 participants, nine reported percepts brighter (phosphenes) and darker (scotomas) than the background and phosphenes were reacted to faster than scotomas. Importantly, the percentage of phosphenes and scotomas did not differ depending on the two backgrounds. The present data suggest that both phosphenes and scotomas are productive phenomena, reflecting the presence of something brighter or darker than the background, that result from neural excitation.

F128

USING TRANSCRANIAL MAGNETIC STIMULATION TO ELUCIDATE INTERACTIONS BETWEEN TOP-DOWN AND BOTTOM-UP BRAIN NETWORKS IN VISUAL DISCRIMINATION

Bruce Luber[1], David Jangraw[2], Austin Harrison[1], Paul Sajda[2], Sarah H Lisanby[1]; [1]Duke University, [2]Columbia University — Previous work using EEG and fMRI on a visual discrimination task identified three brain networks- one most active 170ms after stimulus presentation and involved with bottom-up visual processing, a second active around 220ms and associated with top-down attention-related regions, and the third active in decision processing after 300ms. We used TMS to test the involvement of this latter network, centered upon the lateral occipital complex (LOC). Fourteen healthy adults participated in two TMS sessions, one in which left LOC was stimulated, and in the other, right LOC. Targeting was achieved using frameless stereotaxy and a robotic coil holder. Subjects performed a two-alternative forced choice task in which they were to choose whether a car or face was presented. For each subject, visual coherence of the stimuli had been previously adjusted to approximate a 75% accuracy level. A pair of TMS pulses, separated by 50ms, was applied at 100% motor threshold in each trial beginning at one of five stimulus onset asynchronies (SOAs): -200ms, 200ms, 400ms, 450ms, or 500ms. For %correct, there was a main effect of SOA ($p<0.05$) and a face/car x SOA interaction ($p<0.02$), and for reaction time, a main effect of SOA ($p<0.01$). Across SOAs, performance described U-shaped functions, with subjects were slowest with TMS at 400ms and having lowest %correct at 200 and 400 ms SOA, primarily for cars. TMS was thus able to demonstrate the involvement of LOC in the task at the expected time, but also earlier, suggesting an interaction with the top-down attentional network.

F129

THE IMPACT OF PRIOR KNOWLEDGE ON OBJECT SEARCH IN REAL-WORLD SCENES

Julia Seyfarth[1,2], Joachim E. Weber[1], Johannes Mohr[2], Klaus Obermayer[2], Felix A. Wichmann[3], Andreas Lueschow[1]; [1]Charité – Universitätsmedizin Berlin, Germany, [2]Technische Universität Berlin, Germany, [3]Universität Tübingen, Germany — Humans are excellent at rapidly detecting objects even in complex environments whereas the most advanced artificial systems are slow and unflexible when they have to perform this task. Numerous studies using synthetic search arrays showed that simple object features like contrast or orientation play a critical role in guiding attention in visual search. On the other hand it seems evident that the real world surrounding us offers further clues that might enhance visual processing. For example real objects often have semantic or functional relations to objects in their neighbourhood ("a knife and a plate on the kitchen table"). Here we investigated whether prior knowledge about object location facilitates object detection in real scenes. Former studies regarding this matter using artificially manipulated scenes resulted in conflicting results. We created a photo database of everyday scenes in which only the location of the object to be searched was arbitrarily manipulated. The stimulus set was controlled with respect to various psychophysical parameters like saliency and contrast in order to prevent a confounding with object position at the expected versus the unexpected location. 30 subjects were instructed to search for shortly presented objects in a scene presented afterwards. Reaction times were significantly shorter at the expected location, averaged across 30 subjects as well as across 115 scenes which demonstrates that the effect is not the trivial consequence of extreme values of single subjects or single scenes. In summary our results demonstrate that prior relational knowledge is used to enhance object search in real environments.

F130

RESILIENCE IN DECISION-MAKING: MORE ABOUT COGNITION AND GENDER THAN AGE

Alison Perez[1], Winston Chiong[2], Jeff Spence[3], Lowell Kiel[4], Sandra Chapman[5]; [1]University of Texas at Dallas, Center for BrainHealth, [2]University of California San Francisco, [3]University of Texas Southwestern Medical Center, [4]University of Texas at Dallas, [5]University of Texas at Dallas, Center for BrainHealth — There is a growing demographic of adults arriving to their retirement years. With this period of life come countless crucial

decisions to be made, fiscally, socially, and personally. This collaborative study on decision-making aimed to elucidate the validity of the pervasive negative stereotyping of decline in the cognitive and decision-making abilities of seniors. The goal of this collaborative research study was to highlight key factors that affect very important components of decision-making: the ability to apply a logical strategy to similar decisions in a consistent manner and to recognize biasing information, such as the context in which information is presented, and overcome its influence to make riskier decisions. In a sample of cognitive healthy older adults (50-80 yrs. old), a battery of cognitive tests, as well as a framing paradigm, were used to examine the influence of age and cognitive control on these decision-making abilities. We will present evidence that demonstrates age does not significantly predict the decision-making aptitude of older adults, (p=0.300). Cognitive control, specifically strategic learning, is a significantly better predictor than age and strongly forecasted the abilities of older adults to make logically consistent choices and exhibit less vulnerability to contextual biases, (p=0.002). Results also indicate an interaction between gender and cognitive control in decision-making. These results demonstrate the ability of older adults to maintain robust cognitive performance and retain essential decision-making skillsets in later life. This research has broad public health benefits to mitigate disadvantageous financial decisions and abuse in seniors.

F131

RAPID AFFECTIVE MARKING OF SELF-GENERATED ACTIONS IN THE ANTERIOR INSULA: EVIDENCE FROM HUMAN IEEG

Gilles Pourtois[1], Leonie Koban[2], Leen De Taeye[3], Dirk Van Roost[4], Paul Boon[3], Wim Fias[5], Robrecht Raedt[3]; [1]Department of Experimental Clinical & Health Psychology, Ghent University, Ghent, Belgium, [2]Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland, [3]Laboratory for Clinical and Experimental Neurophysiology, University Hospital, Ghent University, Ghent, Belgium, [4]Department of Surgery, University Hospital, Ghent University, Ghent, Belgium, [5]Department of Experimental Psychology, Ghent University, Ghent, Belgium — Human beings automatically categorize external stimuli as good or bad. However, this evaluation does not only concern external stimuli in the environment, but also self-generated actions. Recently, we found direct evidence for this assumption and showed that simple actions generated during a perceptual decision making task were swiftly evaluated along a negative–positive dimension. Here we present new EEG results obtained in a patient implanted with intracranial electrodes in the right anterior insular cortex prior to surgery for pharmaco-resistant epilepsy. The patient performed a Go/noGo task, in which trial outcome depended not only on action accuracy, but also on an adaptively changing reaction time limit. This enabled us to model outcome prediction and outcome uncertainty as a function of reaction time in each trial. Results show that response-locked single trial iLFPs in the insula systematically varied in amplitude early on following response onset depending on computational estimates of both outcome prediction and outcome uncertainty. Remarkably, these two effects occurred at different latencies, with reward prediction clearly preceding uncertainty. Moreover, anterior insula iLFPs time-locked to the onset of the feedback following action execution revealed that outcome processing was best predicted by uncertainty. Surprisingly, when uncertainty (at the time of the response) was high, outcome processing (at the time of the feedback) was substantially reduced. Altogether, these results suggest that the anterior insula computes predictions regarding action outcome and uncertainty, which may relate to a role of this region in associating affective values to actions.

F132

DISSOCIATIONS IN REWARD NETWORK ACTIVATION WHILE LEARNING FROM COGNITIVE VERSUS HEDONIC FEEDBACK

Jenna Reinen[1], Catherine Insel[1], Tor D. Wager[2], Daphna Shohamy[1]; [1]Columbia University, [2]University of Colorado at Boulder — Converging evidence indicates that the human reward network supports incremental, trial-by-trial learning from feedback. Specifically, functional imaging has demonstrated that prediction error and learning signals are represented in the striatum, prefrontal cortex, hippocampus, and amygdala in response to positive and negative outcomes, and are thought to drive future choices that maximize gain and minimize loss. However, the ability to learn to make the best choices over time would theoretically involve associating cognitive feedback with a stimulus, as well as experiencing an appropriate affective reaction to a reward or loss. To date, most studies present reward information and outcome together, which does not allow one to identify separate contributions of each neural system to cognitive versus affective reactions to feedback. To address this, we tested 24 subjects on a two-stage, probabilistic, feedback-based learning task while undergoing fMRI. Participants made choices in two phases of non-intermixed conditions (gain, loss). On each trial, subjects chose between two shapes and received feedback (correct, incorrect) followed by reward outcome (monetary gain or loss). To assess learning at each stage, we calculated prediction error independently for feedback and reward outcome. Results indicated that there was a dissociation in activation in several structures associated with the reward network. In particular, orbitofrontal cortex showed more activation when subjects received rewards as opposed to reward-related feedback. These findings suggest that structures within the reward network contribute differentially to cognitive and affective aspects of feedback-based reward learning.

F133

PROCESSING OF POSITIVE AND NEGATIVE FEEDBACK IN PATIENTS WITH CEREBELLAR OR BASAL GANGLIA LESIONS

Martina Rustemeier[1], Benno Koch[2], Michael Schwarz[2], Christian Bellebaum[1]; [1]Ruhr University Bochum, Germany, [2]Dortmund Municipal Hospital, Germany — Functional neuroimaging studies and deficit patterns in patients with Parkinson's Disease consistently suggest that the basal ganglia (BG) are critically involved in reward processing and reward-based learning. A cerebellar involvement in reward learning has also been suggested but was studied less intensively. In the present study we investigated learning from and processing of positive and negative feedback in twelve patients with selective cerebellar lesions and eight patients with selective BG lesions. Participants performed a feedback learning task with monetary rewards. The processing of rewards was assessed by means of event-related potentials (ERPs) during a separate task with equal frequencies of positive and negative monetary feedback. Both patient groups neither showed a general learning deficit nor altered transfer performance, i.e. a bias of better learning from positive or negative feedback compared to controls. Feedback-locked ERPs were analyzed with a difference wave approach (ERPs following the presentation of positive feedback subtracted from those for negative feedback). Compared to the respective control group, patients with cerebellar lesions showed significantly higher difference wave amplitudes in a time window between 250 and 450 ms after feedback presentation, whereas BG patients' difference waves did not differ from those of control subjects. Our findings show that feedback processing is altered in patients with cerebellar lesions and add to recent findings on altered performance monitoring despite preserved behaviour associated with cerebellar dysfunction. The results appear to suggest a role of the cerebellum in predicting outcomes of actions, which can be compensated in the case of cerebellar damage.

F134

VENTROMEDIAL PREFRONTAL CORTEX MEDIATES THE EFFECTS OF SOCIAL INFLUENCE ON THE UTILISATION OF REWARDS AND PUNISHMENTS: AN EVENT-RELATED FMRI STUDY

Anja Varjacic[1], Anastasia Christakou[1], Tom Johnstone[1], Doug Saddy[1]; [1]University of Reading, Centre for Integrative Neuroscience and Neurodynamics — There is growing appreciation of the neural mechanisms that integrate the value of decision outcomes with the context in which decisions are made. However, it remains unclear how the judgement of our actions by others is represented in the brain and integrated in the evaluation of our own action outcomes. In this study, we employed a novel task to induce such a "social congruency context". Varying levels of rewards and penalties were experienced in light of different levels of agreement with other people's choices. Healthy young males (N=20) underwent functional magnetic resonance imaging (fMRI) scan whilst performing the task. We measured how the probability of staying with the same option varied as a function of the value of outcomes, the level of social congruency (SC) and their interaction. There was a significant outcome x SC interaction, with the most prominent "stay effect" during penalties paired with low SC. An extensive brain network scaled its responses to outcome magnitudes (reward/punishment), including ventral striatum, insula, medial prefrontal cortex, dorso-lateral PFC and dorsal and ventral anterior cingulate. Ventromedial PFC tracked the level of SC, as revealed by the contrast of high versus low SC. Finally, the preceding SC magnitude modulated responses to losses compared to neutral

outcomes in lateral PFC (BA9/10). These results further characterise the role of the ventromedial PFC in context-dependent evaluation of decision outcomes, with preliminary mediation analyses further indicating that the ventromedial PFC drives behavioural adaptation by directly modulating value representation.

F135

NEURAL SIGNATURES OF VALUE-DRIVEN ATTENTIONAL CAPTURE PREDICT INDIVIDUAL DIFFERENCES IN ECONOMIC CHOICE René San Martín[1,2], Lawrence G. Appelbaum[1], Scott A. Huettel[1], Marty G. Woldorff[1]; [1]Duke University, [2]Universidad Diego Portales, Chile — Few studies have investigated the link between learning-guided decision-making and neural activity elicited by predictive cues. We used event-related potentials (ERPs) in a probabilistic decision-making task to investigate whether attentional allocation to outcome-predicting cues was affected by their learned reward probabilities. Five visual cues were associated with different probabilities of winning versus losing. Each trial started with a pair of these cues presented bilaterally, from which participants had to estimate the probability of winning on that trial in order to choose between a high or low magnitude bet. At the end of each trial, feedback was given indicating if the wagered amount was won or lost, allowing the participant to learn the probabilities associated with each cue in order to improve their choices. We found a posterior negativity (N2pc-like, peaking ~300 ms), similar to that associated with lateralized attentional shifting, which was larger contralateral to the most rewarding cue, relative to the other four cues. We also found that the ability of each participant to bet high on trials with the most rewarding cue scaled with the amplitude of the early portion of this component (~180 ms). In contrast, participants who were good at avoiding high bets when presented with the least rewarding cue had an increased ipsilateral (rather than contralateral) negativity in this latency range, suggesting an attentional aversion to this loss-predicting cue. Our results indicate that attentional allocation to environmental cues can be modulated by their reward-predicting value, which is in turn associated with different economic choices.

F136

CROSS-CONTEXT INFLUENCES: GAINS AND LOSSES IN SOCIAL STATUS AFFECT FINANCIAL RISK TAKING Vincent c Schoots[1,2], Maarten A S Boksem[1,2], Alan G Sanfey[2], Ale Smidts[1]; [1]Erasmus University Rotterdam, [2]Radboud University Nijmegen — Different rewards (i.e. money, food, sex, social inclusion) are encoded similarly by the brain, which can potentially lead to spill-over effects. Here, we find that gains and losses in a social status context can directly impact subsequent financial risk-taking. In a behavioral experiment, participants competed with two others on a simple task. On each round of the game they could either win or lose, thus impacting their competitive rank. This game alternated with a financial choice, always between a sure gain and a risky gamble. The subjective expected utility of the gamble was matched to the sure option for each individual, such that we expected participants to gamble on 50% of the trials; however, participants gambled on only 38%. Players in the top rank (high social status) gambled more after wins, while players in bottom rank (low social status) gambled more after losses (interaction [status*win/loss]). Thus, subjects gambled more (i.e. behaved in the expected direction) when the status-quo was maintained in the social status game. Subsequently, we tested 29 males in an fMRI experiment, using the same paradigm. We observed activity in midline visual cortex, cingulate cortex, and bilateral insula when decisions followed the status-quo, suggesting a role for attention and conflict monitoring. We propose that attention is shifted from the status game to the gambling task during these status-quo trials. While people might base their decision on gut-feeling during low attention, higher attention to the choice options allows for choices more in line with individuals' reasoned risk preferences.

Poster Session G

G1

ATTENTION AMPLIFIES OR SUPPRESSES NEURAL PREDICTION ERROR RESPONSES IN A REGIONALLY SPECIFIC MANNER

Jiefeng Jiang[1], Christopher Summerfield[2], Tobias Egner[1]; [1]Duke University, [2]University of Oxford — Attention and expectation facilitate behavior via distinct mechanisms: attention prioritizes processing of motivationally relevant information, whereas expectation constrains processing using probabilistic inference. Supporting this distinction, attention and expectation have different neural signatures: neural activity increases for attended stimuli but decreases for expected stimuli. An important yet largely uninvestigated question is how attention and expectation interact. One hypothesis is that attention amplifies the processing of prediction error (i.e., unexpected stimuli), whereas another hypothesis holds that attention suppresses prediction error. To adjudicate between these hypotheses we conducted an fMRI study (n = 21) that independently manipulated attention and expectation to face and scene stimuli. Intriguingly, our results showed both types of interactions between the effects of attention and expectation on neural responses, varying by brain region. Specifically, we found suppressed neural prediction error for attended face stimuli in regions belonging to the face processing network, specifically, the fusiform face area (FFA) and in the ventromedial prefrontal cortex (vMPFC). In contrast, we observed amplified neural prediction error for attended stimuli in bilateral caudate nuclei. Thus, attention modulates prediction error in a regionally specific manner: On the one hand, in general learning-related regions (i.e., the caudate), attention boosts prediction error signal, which may in turn improve the efficiency of learning. On the other hand, in regions specialized for processing target stimulus information (i.e., FFA and vMPFC), attention reverses the attenuation of neural responses to expected stimuli, which may in turn enhance their chances of gaining access to higher-level memory and decision-making centers.

G2

THE EFFECTS OF REWARD ON THE ATTENTIONAL BLINK IN HEALTHY HUMANS AND PATIENTS WITH RIGHT HEMISPHERE STROKE

Korina Li[1], David Soto[1], Charlotte Russell[2], Youssuf Saleh[1], Paresh Malhotra[1]; [1]Imperial College London, UK, [2]Brunel University, UK — In healthy individuals, the ability to detect a second target amongst a stream of distractors is typically impaired if it is presented within 200-500ms of a correctly identified first target. This failure of temporal selective attention is the attentional blink (AB) phenomenon. It has been demonstrated to be prolonged in some patients who have suffered from hemispheric stroke, and this extended blink has been related to the spatial neglect syndrome (Husain et al., 1997). There is increasing evidence that motivation and reward can influence attentional processes in healthy individuals and it has recently been shown that reward reduces visuospatial neglect in patients who have suffered from right hemisphere stroke (Malhotra et al., 2012). We aimed to determine whether anticipated reward could modulate the AB in healthy volunteers and right hemisphere stroke patients by adapting a standard rapid serial visual presentation (RSVP) task. Subjects were instructed to identify two targets in a RSVP task, where the temporal location of the second target in relation to the first varied from trial to trial. The task was performed under conditions of no reward and anticipated monetary reward. In both healthy volunteers and right hemisphere stroke patients, reward reduced the AB effect, modulating both its duration and magnitude. These results suggest that reward can specifically affect the temporal dynamics of visual selective attention, possibly through dopaminergic modulation of the capacity-limited processes of encoding and consolidating stimuli into visual working memory (Slagter et al., 2012).

G3

CONTOUR INTEGRATION: STIMULUS AND TASK-BASED MODULATIONS OF ERPS AND GAMMA OSCILLATIONS

Jennifer Padwal[1], Michael Pitts[2], Daniel Fennelly[2], Antigona Martinez[1], Steven Hillyard[1]; [1]University of California, San Diego, [2]Reed College — Contour integration is a mid-level visual process in which spatially-separate edge information is grouped together to form object boundaries. Previous ERP experiments have investigated a purported index of contour integration: a negative amplitude deflection over the posterior scalp from ~150-300ms elicited by contour-present versus contour-absent stimuli. More recent experiments, however, suggest that only the early phase of this ERP difference reflects contour integration ("contour integration negativity" or "CIN"), while subsequent phases reflect attentional and task-related processes. In the present experiment, subjects viewed an array of randomly oriented lines that shifted orientation once per second to form either rectangle or ellipse contour patterns, or another random arrangement. Subjects attended to the contour patterns and reported occurrences of target shapes of a particular orientation (horizontal or vertical). All shapes, regardless of task-relevance, elicited CINs of equal magnitude. Amplitudes of subsequent posterior negativities were modulated as a function of task-relevance. In addition, these effects in the time domain were accompanied by oscillatory bursts in the gamma band (35-45Hz) over the occipital scalp from 300-400ms that were of equal magnitude for all shapes. These results along with those from previous experiments suggest that the CIN component indexes an automatic grouping process, while subsequent posterior gamma oscillations reflect access of this information for task completion.

G4

TOP-DOWN MODULATION OF PRESTIMULUS ALPHA POWER AND ITS RELATION TO A STIMULUS DISCRIMINATION PROCESS

Daniel Roberts[1], John Fedota[1], George Buzzell[1], Raja Parasuraman[1], Craig McDonald[1]; [1]George Mason University — It has recently been demonstrated that the occiptal-temporal N1 component of the event-related potential (ERP) indexes both the difficulty and behavioral outcome of a stimulus discrimination process. The enhanced N1 for difficult, correct responses relative to both easy, correct responses and difficult, incorrect responses has been suggested to reflect the successful application of top-down control. However, the mechanism through which top-down control is exerted in this task has yet to be identified. One candidate mechanism is increased excitability of neurons contributing to the discrimination process reflected by the N1, which may be indexed by suppression in power of the alpha rhythm of the electroencephalogram (EEG) at the site of the N1 effect. The magnitude and topography of alpha modulations in the period preceding stimulus onset have been shown to be related to the locus of spatial attention, as well as the likelihood of detecting a near threshold visual stimulus. Here a contextual flanker task was utilized to manipulate stimulus discrimination difficulty, in which vertical Gabor stimuli are flanked in time by distractor stimuli that vary in their degree of similarity to the vertical targets. In the period preceding stimulus onset, alpha power for difficult, correct responses was suppressed relative to both easy, correct responses and difficult, incorrect responses, mirroring the pattern of the occipital-temporal N1 effect. These results suggest that the observed pattern of alpha modulation reflects the successful application of top-down control, which occurs prior to stimulus onset and contributes to the subsequent N1 effect.

G5

MIND OVER CHATTER: PLASTIC UP-REGULATION OF THE FMRI SALIENCE NETWORK DIRECTLY AFTER EEG NEUROFEEDBACK

Tomas Ros[1,2], Jean Théberge[1,3], Paul Frewen[1], Rosemarie Kluetsch[1,5], Maria Densmore[1,3], Vince Calhoun[4], Ruth Lanius[1]; [1]Department of Psychiatry, University of Western Ontario, London, Ontario, Canada, [2]Laboratory for Neurology and Imaging of Cognition, Department of Neurosciences, University of Geneva, Switzerland, [3]Department of Medical Imaging, Lawson Health Research Institute, London, Ontario, Canada, [4]The Mind Research Network, Albuquerque, NM, USA, [5]Central Institute of Mental Health, Medical Faculty Mannheim / Heidelberg University, Germany — Neurofeedback (NFB) involves a brain–computer interface that allows users to learn to voluntarily control their cortical oscillations, reflected in the electroencephalogram (EEG). Although NFB is being pioneered as a noninvasive tool for treating brain disorders, there is insufficient evidence on the mechanism of its impact on brain function. Furthermore, the dominant rhythm of the human brain is the alpha oscil-

lation (8–12 Hz), yet its behavioral significance remains multifaceted and largely correlative. In this study with 34 healthy participants, we examined whether during the performance of an attentional task, the functional connectivity of distinct fMRI networks would be plastically altered after a 30-min session of voluntary reduction of alpha rhythm (n=17) versus a sham-feedback condition (n=17). We reveal that compared to sham-feedback, NFB induced an increase of connectivity within regions of the salience network involved in intrinsic alertness (dorsal anterior cingulate), which was detectable 30 min after termination of training. The increase in salience network (default-mode network) connectivity was negatively (positively) correlated with changes in 'on task' mind-wandering as well as resting state alpha rhythm. Crucially, we observed a causal dependence between alpha rhythm synchronization during NFB and its subsequent change at resting state, not exhibited by the SHAM group. Our findings provide neurobehavioral evidence for the brain's exquisite functional plasticity, and for a temporally direct impact of NFB on a key cognitive control network, suggesting a promising basis for its use to treat cognitive disorders under physiological conditions.

G6

ENHANCED UTILIZATION OF REWARD PROSPECT LEADS TO IMPROVED PROCESSING OF STIMULUS CONFLICT

Berry van den Berg[1,2], Monicque Lorist[2], Marty Woldorff[1]; [1]Duke University, [2]University of Groningen — Reward prospect can improve task performance in cases in which the cognitive system is challenged, such as in the presence of conflicting stimuli. Little is known, however, about the interaction between reward prospect and attention to achieve such facilitation of conflict processing. Here we used event-related potentials (ERPs) to study how reward prospect influences the neural dynamics of conflict processing. In a color-word Stroop paradigm, color-words printed in colored fonts (e.g., "RED" printed in blue) were presented, with the task to indicate the font color with a button press. Prior to the target, a cue indicated whether there was potential reward on that trial. Results showed faster response times (RTs) for potential-reward than no-reward trials and for congruent than incongruent targets, but no significant interaction between reward and congruency. There were, however, large individual differences in the reward-related RT effects and their relationship to neural activity. In particular, relative to no-reward trials, reward-prospect cues elicited larger attention-related preparatory activity (CNVs), which correlated across subjects with the overall speeding of RTs for rewarded versus non-rewarded targets. Moreover, the amplitude of reward-related CNV enhancement correlated with greater reduction in interference effects for the rewarded (versus unrewarded) targets. This relationship, likely reflecting improved filtering of the irrelevant dimension, was also reflected neurally as greater reduction of the hallmark negative-polarity ERP incongruency effect from 300-450 ms. These results show that increased utilization of reward-related information by the attentional system leads to improved processing of stimulus conflict.

G7

GAZE CUING ELICITED BY GAZING EXPRESSIVE FACES AND ALCOHOLIC/NON-ALCOHOLIC TARGETS IN SOCIAL DRINKERS

Gordon Dodwell[1], Mayfield Abigail[1], Ceballos Natalie[1], Graham Reiko[1]; [1]Department of Psychology, Texas State University — Research suggests that facial expressions can modulate attentional shifts due to changes in gaze direction, especially when affective context is added by the use meaningful targets. In the current study, we investigated the combined effects of facial expression (happy vs. disgusted faces) and appetitive targets (alcoholic vs. non-alcoholic beverage images) on gaze-triggered orienting in social drinkers. Seventy-two social drinkers (43 light drinkers, 29 heavier drinkers) identified targets in a Posner-style cuing task: a face gazed non-predictively to the left or right, and then became disgusted or happy; an image of an alcoholic or non-alcoholic beverage would then appear on the left or right of the face. Analyses revealed a main effect of validity that was mitigated by an interaction with target type: participants were fastest to respond to validly-cued alcohol targets. Furthermore, there was an expression by target type interaction that was moderated by drinking status (heavier vs. lighter drinkers). Whereas light drinkers did not show differences in response times to identify beverages cued by the two different expressions, heavier drinkers were faster to identify alcohol targets cued by happy faces, and slower at identifying alcohol targets cued by disgusted faces. These results are consistent with the notion that affective context can have a powerful effect on gaze and expression interactions and subsequent attentional orienting, of which attitudes toward target objects are an important component.

G8

INCREASED DISTRACTION IN ADULT ATTENTION-DEFICIT HYPERACTIVITY DISORDER CAN BE AMELIORATED WITH HIGH PERCEPTUAL LOAD

Sophie Forster[1], David J. Robertson[1], Alistair Jennings[1], Jonna Kuntsi[2], Philip Asherson[2], Nilli Lavie[1]; [1]University College London, [2]King's College London — Impoverished ability to focus attention in the face of distractions is a core, and highly disruptive, symptom of Attention-Deficit Hyperactivity Disorder (ADHD). Perceptual load has been established within non-clinical populations as a critical determinant of both the efficiency of distractor rejection, and the stage of processing at which this occurs: Increasing perceptual load induces early selection and thus reduces distractor processing at an early perceptual stage. Here we ask whether high perceptual load can ameliorate distraction in ADHD. The performance of 17 adults with ADHD was compared with that of 17 age- and IQ-matched controls on a novel measure of irrelevant distraction under load (Forster & Lavie, 2008), designed to parallel daily-life distraction. Participants performed letter search with either high load (set-size: 6) or low load (set-size: 1). A salient yet entirely task-irrelevant distractor (selected from images of famous cartoon characters) was presented in the periphery on 10% of trials. Search reaction times were significantly increased in the presence (versus absence) of an irrelevant distractor, and this effect was significantly greater for adults with ADHD. Critically, even the inflated levels of distractor interference exhibited by the ADHD group were significantly reduced by high load: This beneficial effect of perceptual load was as potent for the ADHD group as the control group. These findings imply that increased distraction in ADHD reflects disruption to late selection processes, while early selection remains intact. In demonstrating a tangible method for reducing distraction experienced in ADHD, our findings also have promising implications for future interventions

G9

THE EFFECTS OF MIND WANDERING ON PROSPECTIVE MEMORY

Julia Kam[1], Megan MacPherson[1], Todd Handy[1]; [1]University of British Columbia — When mind wandering, or when our attention is away from the task at hand, the processing of external stimuli at both the sensory and cognitive level attenuates. Recent studies have found a bias towards future as opposed to past thinking while mind wandering. Given these findings, we were interested in the extent to which our attention to task affects one's prospective memory – memory that involves performing an act in the future. To address this question, we administered several prospective memory tasks and had participants complete the Stroop test. First, participants were asked to remember to retrieve an item from the experimenter after the computer task. Second, they were given instructions to two tasks that they had to perform upon a cue at the end of the experiment. Participants then completed the Stroop – as a filler task – and were occasionally asked about their attention state during their performance. For our primary analysis, we found that the frequency and content of mind wandering predicted performance on the prospective memory tasks. Interestingly, we also found that behavioral performance on the Stroop task (i.e. reaction times and accuracy) was modulated by whether they preceded reports of on-task vs. mind wandering. Together, this suggests that the effects of mind wandering extend beyond sensory and general cognitive level processing to prospective memory and response inhibition.

G10

PRACTICE IMPROVES LATE-STAGE DISTRACTOR FILTERING: A COMBINED EEG-FMRI STUDY.

Todd Kelley[1], George Mangun[2]; [1]Microsoft Corporation, [2]University of California, Davis — Avoiding distraction is a critical capacity for survival. Research has shown that people improve their ability to ignore distracting stimuli with practice, but the specific neural mechanisms of this practice effect are not fully understood. We conducted an electroencephalography/event-related potential (EEG/ERP) and functional magnetic resonance imaging (fMRI) study to investigate how neural activity changed as observers became more practiced at ignoring distractors. Two groups of participants performed a color discrimination task on a target object. While performing this task, they also had to ignore irrele-

vant (distractor) objects that could appear next to the target. The presence of these distractor objects initially resulted in slower responses with lower accuracy. However, these behavioral deficits were reduced with practice within sessions. ERPs showed no changes with practice in the lateralized readiness potential (associated with response planning) or the PD component (associated with suppression of task-irrelevant sensory signals). However, there was an increase in the coherence of parietal alpha (8-12 Hz) oscillations evoked by distracting stimuli. The fMRI data showed reduced response to distractors across parietal and frontal regions with practice, but no change in the response in early visual cortex. These data suggest that practice leads to improved suppression of post-sensory distracting information as indexed by the alpha oscillations. This in turn leads to decreased need for parietal and prefrontal filtering mechanisms, as indexed by the decreased BOLD response to distractors. We propose that practice improves late selection attention mechanisms that prevent irrelevant information from reaching working memory. Supported by MH055714.

G11

VISUAL ATTENTION TO THE PARTS OF ANIMALS AND ARTIFACTS: EVIDENCE FOR EARLY SELECTION FOR HANDLES

Heath Matheson[1], Aaron Newman[1], Nicole White[2], Patricia McMullen[1]; [1]Department of Psychology, Dalhousie University, [2]Department of Psychology, University of Toronto — In the object perception literature, previous research has demonstrated that participants are faster at making a response (e.g. object orientation decision) with the hand that is aligned with the handle of a manipulable object. According to the embodied cognitive account of object representations, this finding suggests that the presentation of a manipulable object automatically elicits sensorimotor simulations of the respective hand and these simulations facilitate the response, decreasing its latency. However, one would also expect faster responding with a hand that is in the same spatial location as a handle if handles automatically attract visual attention (i.e. stimulus-response compatibility). In the present study, we modified the Posner-style attentional cuing paradigm to test this hypothesis. Participants were shown target dots in the left or right visual field and had to press a button to indicate their location (i.e. target detection). Each dot was 'cued' by a centrally presented artifact or animal, oriented towards the left or the right. Each image was oriented such that the functional-end/head or the handle/tail was in the same spatial location as the target dot. We showed that a) participants are better at detecting target dots cued by handles, and b) that the P1, an index of early visual attention, is greater in response to targets cued by handles than targets cued by functional-ends. This result suggests that object handles automatically bias attention. This attentional bias may account for earlier behavioural findings, without any recourse to embodied theories of cognition.

G12

ALCOHOL-RELATED ATTENTIONAL BIASES IN FEMALE COLLEGE FRESHMAN: A CROSS-CULTURAL ERP STUDY

Abigail Mayfield[1], Natalie Ceballos[1], Reiko Graham[1]; [1]Texas State University — Young women may be at risk for problem drinking during the transition from home to college, Latinas in particular. We assessed event-related potential (ERP) correlates of alcohol-related processing, alcohol attitudes, and consumption in freshman females using a 3-stimulus oddball paradigm and a longitudinal design. Participants (24 Non-Hispanic/Caucasian and 17 Hispanic, 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 they responded to alcohol targets (ignore other objects or nonsense shapes) and another where they responded to object targets. Groups did not differ on age, depression, acculturation or family history of drinking. Both groups reported very low drinking levels that remained stable over 6 months. Overall, Non-Hispanic/Caucasian freshmen had more extreme positive and negative attitudes towards alcohol; attitudes remained stable over time. Analyses focused on the parietal P300, which was maximal approximately 350-450 ms after stimulus onset. Peak amplitudes (350-450 ms) were larger to alcohol images for both groups, suggesting that alcohol images were salient. This effect was more marked for Non-Hispanic/Caucasians and remained relatively stable over time. Exploratory correlational analyses revealed that late P3 amplitudes (450-550ms) at both Time 1 and Time 2 were negatively correlated with self report and alcohol intake measures at Time 2. Longitudinal assessments of use are currently underway to determine whether or not these ERP indices of alcohol salience during the freshman year predict future drinking patterns in this group of women.

G13

PROLONGED ATTENTIONAL BLINK RELATES TO ERROR PROCESSING IN THE CINGULO-OPERCULAR NETWORK

Maital Neta[1], Andrew Padgett[1], Steve Petersen[1,2,3,4,5,6]; [1]Department of Neurology, Washington University School of Medicine, [2]Department of Radiology, Washington University School of Medicine, [3]Department of Anatomy & Neurobiology, Washington University School of Medicine, [4]Department of Neurosurgery, Washington University School of Medicine, [5]Department of Psychology, Washington University, [6]Department of Biomedical Engineering, Washington University — The attentional blink is a phenomenon found during rapid serial visual presentation (RSVP) tasks by which the detection of a target (T1) suppresses the ability to detect a second target (T2) that follows shortly (400-600 ms) thereafter. This effect is thought to reflect generalized interference related to passing a processed item into a limited capacity processor (focal attention). Activity in the cingulo-opercular network (comprised of the dorsal anterior cingulate/medial superior frontal cortex and bilateral anterior insula/frontal operculum) has been characterized, at least in part, as indexing focal attention. Cingulo-opercular activity also shows greater and more prolonged activity for errors than correct trials. Combining these concepts suggests that the attentional blink should be prolonged during trials where there is an error at T1. Participants performed an RSVP task, where 15 words were presented, one immediately after the other, for 250 ms each. Most of the words were nouns, but targets (1 or 2 per list) were verbs. Participants were instructed to report each verb (target) aloud. We replicated the attentional blink effect for accurately detected T1s; participants were less accurate at detecting T2 at short SOAs as compared to longer SOAs. Importantly, after an error at T1, accuracy for T2 detection was significantly attenuated across a large range of SOAs, consistent with a prolonged attentional blink. This experiment deepens the tie between activity in the cingulo-opercular network and focal attention, by showing that activity profiles in these regions can predict the outcome of a commonly used attentional interference task.

G14

DIFFERENCES IN ATTENTIONAL BLINK AFTER OPEN-MONITORING AND FOCUSED-ATTENTION MEDITATION

Chivon Powers[1], Marcia Grabowecky[1], Mark Beeman[1]; [1]Northwestern University — Open awareness and focused attention influence thinking in different ways. We induced open perceptivity and focused attention via a guided session of either open-monitoring meditation (OM) or focused-attention meditation (FA). We then examined the effect of these two meditation styles on attentional blink, which is thought to measure allocation of cognitive resources during selective attention. After 30 minutes of OM, FA, or no meditation, we gave 57 age and education-matched participants a rapid serial visual presentation (RSVP) task. Participants identified two target letters (T1 and T2) presented at short and long lags within a stream of rapidly-presented numbers. In each group, we compared accuracy for detecting both targets at short and long lags to measure attentional blink. We found a marginal effect of group on target accuracy. Participants who practiced OM showed a greater attentional blink than FA and control participants during short lags. Yet all groups showed similar T1 detection across both lags and T2 detection at long lags. These results indicate that a single attempt at meditation by inexperienced meditators has immediate influences on cognitive processes associated with attentional deployment. OM meditation may induce a receptive state wherein distractors are given more attention than when attention is more directly focused. Thus, OM may amplify the attentional blink by effectively training the mind to allow distractors to capture more attention than would normally be allocated for non-meaningful information. We further distinguish effects of OM and FA by examining target-related electroencephalographic differences among novices as they perform the RSVP task.

G15

NEURAL PROCESSING OF MALE AND FEMALE FEARFUL FACES IN A SPATIAL ATTENTION MODULATION TASK

Andrew Hathaway[1], Karen Reinke[1]; [1]University of Illinois Springfield — Previous research has shown that attention can be modulated by the presentation of a fearful

face. The purpose of the current research was to examine the differences in modulation based on whether or not the fearful face was male or female. A dot-probe paradigm was used to measure reaction times. A 128-channel electroencephalography (EEG) cap was used to examine the event related potentials. Participants viewed two face stimuli of the same sex for 166ms on either side of a fixation point. The stimuli were immediately replaced by a target dot on one side of the fixation point. There were six different trial types, three for each sex of faces. Congruent: one neutral and one fearful face with the target dot presented in the same visual field as the fearful face. Incongruent: one neutral and one fearful face with the target dot presented in the opposite visual field as the fearful face. Baseline: both faces were neutral and the target dot could appear in either visual field. Both male and female faces produced a congruency effect. There was also a slight, but non-significant, difference in reaction times to male faces versus female faces. However, EEG waveforms differed for male versus female faces, suggesting that there was a difference in neural processing based on the sex of the fearful face.

G16

RELATION OF ANXIETY AND DEPRESSION TO COGNITION IN PARKINSON'S DISEASE

Gretchen Reynolds[1], Alice Cronin-Golomb[1]; [1]Boston University — The study of Parkinson's disease (PD) typically focuses on the classic motor symptoms of the disease, but many non-motor symptoms occur in PD and significantly contribute to a poorer quality of life. Specifically, anxiety occurs in up to 40% of PD patients and is often comorbid with depression and other psychiatric symptoms. In the general population, limbic, prefrontal, and temporal brain regions have been implicated in the pathogenesis of anxiety and depression. In our sample of 28 non-demented PD patients (16M, 12F; mean age = 63.5), we examined levels of anxiety and depression with the Beck Anxiety and Depression Inventories (BAI, BDI-II) and the Geriatric Depression Scale (GDS), and assessed their relation to cognition. Anxiety and depression were correlated with one another (BAI with BDI: r=0.46, BAI with GDS: r=0.53) and with quality of life as indexed by the PD Quality of Life questionnaire (PDQ-39) (BAI with PDQ-39: r=0.72; BDI with PDQ-39: r=0.68). Regarding cognition, anxiety correlated with executive function, including response inhibition and fluid thinking (Ruff Figural Fluency Test: r= -0.48) and set-shifting (Trail Making Test [TMT] B: r=0.47). Similarly, depressive symptoms correlated with Ruff (r=-0.49) and TMT B (r=0.38) performance. All correlations were at $p<.05$. Anxiety and depression did not correlate with cognitive tests of memory or visuospatial function, indicating a relatively specific relation to executive function. The results suggest that dysfunction in prefrontal brain regions affected in PD, as indexed by scores on executive-function tests, may also contribute to the development or maintenance of anxiety and depression.

G17

THE MANY FACES OF DREAD: DISSOCIABLE EFFECTS OF ANTICIPATORY ANXIETY ON ATTENTION CONTROL AND SENSORY PROCESSING IN V1

Valentina Rossi[1], Leonie Martens[1], Gilles Pourtois[1]; [1]Ghent University — The fronto-parietal network (FPN) is involved in directing attention toward goal-relevant stimuli, and it is recruited when the need for top-down control is enhanced. As a consequence, adaptive behavior is maintained through focusing on task-relevant processing, and through efficient filtering of irrelevant (though salient) information. However, emotional states, such as sustained fear, can transiently compromise the ability to rely on this dorsal system, potentially resulting in inefficient stimulus selection. We tested, using high-density EEG, source localization and physiological measures, whether different types of anticipatory anxiety would differentially alter attention control, impairing goal-related stimulus processing and perturbing efficient filtering of irrelevant stimuli in primary visual cortex. Participants performed an easy or more difficult task. As predicted, increased load was accompanied by enhanced activation within the FPN and the anterior cingulate cortex (ACC), and by efficient early filtering of irrelevant information in V1. Anticipatory anxiety induced by aversive stimuli (sounds) also modulated cingulate cortex recruitment, indicating sustained effort. However, responses in the FPN were not increased in this condition, eventually resulting in insufficient filtering of irrelevant information rapidly following stimulus onset. On the contrary, anticipatory anxiety related to social threat did not impair attention control, and maximized filtering in early visual cortex. Our results indicate that transient negative emotional states can have widespread effects on attention selection and early sensory processing. Crucially, the balance between goal-relevance and saliency governing attention allocation can be swiftly tipped over by emotion. However, these effects are not generic, but specific to the actual anxiety state.

G18

WHETHER EMOTION LEADS TO RETROGRADE AMNESIA OR FACILITATION DEPENDS ON THE FOCUS OF TOP-DOWN ATTENTION

Michiko Sakaki[1], Kellie Fryer, Mara Mather; [1]University of Southern California, [2]University of Southern California, [3]University of Southern California — Many studies reveal enhanced memory for emotional stimuli. But there are contradictory findings about how emotional stimuli seen in a sequence influence memory for preceding or subsequent neutral stimuli. For example, while many studies reveal impaired memory for neutral stimuli preceding emotional items (e.g., Strange et al., 2003; Knight & Mather, 2009), other studies show facilitated memory for neutral stimuli preceding emotional items (e.g., Anderson, Wais & Gabrieli, 2006). The current study tested the hypothesis that top-down attentional focus determines whether emotional arousal enhances or impairs memory for other neutral stimuli. Consistent with our hypothesis, we found that emotion facilitates memory for preceding neutral items when people prioritize those neutral items. In contrast, emotion impaired memory for preceding neutral items when people do not prioritize those neutral items, and instead focus on the following emotional items. These patterns were observed irrespective of emotional valence (positive or negative). Furthermore, we found similar attention effects on memories for neutral items that appeared after the emotional items. These results support the arousal-biased competition theory (Mather & Sutherland, 2011) and indicate that the top-down priority determines whether emotion facilitates or impairs memory for other neutral information.

G19

INCREASED FUNCTIONAL CONNECTIVITY OF THE NUCLEUS ACCUMBENS WITH AUDITORY AND VALUATION REGIONS OF THE BRAIN PREDICTS REWARD VALUE OF MUSICAL EXCERPTS

Valorie N. Salimpoor[1,2], Iris van den Bosch[3], Natasa Kovacevic[2], Anthony Randal McIntosh[2], Alain Dagher[1], Robert J. Zatorre[1]; [1]Montreal Neurological Institute, McGill University, [2]Rotman Research Institute, University of Toronto, [3]Utrecht University — Auditory expectations are thought to play a crucial role in shaping emotional responses to music. How can we predict the direction of novel music? We used functional magnetic resonance imaging to examine how music gains reward value the first time it is heard. To assess reward value objectively, an auction paradigm was used as 11 participants (6 male) listened to 70 new music clips, making a bid after hearing each item. To increase ecological validity, participants kept music won through the auction and remainder of their budget. The best predictor of reward value during music listening was activity in the nucleus accumbens (NAcc), known to be associated with positive prediction error, suggesting that participants make predictions despite any explicit familiarity with the music. Importantly, reward value was also related to increasing functional connectivity of the NAcc with superior temporal gyri, associated with storing templates of music information implicitly accumulated over year of listening, linking predictions to previous auditory experience. These data can help explain why different people like different music. We also found a dissociation in reward-related processes as the auditory cortices, amygdala, and ventromedial prefrontal regions were active to a similar extent during all listening conditions requiring valuation, but did not predict reward value of items, which was instead predicted by increasing functional connectivity of these regions with the NAcc as reward value increased. This finding provides direct evidence that aesthetic rewards arise from the interaction between mesolimbic reward circuitry and cortical networks involved in perceptual analysis and valuation.

G20

EMPATHY AND SOCIAL PROBLEM SOLVING IN ALCOHOL DEPENDENCE

Tobias Schmidt[1], Patrizia Thoma[1], Patrik Roser[2], Georg Juckel[2], Boris Suchan[1]; [1]Ruhr University Bochum, Germany, [2]LWL University Hospital Bochum, Germany — Empathy and social problem solving are fundamental for everyday functioning. Currently, little is known about specific changes of these aspects of social cognition in alcohol dependence. In the current

study, we investigate distinct components of empathy and social problem solving in patients with alcohol dependence and depression in comparison to healthy controls. Recently detoxified patients with alcohol dependence (ALC), patients hospitalized for depression (DEP) and a group of 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. Furthermore, standardized executive measures were administered. Current data suggest a tendency for faster reactions of the ALC group relative to the HC group when responding on the personal concern and the affective perspective taking subtasks, while the performance of the DEP group was inconspicuous. ALC patients generated significantly fewer socially acceptable solutions for interpersonal problems than DEP and HC groups and significantly fewer irrelevant solutions than DEP patients. Mentalizing about scenario content was significantly better in DEP relative to ALC patients. DEP patients were impaired in selecting optimal solutions for interpersonal problems relative to healthy controls. The ability to select optimal solutions for difficult interpersonal situations correlated significantly with executive performance in the overall group. Our data provide evidence of specific patterns of altered empathic responding and social problem solving in alcohol-dependent relative to depressed patients and healthy controls. This might partly be related to executive dysfunction.

G21

MODULATIONS OF CORTICAL RESPONSES (ERPS) TO PERIPHERALLY PRESENTED EMOTIONAL FACES, WORDS, AND GESTURES BY ATTENTIONAL LOAD

Patrik Schoch[1], Johanna Kissler[2]; [1]University of Konstanz, Germany, [2]University of Bielefeld, Germany — It is debated, to what extent attentional resources are necessary for prioritized processing of emotional stimuli. If attention is required (Pessoa et al., 2005), emotion effects in vision should be modulated by the task at hand and follow some amount of perceptual processing, implying relatively late emotion effects. If attention is not directly needed (Dolan and Vuilleumier, 2003; LeDoux, 1996), reduced attentional resources should not constrain emotional processing and responses to emotional stimuli should appear rapidly, with little previous perceptual processing. Two event-related potential (ERP) experiments were conducted to investigate these issues. Emotional and neutral faces, words, and gestures were presented peripherally in separate blocks while the participants' EEG was recorded. In experiment 1, participants had to maintain fixation on the central fixation cross while stimuli were presented peripherally (~10°), each for 150ms. In experiment 2, peripheral stimulation remained the same, but participants additionally had to count color-changes of the fixation cross. Two salient results emerged: When attention was centrally engaged by counting the color changes, no significant emotion effects emerged following stimulus presentation in the left visual field, as right hemisphere resources were taken up by the task. Without attentional load, right hemispheric emotion effects were also found for left visual field presentation. Second, there were significant P1-effects during passive viewing, but not during the task. These results reconcile both perspectives: Whereas emotional stimuli do not need to be directly attended to receive privileged processing, insufficient attentional resources or distraction (Lavie, 2005) can diminish emotional cortical processing.

G22

EMOTIONAL MODULATION OF THE RELATIONSHIP BETWEEN ATTENTIONAL CONTROL AND BRAIN ACTIVITY IN ADOLESCENTS WITH MENTAL HEALTH DISORDERS: AN FMRI INVESTIGATION.

Andrea T. Shafer[1], K. Jessica Van Vliet[1], Sunita Vohra[1], Lihong Wang[2], Anthony Singhal[1], Florin Dolcos[1,3]; [1]University of Alberta, [2]Duke University, [3]University of Illinois at Urbana-Champaign — Research in healthy young adults has shown that increased attentional control (AC) enhances goal-relevant processing and minimizes emotional distraction (ED). Also the degree of brain activity in attention and emotion processing regions, in response to emotional stimulation has been linked to individual differences in self-reported measures of AC. However, it is unclear whether similar relationships are found in earlier stages of development, and how more rigorous standardized measures of attention are linked to brain activity related to goal-relevant processing and ED. These issues were investigated using the Test Of Variables of Attention and fMRI in conjunction with an emotional oddball task, where infrequent emotional images (distracters) and targets were presented amongst a stream of frequent scrambled images, in 40 adolescents with affective mental health disorders. Results showed overall reduced AC linked to slower responses to both emotional distracters and targets, but with a stronger specific impact on targets. Activity in areas associated with both attention (anterior middle frontal gyrus-aMFG, cingulate, putamen, caudate) and emotion regulation (bilateral ventrolateral prefrontal cortex-vlPFC) was linked to increased AC and enhanced target performance. Interestingly, the relationship between aMFG, putamen, and cingulate and AC was also modulated by the preceding emotional distracter. Moreover, a hemispheric asymmetry was identified in the vlPFC, with right hemisphere being linked to general distraction inhibition and left specifically inhibiting ED. These results provide novel findings concerning emotion-attention interactions in the adolescent brain, linked to individual differences in standardized AC scores, and have relevance for understanding cognitive and emotional developmental disturbances.

G23

TASK-SPECIFIC FRONTAL-AMYGDALA NETWORK CONCORDANCE PREDICTS INDIVIDUAL DIFFERENCES IN AFFECTIVE EMPATHY

Tong Sheng[1], Katherine Fu[1], Lisa Aziz-Zadeh[1]; [1]University of Southern California — Empathy refers to one's capacity to understand and feel another person's emotional experiences and is an important aspect of social cognition. Empathy encompasses affective and cognitive components, and correspondingly, a number of affective, sensorimotor, and higher cognitive brain regions have been implicated in empathic processing. However, individuals display large variances in their empathic abilities and tendencies, and a network-level understanding of the neural bases of such individual differences is currently lacking. In the current study, we used fMRI to characterize the extent to which an emotion-processing network comprised of inferior frontal/orbitofrontal cortices and the amygdalae can account for individual differences in affective empathy under different task conditions. Specifically, subjects were scanned during: (1) resting state; (2) passive auditory emotion perception; (3) an affective auditory emotion perception task; (4) a cognitive auditory emotion perception task. The overall concordance of the inferior frontal/amygdala emotion-processing network was calculated for each condition, and a multiple regression model showed that, collectively, network concordances during the various tasks accounted for a substantial amount of the variance in individual differences in affective empathy. Post-hoc analyses revealed that network concordances during the affective and cognitive emotion perception tasks were the strongest predictors of individual scores in empathy. These findings demonstrate a multivariate, functional-network-level account of individual differences, and highlight the importance of the task-specific nature of the relationship between brain function and behavior.

G24

CONTRIBUTION OF SAFETY SIGNALS TO ESCAPE/AVOIDANCE LEARNING IN HEALTHY INDIVIDUALS

Jony Sheynin[1], Saima Shikari[2], Jackie Ostovich[2], Barbara Ekeh[2], Kevin D. Beck[1,3,4], Kevin C.H. Pang[1,3,4], Richard J. Servatius[1,3,4], Mark W. Gilbertson[5], Scott P. Orr[6], Catherine E. Myers[1,3,4]; [1]Graduate School of Biomedical Sciences, University of Medicine and Dentistry of New Jersey, Newark, NJ, [2]Honors College, Rutgers University, Newark, NJ, [3]Stress & Motivated Behavior Institute, New Jersey Medical School, Newark, NJ, [4]Department of Veterans Affairs, New Jersey Health Care System, East Orange, NJ, [5]Department of Veterans Affairs, Manchester VA Medical Center, Manchester, NH, [6]Massachusetts General Hospital and Harvard Medical School, Boston, MA — Avoidance behavior is a predominant symptom in all anxiety disorders. The propensity to acquire and express such behavior may be an important vulnerability factor contributing to the etiology and pathogenesis of the disorders. To date, a more complete understanding of how avoidance behavior is exhibited by humans is limited by the absence of relevant tasks. Specifically, it is of interest to test the contribution of "safety signals", stimuli that indicate periods of non-threat and were shown to facilitate avoidance learning in animals. Here, we modified our computerized avoidance learning task for human subjects (Sheynin et al. 2012, SfN annual meeting) to test the effect of adding a safety signal. The task included 12 acquisition trials where subjects were expected to learn to escape/avoid an aversive on-screen event by moving an object to a safe area, followed by 12 extinction trials. Results in healthy young adults sug-

gest that the introduction of a visual safety signal during acquisition phase facilitated performance during extinction (but not acquisition) phase. This finding is consistent with recent work demonstrating quicker extinction of lever-press avoidance behavior in a subgroup of rats exposed to a safety signal during the acquisition phase (Beck et al. 2011). Furthermore, we will analyze the impact of safety signals on subjects with high versus low trait anxiety vulnerabilities. Such investigation has an important role for understanding the pathogenesis of anxiety disorders and might guide the development of better therapeutic approaches.

G25

NEURAL CORRELATES OF HUMOR COMPREHENSION AND APPRECIATION: A FUNCTIONAL MRI STUDY Midori Shibata[1,2], Yuri Terasawa[2,3,4], Satoshi Umeda[2]; [1]Hokkaido University, [2]Keio University, [3]National Institute of Mental Health, National Center of Neurology and Psychiatry, [4]Japan Society for the Promotion of Science (JSPS) — The perception of humor evokes a pleasant emotional response while causing laughter or changes in the brain and body via the autonomic system. However, little is known about what kind of mechanism elicits the emotional response. To elucidate this mechanism, we conducted fMRI study using the same context across conditions (i.e., the first two sentences and the punch line were identical, but the third sentence was different). The results indicate that despite using the same sentences, only the punch line in the humor sentence condition induced a perception of funniness and resulted in greater activation in the fronto-temporal region and the mesolimbic reward region. We found that the fronto-temporal regions are involved in processing the semantic aspects of humor comprehension. Further, the punch line in the humor sentence condition showed greater activation in a network of subcortical regions, including the hippocampus, amygdala, ventral striatum, and midbrain, which have been implicated in experiencing positive rewards. In addition, functional connectivity analyses revealed that the activity of the ventromedial prefrontal, inferior frontal (BA 47; pars orbitalis), and middle temporal cortex functionally interacted with that of the mesolimbic reward region. These results suggest that the network including the ventromedial prefrontal, inferior frontal (BA 47; pars orbitalis), middle temporal cortex and mesolimbic region plays a critical role in the interaction between the cognitive and affective components involved in humor comprehension and appreciation.

G26

INTERNET ADDICTION DISORDER AND ALTERATIONS IN WHITE MATTER INTEGRITY: A DTI STUDY HYE ILL SHIN[1], Heung Sik Yoon[1], Hyeon Guk Kang[1], Hyeon Min Ahn[1], Sang Hee Kim[1]; [1]Korea University, Seoul, Korea — As Internet addiction (IA) has become more prevalent recently, there has been increased awareness for the need of better understanding of its neural pathology. Previous neuroimaging studies have shown abnormal functional reactivity of the brain in Internet addiction; however, the possibility of structural abnormality in the brain associated with this condition has not received much research attention. In this study, we wanted to investigate differences in white matter (WM) integrity in Internet addiction disorder. Adults with Internet addition (n=13, age 23.87, Female/Male=2/11) and healthy controls (n=24, age 25.69, Female/Male=12/12) were recruited for this study. Group assignment was based on Young's Internet Addiction test. Diffusion tensor imaging (DTI) data were obtained and analyzed using tract-based spatial statistics (TBSS) implemented in FSL. Fractional anisotropy (FA) was assessed as an index of directional diffusivity of water molecules in the brain. Participants with IA showed reduced diffusivity within bilateral Inferior longitudinal fasciculus (ILF), right superior longitudinal fasciculus (SLF), and bilateral Inferior fronto-occipital fasciculus (IFOF). Furthermore, individual's FA values in the IFOF were negatively correlated with IA scores of Young's scale. Our preliminary results indicate a possible alteration in white matter integrity associated with Internet addiction disorders.

G27

INDIVIDUAL DIFFERENCES IN EMOTION-COGNITION INTERACTIONS: EMOTIONAL VALENCE INTERACTS WITH SEROTONIN TRANSPORTER GENOTYPE TO INFLUENCE BRAIN SYSTEMS INVOLVED IN EMOTIONAL REACTIVITY AND COGNITIVE CONTROL Melanie Stollstorff[1,2], Yuko Munakata[1,2], Harry Smolker[1], Arielle Jensen[2], Ryan Guild[2], Joseph Devaney[3], Marie Banich[1,2]; [1]Institute of Cognitive Science, University of Colorado Boulder, Boulder, CO, USA, [2]Department of Psychology & Neuroscience, University of Colorado Boulder, Boulder, CO, USA, [3]Department of Integrative Systems Biology, Research Center for Genetic Medicine, Children's National Medical Center, Washington, DC, USA — The serotonin transporter gene (5-HTTLPR) influences emotional reactivity and attentional bias towards or away from emotional stimuli, and has been implicated in psychopathological states, such as depression. The short allele is associated with increased reactivity and attention towards negatively-valenced emotional information, whereas the long allele is associated with that towards positively-valenced emotional information. The neural basis for 5-HTTLPR-mediated differences in the ability to exert cognitive control over these bottom-up biases in emotional reactivity and attention is unknown, an issue investigated in this study. Healthy adults (two groups based on 5-HTTLPR genotype: "Long", "Short") underwent functional Magnetic Resonance Imaging (fMRI) while completing an Emotional Stroop-like task that varied in congruency of task-relevant and task-irrelevant information and in emotional valence. Consistent with prior reports, bottom-up reactivity (i.e., amygdala activation) was modulated by 5-HTTLPR, with Short-carriers showing more reactivity to negative, and Long-carriers showing more reactivity to positive, information. Behaviorally, participants demonstrated the classic Stroop effect, which did not differ by genotype. However, fMRI results revealed that genotype influenced brain regions engaged depending on emotional valence. While the Long group recruited right inferior frontal gyrus and amygdala during positive emotional conflict, the Short group recruited these regions during negative emotional conflict. Thus, participants successfully engaged cognitive control to overcome conflict in an emotional context using similar neural circuitry, but the engagement of this circuitry depended on emotional valence and 5-HTTLPR status. These results suggest that the interplay between emotion and cognition is modulated, in part, by a genetic polymorphism that influences serotonin neurotransmission.

G28

CAN WE DISSOCIATE THE MUSICAL EMOTIONAL PATHWAY FROM THE VOCAL ONE? Sebastien Paquette[1], Isabelle Peretz[1], Belin Pascal[1,2]; [1]University of Montreal, [2]University of Glasgow — Why does music move us? Recently, certain brain areas (e.g. striatum, amygdala) have been associated with musical emotions processing. These same areas have also been associated with basic biological functions (sex, pain). How can we conceptualize the relations between music and these neurobiological substrates? One possibility is that music co-opts or invades emotional circuits that have evolved for biologically important vocalizations (e.g. laughs, screams). There is currently little experimental support for the existence of a common musical and vocal channel. By using fMRI while presenting very comparable (acoustically, ecologically) emotional musical and vocal stimuli, we aim to provide an in-depth comparison of the musical and vocal emotion channels and identify their common neurobiological substrates. Two batteries of stimuli depicting basic emotional expressions (happy, sad, scary, neutral) were used: the Montreal Affective Voices (non-linguistic vocal bursts; mean duration:1.3 sec) and the Musical Emotional Bursts (improvisations or imitations of an emotion on a violin or a clarinet; mean duration:1.6 sec). Twenty participants realized a one-back task while listening to the affective bursts presented in blocs of forty stimuli by timbre (violin, clarinet, voice), and repeated four times. Univariate analyses, performed using SPM, revealed an interaction (emotion x timbre) in the temporal lobes: vocal fear elicited stronger activation than their music counterparts and the opposite was found for happy stimuli. Activation patterns by vocal and musical emotions showed striking similarities. Ongoing analyses using MVPA will help determine if the musical emotional pathway can be dissociated from the vocal one.

G29

INTERACTION OF PAIN AND PLEASURE NETWORKS Eric Porges[1], Karen Smith[1], Jean Decety[1]; [1]University of Chicago, Chicago, IL, United States — BACKGROUND: Observing another individual in pain elicits a predictable network of neural activation. Separately, pleasurable stimuli elicit a different, but overlapping network. These networks, however, are modulated by several physiological and psychological factors (e.g. related to the

perspective being taken, etc). fMRI, self-report of subjective appetitiveness and aversiveness of stimuli, and autonomic measures were employed to explore the neural pathways common to both pain and pleasure. METHODS: 60 males (18-30 yrs), selected based on their like or dislike for watching sports where the aim is to injure another person (e.g.,boxing, mixed martial arts, etc). Subjects were shown 20 10s videos of violent sports or control of similar content containing no injuries or intent to injure. Data collected included fMRI, autonomic activity (heart rate variability, electrodermal activity, respiration), salivary cortisol, and testosterone. RESULTS: Relative to control condition, increased activation was observed in the subgenual region of the ACC, right amygdala, pre-motor cortex, primary motor cortex and bilateral insula. Psychopathy index scores were correlated with bilateral activation in the head of the caudate. Alexithymia scores were correlated with increased prefrontal and ACC activation, and inversely correlated with activation of the aMCC DISCUSSION: Brain regions previously implicated in representations of pain and pleasure are simultaneously recruited in individuals who report enjoyment when watching violent sports. Relations were observed between activation of the neural networks and features of alexithymia and psychopathy. These data have implications for understanding the relationship between personality traits and the brain-behavior mechanisms involved in pleasure and pain.

G30

YOU LOOKIN' AT ME? THE ROLE OF GAZE DIRECTION IN THE MODULATION OF THE ACOUSTIC STARTLE RESPONSE BY EMOTIONAL FACES

Kiran Puri[1], Albert Porterfield[1]; [1]Oberlin College — It is well established that the affective valence of foreground visual stimuli modulates the acoustic startle blink, with negatively-valenced photos generally potentiating and positively-valenced photos generally suppressing orbicularis oculi activation in response to a sudden, intense acoustic stimulus. Some research suggests that this effect extends to the viewing of faces varying in emotional expression, although findings are inconsistent. FMRI studies indicate that the amygdala, a key element of the startle circuitry, is differentially responsive to both the emotional expression and the gaze direction of target faces. The present study examined the role of both of these variables on the acoustic startle blink. Orbicularis EMG was recorded from female undergraduates as they viewed frontal photos of models displaying neutral, happy, angry, and frightened facial expressions, half with a direct and half with an averted (left or right) gaze. Randomly, half of the photos were probed with a 50 ms, 101 dB[a] burst of white noise. Analysis of EMG activity indicated that target face expression did not significantly affect blink amplitude, but gaze direction did, with averted gazes eliciting smaller blinks than direct gazes. Although the expression × gaze interaction was not significant, post-hoc testing revealed that happy faces with averted gazes elicited smaller blinks than all other stimuli, either individually or in the aggregate. These findings suggest that interpersonal engagement, as signified by eye contact, enhances the tone of the defensive motive system underlying the startle reflex.

G31

ACTING ON ANGER: SOCIAL ANXIETY MODULATES APPROACH-AVOIDANCE TENDENCIES AFTER OXYTOCIN ADMINISTRATION

Sina Radke[1], Karin Roelofs[1], Ellen R. A. De Bruijn[2]; [1]Radboud University Nijmegen, The Netherlands, [2]Leiden University, The Netherlands — Oxytocin attenuates responses to stress and threat, e.g., by fostering social approach in animals and decreasing anxiety. However, whether the hormone also facilitates approach-related social behaviors in humans has not been investigated until now. To assess approach-avoidance tendencies, participants responded to images depicting happy and angry faces with direct or averted gaze by either pulling a joystick toward (approach) or pushing it away from themselves (avoid). Under placebo, the typical action tendencies were present, with happy faces eliciting approach and angry faces avoidance responses, but 24 IU of oxytocin moderated these tendencies. Importantly, the inclination to approach angry faces with direct gaze after oxytocin administration was negatively related to social anxiety. These results demonstrate that oxytocin facilitated approach in humans in response to social threat, verifying its anxiolytic potential. In addition, they underline the moderating role of dispositional factors in endocrine research and their therapeutic implications.

G32

THE INFLUENCE OF STRESS ON EXTINCTION RECALL

Candace Raio[1], Edith Brignoni-Perez[2], Rachel Goldman[1], Elizabeth Phelps[1]; [1]New York University, [2]University of Puerto Rico — Extinction learning is a form of inhibitory learning that allows an organism to associate a previously aversive cue with new, safe outcome. Extinction learning, however, creates a competing association that may or may not be retained when the cue is again confronted. Examining the conditions under which extinction learning is retained is critical to the enhancement of treatments for anxiety disorders. Stress exposure is one factor that might alter how successfully extinction memory is retrieved, especially since the brain regions crucial to extinction retrieval are exceptionally sensitive to the effects of stress. To investigate this, we used a classical fear-conditioning paradigm, whereby participants were presented with one image that was paired with shock on a subset of trials while the other image (CS-) was never paired shock. Extinction training directly followed, whereby both CSs were repeatedly presented without shock. Skin conductance served as our index of fear arousal. The next day, participants were either exposed to an acute stressor (cold-pressor) or a control task before undergoing an extinction retention test. Significant increases in cortisol relative to baseline were found in the stress group only. We calculated a fear recovery index by examining the difference between conditioned responses (mean CS+ minus CS-) during the last trial of extinction and the first trial of re-extinction. Participants in the stress group demonstrated significantly lower extinction recall than those in the control group, suggesting that acute stress may impair the recall of extinction memory and may instead prompt the return of conditioned fear.

G33

SUBSEQUENT MEMORY EFFECTS IN FRONTAL SLOW WAVES ELICITED BY EMOTIONAL WORDS

Nasreen Sadeq[1], Chelsea Goodwin[1], Elyse Cadena[1], Siri-Maria Kamp[1], Emanuel Donchin[1]; [1]University of South Florida — In list learning paradigms, words that "stand out" elicit a larger P300 when they are later successfully recalled, while items encoded under elaborative strategies and non-distinctive items elicit Frontal Slow Wave "subsequent memory effects" (Karis et al. 1984). Another line of research indicates that emotional words elicit Frontal Slow Waves whose lateralization depends on the valence (e.g. Cunningham et al. 2005). We investigated whether the Frontal Slow Waves elicited by emotional stimuli are also correlated with subsequent recall. In two sessions, 17 participants studied and immediately recalled lists of neutral words containing an emotional "isolate" (positive or negative), lists of emotional words (either positive or negative) or lists with an "isolate" in a larger font size. Here, we only report findings from the neutral- and emotional lists. Positive word lists showed higher recall levels than negative or neutral lists. A principal component analysis revealed two Frontal Slow Wave components: One was left lateralized and largest for positive words, and the other was right lateralized and largest for negative words. The right- but not the left Slow Wave showed subsequent memory effects across word types: Its amplitude was largest for words that were later not recalled. This subsequent memory effect is in the opposite direction as previously reported for Slow Waves. In addition, a P300 subsequent memory effect was present for negative words only. Our data indicate that Frontal Slow Waves that vary with emotional valence are not the same as those previously reported to correlate with later recall.

G34

SOMATOSENSORY CORRELATES OF FACIAL EMOTION PERCEPTION: EVIDENCE FROM ERPS

Alejandra Sel[1], Beatriz Calvo-Merino[1,2], Bettina Forster[1]; [1]Department of Psychology, City University London, UK, [2]Department of Psychology, Complutense University of Madrid, Spain. — Simulationist models of emotion have proposed that somatosensory regions crucially contribute to face expression processing. In particular, rTMS over the right face somatosensory cortex (rSC) at 100-170ms after stimuli presentation selectively impairs facial emotion discrimination. However, the nature of the somatosensory contribution to emotional face processing is still unknown. Here we present an ERP study where we directly measured somatosensory processing during an emotion recognition task (fearful faces vs. neutral faces) by delivering tactile probes to participants' left cheek or index finger (105 ms post-stimuli) while recording SEPs. Importantly, to isolate the somatosensory response and eliminate any contamination of SEPs by visual processing, facial expressions were also presented alone (without

tactile stimulation). We then subtracted VEPs (visual only condition) from SEPs (visual-tactile condition), which included visual and tactile event-related activity. The resulting difference somatosensory-evoked activity was contrasted for fearful and neutral emotional conditions. Results revealed that observing fearful faces enhances early mean amplitude somatosensory-evoked activity as opposed to neutral faces. Interestingly, source localization analysis focuses this differential activity in primary and secondary somatosensory areas (SI, SII). Moreover, in contrast to previous findings of site specificity within rSC for emotion discrimination, our results showed similar emotional effects on cheek and finger somatosensory related activity suggesting rapid involvement of non-facial somatosensory areas in at least early face expression processing. Taken together, our findings provide novel direct neural evidence of enhanced early somatosensory evoked activity, over and above associated visual effects during face expression processing.

G35

PUTTING THE BODY BACK IN EMBODIED EMOTION: FMRI EVIDENCE FOR THE MODULATION OF SPINAL CORD NEURONS BY FACIAL EXPRESSIONS

Stephen D. Smith[1], Jennifer Kornelsen[1], Theresa A. McIver[1]; [1]University of Winnipeg, Canada — In addition to communicating emotional intentions, facial expressions serve important protective and information-processing functions. For instance, facial expressions of disgust, which involve movement of the levator labii muscles on the nose, produce an oral-nasal rejection of aversive chemosensory stimuli. Specifically, this expression constricts the air cavities in the nostrils and reduces the speed of air intake (Susskind et al., 2008). In the current research, we hypothesized that generating disgusted expressions would also elicit parasympathetic activity in the vagus nerve, resulting in a tightening of chest muscles surrounding the air pathway. We used fMRI of the thoracic spinal cord to measure somatosensory feedback related to this muscle constriction. Twelve participants completed two spinal fMRI runs in which the lower cervical and thoracic segments of the spinal cord were measured using a HASTE scanning sequence. Each five-minute 40-second run consisted of three 60-second blocks in which participants repeatedly generated a disgusted facial expression or a non-emotional expression consisting of repeated stretching of the lips (and which did not involve the nasal cavity). Forty-second rest blocks were interleaved between each expression block. The results demonstrated that generating emotional expressions of disgust produces significantly more activity than producing non-emotional facial expressions (70 vs. 37 active voxels). This activity occurred primarily in the dorsal horn of thoracic spinal cord segments T1-5, indicating somatosensory feedback from the chest. These results suggest that facial expressions can influence bodily responses to emotional stimuli, and demonstrate that spinal fMRI is a useful tool for the assessment of brain-body interactions.

G36

HUMAN APPROACH-AVOIDANCE ANXIETY ACTIVATES THE ANTERIOR HIPPOCAMPUS

Dominik Bach[1,2], Marc Guitart Masip[2], Raymond Dolan[2]; [1]Department of Psychiatry, University of Zurich, [2]Wellcome Trust Centre for Neuroimaging, University College London — Anxiety behaviour in animal approach-avoidance tasks, such as the open field, elevated plus maze, and various conflict tests, is thought to stem from hippocampal theta oscillations. Knowledge about similar mechanisms in humans is ambiguous, mainly because no comparable test bed exists. Human experiments commonly employ social anxiety paradigms or investigate patients with generalised anxiety disorder. Here, we develop and validate a virtual computer game for humans, drawing on ideas from approach-avoidance conflict in a foraging environment, that approximates an open field task. By manipulating threat probability, we vary avoidance motivation and thus conflict, and show that humans show behavioural responses similarly to animals in classical approach-avoidance tasks. This behaviour is non-optimal and can not fully be explained by rational game strategies. Functional magnetic resonance imaging (fMRI) demonstrates activity in the anterior hippocampus covaries with level of threat, in keeping with findings from animal models. Further, application of the benzodiazepine lorazepame reduces some, but not all, behaviour components sensitive to threat. Hence, we provide a novel paradigm that furnishes an ecologically valid measure of anxiety behaviour in humans, building on animal models and replicating the hippocampal origin of this behaviour.

G37

ABERRANT GAZE HABITUATION IN FRAGILE X SYNDROME

Jennifer Bruno[1], Amy Garrett[1], Eve-Marie Quintin[1], Allan Reiss[1]; [1]Stanford University — Fragile X syndrome (FXS), the most common known cause of inherited intellectual disability, is associated with social deficits that overlap with characteristics of autism spectrum disorder and social anxiety disorder. Eye contact aversion, one particularly maladaptive deficit, has been linked to atypical neural functioning in FXS. We sought to investigate the hypothesis that individuals with FXS would demonstrate atypical neural system habituation to eye gaze. The study participants included 27 individuals with FXS (mean age 20.93 years, SD = 2.75, 14 females) and 24 individuals frequency matched for age, gender and general intellectual functioning (mean age 19.27 years, SD = 3.15, 12 females) without FXS. During functional magnetic resonance imaging (fMRI) participants viewed four different faces presented repeatedly in a randomized, jittered, event related design. Habituation was defined as decreasing activation across the imaging session, which lasted 14 minutes. Individuals with FXS demonstrated significantly less habituation to eye gaze in regions related to face/gaze processing including the fusiform gyrus and temporal regions as well as in the cingulate, a region involved in emotion processing. These results may provide important evidence regarding how the neural systems involved in face/eye gaze processing are altered in FXS. Reduced or lack of habituation in specific brain regions may underlie the evolution of gaze aversion and social avoidance in FXS. Elucidation of neural patterns underlying aberrant behavior in FXS can provide biomarkers for treatment trials and distinguish FXS from autism spectrum disorder and social anxiety disorder.

G38

THE HUMAN OPIOID SYSTEM MEDIATES ATTENTION TO OTHERS' EYES

Olga Chelnokova[1], Bruno Laeng[1], Jeppe Riegels[1], Guro Løseth[1], Marie Eikemo[1], Siri Leknes[1]; [1]Department of Psychology, University of Oslo — Of all facial features the eyes are typically attended the most. Looking someone in the eyes is rewarding, and facial attractiveness increases activity in the brain's reward circuits when gaze is direct as opposed to when it is averted. The human brain reward system is rich in both dopamine and opioid receptors. There is increasing evidence for opioid system involvement in reward processing. We assessed the role of the human opioid system in a basic social reward: looking at someone's eyes. In this randomized double blind cross-over study, 30 males received a μ-opioid agonist (morphine 10 mg), a non-selective opioid antagonist (naltrexone 50 mg) or placebo (per-oral) on three separate days. Participants viewed photos of faces while their eye movements were recorded. Facial stimuli varied in attractiveness and included photos with both direct and averted gaze. Fixation time for selected regions of interest of female faces was analyzed in a multiple regression analysis. Facial attractiveness affected scan patterns so that less time was spent looking at the eyes and more at the nose-mouth region of the least attractive females. We also observed a linear effect of the opioid drug manipulation on looking time for the eye region, such that morphine increased and naltrexone decreased the time spent fixating on the eyes of females. Overall, our results illustrate the rewarding nature of looking at eyes, and demonstrate the role of opioids in mediating attention to this socially significant facial region.

G39

EMOTION FROM ABSTRACT ART: A PSYCHOPHYSICAL EXPLORATION OF PERCEPTION OF EMOTION

Stephanie Dubal[1], Marine Taffou[1], Aure-Elise Duret[1], Jerome Pelletier[2], Yolaine Escande[3], Kenneth Knoblauch[4]; [1]CNRS - La Salpêtriere Hospital, [2]CNRS-ENS-EHESS, [3]CNRS – EHESS, [4]INSERM — How emotion is detected and perceived from artwork is a current subject of exploration. We used Signal Detection Theory to determine whether or not naive subjects were able to detect the emotional classification proposed by an artist. Thirty pairs of Chinese characters were produced by an artist so as to render the same Chinese sign with different emotional expressive intensity: one with high emotional expressivity and a second with low emotional expressivity. Twenty one participants were asked to rate emotional intensity on a 4 point scale while viewing each calligraphy. d', a sensitivity measure reflecting the capacity to detect a signal from a noisy background, was estimated from ROC curves. If the participants categorized the stimuli according to the artist's classification (or in direct opposition), d' would differ significantly from 0. Sixteen of the participants

had d' values significantly different from 0, thereby showing that they discriminated the emotional categorization of the calligraphies. Among them, 4 had a negative d' index, i.e. they perceived the difference between the two categories of stimuli but classified, in opposition to the artist's classification. d' for the remaining 5 subjects did not differ significantly from 0 indicating that these participants did not detect the artist's classification. Those results indicate a significant resemblance in the classification of calligraphies in emotional level between a non-Chinese speaking population ignorant of the art of calligraphy and the artist's own classification. Some implications of these results for the study of emotion perception relate to the perception of movement.

G40

EFFECTS OF BETA-ADRENERGIC ANTAGONISM ON SOCIAL INTERACTION IN AUTISM SPECTRUM DISORDERS Bradley Ferguson[1], Rachel Zamzow[1], Emily Reznicek[1], Morgan Lewis[1], Shawn Christ[1], Janine Stichter[1], David Beversdorf[2]; [1]University of Missouri — Many current pharmacologic treatments for autism spectrum disorders (ASD) target psychiatric symptoms such as agitation and repetitive and obsessive behaviors, but few target core symptomatology such as social functioning. Individuals with ASD report greater generalized anxiety and social anxiety relative to those without ASD, which may contribute to difficulties in social situations. Therefore, it may be possible to enhance sociability in ASD by pharmacologically reducing anxiety levels. A promising agent is propranolol, a non-selective β-adrenergic receptor antagonist which has known anxiolytic effects. Propranolol blocks the noradrenergically mediated sympathetic response, leading to reductions in perceived stress and anxiety, which may lead to enhanced sociability in ASD. Thus, the present study seeks to investigate the effects of propranolol on social functioning in ASD. Participants were administered a single 40mg dose of propranolol or placebo in a double-blinded, counterbalanced manner. After a one-hour wait period, the researcher administered the General Social Outcomes Measure (GSOM), a semi-structured assessment of social functioning. In an initial sample of participants from this ongoing study, a dependent samples t-test revealed significant improvements in performance on the GSOM for the propranolol condition relative to the placebo condition. These initial results suggest that propranolol may provide increases in general social functioning in individuals with ASD. Subsequent work will determine whether participants with the greatest psychophysiological markers of arousal will be the best responders. Having this knowledge will help guide future treatments for those with ASD.

G41

ATYPICAL RIGHTWARD LATERALIZATION OF THE CORPUS CALLOSUM IS PRESENT IN MALES BUT NOT FEMALES WITH AUTISM. Dorothea Floris[1], Lindsay Chura[1], Rosemary Holt[1], John Suckling[2], Simon Baron-Cohen[1], Michael Spencer[1]; [1]Autism Research Centre, Department of Psychiatry, University of Cambridge, Cambridge, UK, [2]Department of Psychiatry, Herchel Smith Building for Brain and Mind Sciences, University of Cambridge, Cambridge Biomedical Campus, Cambridge, UK — Rightward cerebral lateralization has been suggested to be involved in the neuropathology of autism spectrum conditions. Corpus callosum volume is related to functional brain asymmetries and might show lateralized morphology itself. We investigated whether rightward cerebral lateralization is (a) more common in adolescents with autism compared to their unaffected siblings and typically developing controls, (b) correlated with clinical measures of symptom severity, and (c) different in males and females with autism. Participants comprised adolescents with autism (males=35; females=17), their unaffected siblings (males=12; females=28) and typical controls (males=20; females=20) aged 12-18 years. We assessed functional asymmetry in terms of handedness using the Edinburgh Handedness Inventory and neuroanatomical lateralization in terms of corpus callosum asymmetry through manual tracing. Symptom severity was assessed using subdomains of the ADI-R and ADOS-G. Male adolescents with autism showed stronger rightward lateralization in the posterior and anterior midbody the more left-handed they were, compared to controls. There were no significant differences in females with autism. In both sexes, symptom severity was related to rightward asymmetry in several subregions (splenium, isthmus, posterior midbody and rostral body). However, the same directional associations occurred with different symptoms in the two sexes. We did not find similar results in siblings. This sex difference might account for the established sex differences in prevalence and clinical phenotype. Future research should focus on the meaning of handedness and corpus callosal morphometry as a potential marker of clinical subgroups.

G42

EMOTIONAL INTENSITY MATTERS! THE DIFFERENTIAL EFFECT OF EMBODIMENT ON THE PROCESSING OF MODERATELY VS. STRONGLY EMOTIONAL MATERIAL. Francesco Foroni[1], Jenny-Charlotte Baumeister[1], Giovanni Papa[2], Raffaella I. Rumiati[1]; [1]SISSA - Trieste, [2]Azienda Ospedaliera Cattinara - Trieste — According to the theories of embodied cognition the processing of emotional content relies on the re-experience of that emotion (embodied simulations) that engages the same sensory-motor systems involved in the actual experience of an emotion. That is, reading of someone happy and smiling will induce a compatible spontaneous facial expression (i.e., a smile). Blocking the possibility of simulating the emotional content (e.g., blocking facial muscles) generally interferes with the recognition, processing and experience of the emotional content, even though evidence is contradicting. We speculate that contradicting results are due to the difference in intensity of the stimulus material (moderately vs. extremely emotional material). We advanced the novel hypothesis that embodied simulations play a role especially in processing emotional information that is moderate in intensity, as the simulations provide useful cues particularly when facing less distinct and less extreme emotional information. Patients undergoing subcutaneous cosmetic injections of Botulinum Toxin-A (Botox) took part in the experiment, rating the emotionality of moderately and extremely emotional sentences (happy and sad) in two different sessions (one before and one after treatment). Consistent with embodied cognition hypothesis emotional sentences were rated significantly less emotional after the treatment. However, consistent with our hypothesis, the impairment was significantly larger when processing extremely emotional sentences. The results indicate that embodied simulations are crucial in processing and experiencing emotional information, but particularly for moderately emotional material possibly because of their indistinctness. This distinction provides an important boundary condition to the embodied theory of emotional processing.

G43

NEURAL CORRELATES OF CHOCOLATE CRAVING DURING CUE EXPOSURE WITH RESPONSE PREVENTION (CERP) WITH CHOCOLATE Astrid Frankort[1], Anne Roefs[1], Nicolette Siep[1], Alard Roebroeck[2], Remco Havermans[1], Anita Jansen[1]; [1]Department of Clinical Psychological Science, Faculty of Psychology and Neuroscience, Maastricht University, The Netherlands, [2]Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, The Netherlands — Cue reactivity and craving can be influenced by cue exposure with response prevention (CERP). Usually a short exposure is accompanied by an increase in craving, whereas a longer exposure leads to an extinction of craving. CERP could be an effective treatment for overeaters. This study investigated the neural correlates of CERP using fMRI while participants smelled chocolate (17 participants) or a control object (17 participants). CERP was interrupted by seven scanning sequences measuring the brain response to neutral and chocolate pictures. Chocolate craving was hypothesised to be mirrored by activation in brain reward regions. As expected, control group craving remained similar throughout the session. A short exposure (30 min) increased chocolate craving in the experimental group, which was mirrored by significant group differences in activation in nine regions involved in appetitive motivation. Unexpectedly, a long exposure (60 min) did not lead to craving extinction in the experimental group, although craving started to decrease at this point. On a neural level however, after the long exposure, the activation in the same nine regions seemed to have extinguished in the experimental group participants, as activation levels returned to control group levels. This supposed extinction of activation in brain reward regions in the experimental group was corroborated by an additional analysis. These results indicate that brain reward activation during CERP is linked to craving, at least for a short exposure. Regarding a longer exposure, the decline in brain reward activation in the experimental group may be a precursor of a decrease in craving.

G44

MULTI-VOXEL PATTERN ANALYSIS OF VALENCE IN DEPRESSION Isabelle Habes[1], Sarah Krall[2], Stephen Johnston[3], Kenneth Yuen[4], David Healy[1], Rainer Goebel[2], Bettina Sorger[2], David Linden[1]; [1]Cardiff University, UK, [2]Maastricht University, The Netherlands, [3]Brunel University, UK, [4]University Medical Centre Hamburg-Eppendorf, Germany — Neuroimaging biomarkers of depression have potential to aid diagnosis, identify individuals at risk and predict treatment response or course of illness. Nevertheless none have been identified so far, potentially because no single brain parameter captures the complexity of the pathophysiology of depression. Multi-voxel pattern analysis (MVPA) may overcome this issue as it can identify patterns of voxels that are spatially distributed across the brain. Here we present the results of an MVPA application to investigate the neuronal patterns underlying passive viewing of positive, negative and neutral pictures in depressed patients. A linear support vector machine (SVM) was trained to discriminate different valence conditions based on the functional magnetic resonance imaging (fMRI) data of nine unipolar depressed patients. A similar dataset obtained in nine healthy individuals was included to conduct a group classification analysis via linear discriminant analysis (LDA). Accuracy scores of 86% or higher were obtained for each valence contrast via patterns including limbic areas such as the amygdala and frontal areas such as the ventrolateral prefrontal cortex. These areas have previously been associated with emotion regulation yet were not identified by a comparable univariate analysis. This demonstrates the superior sensitivity of MVPA. The LDA identified two areas (the dorsomedial prefrontal cortex and caudate nucleus) that allowed group classification with 72.2% accuracy. Our preliminary findings thus suggest that MVPA can identify stable valence patterns in depressed participants and that it may be possible to discriminate between healthy and depressed individuals based on differences in the brain's response to emotional cues.

G45

FUNCTIONAL CONNECTOME DIFFERENCES PREDICT PREFERRED DIVISION OF RESOURCES IN HUMANS Tim Hahn[1], Karolien Notebaert[2], Christine Anderl[1], Philipp Reicherts[3], Matthias Wieser[3], Juliane Kopf[3], Andreas Reif[3], Sabine Windmann[1]; [1]University of Frankfurt, [2]University of Leuven, [3]University of Würzburg — Social value orientation (SVO) characterizes individual differences regarding the division of resources. It determines behavior in economic games and real-life situations. Prosocials maximize the sum of resources for themselves and for others, while simultaneously minimizing the difference between the two. In contrast, individualists maximize resources for themselves. Recent evidence suggests that automatic emotional processing of unfair splits in the amygdala is essential for behaviour in prosocials. Here, we investigate the neural bases of SVO in prosocials and individualists. As social dispositions influence behavior in a wide range of situations and are highly stable over the life-span, we hypothesize to find differences between prosocials and individualists at rest, i.e. independent of any specific task. To this end, we measured resting-state functional Blood Oxygen Level Dependent dynamics in 29 subjects (n=15 Prosocials and n=14 Individualists), calculated functional connectivity and applied a Support-Vector-Machine-based approach to predict SVO. We show that functional whole-brain connectivity of the amygdala during rest is predictive of SVO (accuracy=.56; p<.001). Specifically, connectivity of the amygdala with the orbitofrontal cortex (accuracy=.71; p<.001), the right caudate (accuracy=.75; p<.001), and occipital temporal areas (accuracy=.71-.75; p<.001) allows for the most accurate differentiation between prosocials and individualists. In summary, we show that stable individual differences in the preference for the division of resources are mirrored by differences in the functional connectivity of the amygdala at rest. This evidence supports the idea that trait-like differences of the resting-state functional connectome determine SVO and might thus be at the heart of individual differences in human cooperation.

G46

ALL COMPETITION IS NOT ALIKE: DISSOCIATING NEURAL PROCESSES FOR RESOLVING PREPOTENT AND UNDERDETERMINED COMPETITION Hannah Snyder[1], Marie Banich[2], Yuko Munakata[2]; [1]University of Colorado Denver, [2]University of Colorado Boulder — When we speak, we must constantly select among competing words. This competition can occur among multiple valid response options (e.g., multiple verb associates in the verb generation task; underdetermined selection demand) or from strongly dominant, but task-inappropriate responses (e.g., non-verbs in the verb generation task; prepotent selection demand). Some previous accounts propose that left ventrolateral prefrontal cortex (VLPFC) plays a role in both underdetermined and prepotent selection, while others propose that areas of dorsolateral prefrontal cortex (DLPFC) are key for resolving prepotent competition. We tested these possibilities with an fMRI study that directly contrasted underdetermined and prepotent selection demands within the same task for the first time. Participants completed a verb generation task, in which we manipulated underdetermined competition among multiple verb responses and competition from prepotent non-verb associates. We found that left VLPFC is sensitive to underdetermined, but not prepotent, competition. In contrast, an area of left DLPFC is sensitive to both underdetermined and prepotent competition. We explored possible neural mechanisms underlying these responses in a neural network model. These simulations suggested that competitive lateral inhibition in VLPFC is necessary and sufficient for resolving underdetermined competition, while resolving prepotent competition requires active maintenance of task goals in DLPFC to bias competition in VLPFC towards task-relevant responses. Better understanding how these processes and brain areas interact during language production may ultimately have implications for better understanding and treating impairments associated with prefrontal damage and psychopathology.

G47

THE PREFRONTAL CORTEX AND THE INTRAPARIETAL SULCUS DISTINGUISH BETWEEN NUMBER NOTATIONS DURING TARGET DETECTION Lisa Sprute[1], Donna Coch[1]; [1]Dartmouth College — Number comprehension is theorized to rely on representing a number's magnitude and relating that magnitude to the magnitude representations of other numbers. These magnitude representations are theorized to be abstract and notation-independent. However, scant evidence exists concerning the nature of representations for numbers like decimals and fractions. In order to examine representations of fractional quantities, we measured neural distance effects during an fMRI oddball task. Participants (N=28) identified a red numerical target presented among a black numerical standard and red and black deviants. Overall, fractions elicited more BOLD activity than decimals in the right intraparietal sulcus and right rostrolateral prefrontal cortex, the superior parietal lobule, the middle cingulate gyrus, and the bilateral cerebellum. Activation in these regions was modulated by task demands, with more activity for numbers colored like the target. In addition, behavioral distance effects were measured on separate comparison and conversion tasks. In the comparison task, notation accounted for the majority of variation, with fractions eliciting longer behavioral response times and more errors than decimals. Greater fluency in processing decimals and fractions in the behavioral tasks was associated with reduced neural distance effects in the cerebellum and middle cingulate. Consistently, these neural and behavioral findings suggest that there are distinct representations of decimals and fractions representing the same magnitudes, rather than abstract, notation-independent representations of all rational numbers.

G48

INCREASED RESPONSE VARIABILITY AS A MARKER OF EXECUTIVE DYSFUNCTION IN COMBAT VETERANS WITH POST-TRAUMATIC STRESS DISORDER Diane Swick[1,2], Nikki Honzel[1,2], Victoria Ashley[1,2], Jary Larsen[1]; [1]VA Northern California Health Care System, [2]University of California, Davis — Consistency in behavioral responding is required for the efficient performance of many cognitive tasks. Often measured as trial-to-trial variability in reaction time (RT), intra-individual variability indexes the stability of executive control processes over time (West et al., 2002). A high level of response variability has been characterized as a marker of executive dysfunction and inhibitory inefficiency, cognitive instability, and mental noise. Specific regions of the prefrontal cortex (PFC) have been associated with this aspect of executive function. Previous studies in our lab demonstrated that combat veterans with post-traumatic stress disorder (PTSD) showed substantial impairments in inhibitory control (Swick et al., 2012). Here, RT variability in the Go/NoGo response inhibition task was assessed for 34 controls and 45 PTSD patients using the intra-individ-

ual coefficient of variation (Standard Deviation/mean RT). Despite having mean RTs that were indistinguishable from controls (patients: 370 msec; controls: 379 msec), the PTSD patients had significantly greater RT variability. More variable RTs were in turn associated with a greater number of false alarm errors, replicating previous findings (Bellgrove et al., 2004). RT variability was also highly correlated with self-reported symptoms of PTSD and depression. Stuss and colleagues (2003) have suggested that an alteration in the consistency of task performance could contribute to the PFC patients' difficulties in everyday life. Likewise, the combination of inconsistent performance and impaired response inhibition shown by the veterans with PTSD could have deleterious effects on daily activities requiring these cognitive control functions, such as driving and multi-tasking (Honzel et al., this meeting).

G49

INHIBITORY CONTROL IN AUTISM SPECTRUM DISORDERS

Yukari Takarae[1], Fernanda Vieira[1], Iman Mohammad Rezazadeh[1], Clifford Saron[1]; [1]University of California, Davis — Impairments in inhibitory control are frequently observed in autism spectrum disorders (ASD) and likely contribute to social difficulty and reduced flexibility in affected individuals. We investigated neural correlates of inhibitory control impairments in ASD using 124-channel ERPs. Participants were 13 children with ASD and 10 typically developing children who were 12 to 18 years old. Participants alternated between blocks with an antisaccade (ANTI) task that required looking away from a suddenly appearing peripheral target, and a prosaccade (PRO) task that required looking at the peripheral target. Reaction time and saccade suppression error rates were similar between groups. The ASD group had greater presaccadic occipitoparietal positivity time locked to the target onset compared to the TD group during the ANTI task, but not during the PRO task. A frontal negativity preceding the occipitoparietal activation was also reduced in the ASD group compared to the TD group during the ANTI task, and the amplitude of this negativity correlated with the amplitude of the subsequent occipitoparietal positivity. Further, the amplitude of the occipitoparietal activation was correlated with latency of correct antisaccade responses in the ASD group, with higher amplitude predicting longer latencies. Previous studies have suggested that top-down modulation of early stimulus-related activation is critical in implementing cognitive control over motor output, and suppressing early sensory responses leads to successful performance during the ANTI task. Thus, the extent of sensory activation, likely reflecting frontally mediated top-down control, appears to influence performance during the ANTI task in the ASD group.

G50

IN-TASK INFLUENCES OF VALENCE AND AROUSAL ON THE ERN AND ACTION MONITORING

Jason Themanson[1], Kathleen McCortney[1]; [1]Illinois Wesleyan University — The relationships between arousal, valence, and indices of self-regulatory action monitoring were assessed for 26 healthy young adults during a flanker task that varied levels of arousal and valence in-task. Previous studies have largely confounded arousal and valence in their examination of action monitoring and have concluded that the ERN is partially determined by negative affect, without separately examining arousal. For our study, flanker stimuli were photographs selected from the International Affective Picture System (IAPS) that varied on ratings of arousal (high, low) or valence (negative, positive). The error-related negativity (ERN) and behavioral measures of response time, accuracy, post-error slowing, and post-error accuracy were assessed for each type of flanker stimulus. Results revealed both an arousal main effect and an interaction effect for task performance, indicating that participants responded most accurately and fastest for negatively valenced, non-arousing stimuli compared to other stimuli. For post-error behavior, no significant effects were evident when controlling for overall task performance. ERN findings showed an arousal effect, with larger ERN amplitudes for non-arousing stimuli, but no effects for valence. Additionally, partial correlations controlling for task performance revealed relationships between the ERN and post-error accuracy for each stimulus type, suggesting the functional connection between neural and behavioral indices of action monitoring is robust to different stimulus characteristics. These findings indicate that the activation of the ERN may be more sensitive to arousal, not valence, during task execution as the ERN was dissociable from task valence, but was modulated by levels of task arousal.

G51

DISSOCIABLE NEURAL MECHANISMS MEDIATE PROACTIVE CONTROL OVER EMOTIONAL VS. NON-EMOTIONAL CONFLICT

Maryem Torres-Quesada[1], Franziska M. Korb[2], Maria Jesús Funes[1], Juan Lupiáñez[1], Tobias Egner[2]; [1]Universidad de Granada, [2]Duke University — Recent models of cognitive control distinguish between reactive and proactive mechanisms (Braver et al., 2007). Reactive control can be observed via trial-by-trial performance adjustments in reaction to conflict ("Conflict Adaptation" [CA] effects: less interference following incongruent trials); and proactive control can be seen in strategic adjustments to the frequency of congruent relative to incongruent stimuli over longer sequences of trials ("Proportion Congruent" [PC] effects: less interference when incongruent trials are frequent). The neural correlates of CA effects have been extensively investigated and much evidence points to a distinction between circuits involved in resolving cognitive (non-emotional) conflict from those that resolve emotional conflict (e.g., Egner et al., 2008; Maier & Di Pellegrino, 2012). By contrast, the study of PC effects' neural correlates has received relatively little attention and it is presently unknown whether there are dissociable neural mechanisms underpinning proactive emotional vs. non-emotional conflict-control processes. We addressed this question in an fMRI study where we manipulated the proportion of congruency in emotional vs. non-emotional conflict tasks. Reliable behavioral PC effects were observed for both the non-emotional and emotional domains. At the neural level, we found general (domain-independent) conflict-related activations in the dorsal anterior cingulate cortex and pre-supplementary motor area. More importantly, we also found clear evidence for domain-specific neural mediators of PC effects; in particular that the dorsal striatum and anterior insula were exclusively involved in tracking proactive control effects in the emotional domain. These data supply the first evidence for partly dissociable neural substrates of proactive control over emotional conflict.

G52

MEASURING INHIBITION BY LOCKING EVENT-RELATED POTENTIALS TO UNEXECUTED RESPONSES: ESTIMATING KNOWN UNKNOWNS USING KNOWN KNOWNS IN THE BRAIN

Avinash R. Vaidya[1], Eldad Yitzhak Hochman[1], Linda Q. Yu[1], Lesley K. Fellows[1]; [1]McGill University — Functional activity in the brain is commonly measured by averaging recordings around a discrete external event. This allows for sampling how the brain prepares for, and reacts to stimulation (i.e. the sound of music), or behavior (i.e. playing a note on a piano). However, in the case of response inhibition, a behavior may be coded, but never executed due to a rapid suppression of motor output. As a result, no overt, or electromyographic indicator may be left of the coded response, complicating measurement of the inhibition itself, as there may be no discrete external event to lock brain activity to. To address this problem, we have designed a new method for locking electroencephalographic (EEG) data to estimated lateralized readiness potentials (LRPs) in the cortex. This method uses accumulated evidence about the latency and amplitude of LRPs on trials where responses were executed, and evidence about noise peaks, to build a Bayesian classifier that can accurately identify probable LRPs in single-trial EEG data. This estimation technique allows us to examine the endogenously signaled inhibition of a motor command through event-related potentials (ERPs) directly locked to the probable LRPs of unexecuted, unwanted, responses in an Eriksen flanker task. We found that both executed and unexecuted unwanted responses elicit similar frontocentral negativities shortly after the LRP peaks. We suggest that these frontocentral potentials could reflect a common process responsible for signaling the inhibition of an unwanted response tendency.

G53

INCENTIVE EFFECTS IN EXECUTIVE FUNCTIONING ASSESSMENTS: DOES EFFORT CONFOUND MEASUREMENT OF SKILL?

Amar Hamoudi[1], Margaret Sheridan[2]; [1]Duke University, [2]Children's Hospital Boston — Several previous studies have demonstrated a negative association between executive functioning and exposure to childhood adversity, commonly supposed to be the result of the effect of early experience on cognitive function. However no study has examined how motivation, known to differ by adversity exposure, contributes to differences in executive function. Here we evaluate whether assessment of executive function

may be confounded by individual motivation to exert effort. We developed task-based assessments for use on tablet PCs to measure these skills in a representative sample of children aged 7-12 being seen for well-child visits at a primary health clinic. Each child performed an inhibitory control task (Simon Task) and a working memory task (spatial delayed match to sample task; SWM). Motivation was manipulated by assigning a randomly selected half of children to be told that they would win a prize (an age-appropriate toy worth $10) if they performed sufficiently well. Children in the control group were told they would be rewarded with a sticker regardless of performance. Children in the incentivized condition had longer response times and improved accuracy in the SWM task and faster reaction times but decreased accuracy on the Simon task compared to controls. It is apparent from these findings that incentivizing performance affects speed-accuracy tradeoffs, suggesting that standard executive functioning assessments may be confounded by individual characteristics like motivation and that these, instead of (or in addition to) stable individual characteristics, could account for group differences in performance.

G54

EXAMINING THE STRUCTURAL UNDERPINNINGS OF EXECUTIVE CONTROL PROCESSES Jason Hubbard[1], Ulrich Mayr[1]; [1]University of Oregon — In psychometric work, working memory and task-switching ability emerge as two dissociable individual differences constructs. However, potential neuroanatomical underpinnings of this behavioral-level dissociation have received little attention, and are primarily examined from a pathological perspective (e.g., G. Sánchez-Benavides et al., 2010; Hartberg et al., 2011). The present study sought to determine the structural brain characteristics responsible for individual differences in executive processes in healthy adults. We assessed cortical thickness, surface area, and white matter volume in normal adults, along with measures of task-switching and visual working memory. Each of the two ability constructs were assessed reliably, but––in line with previous work––were not related to each other. We hypothesized that this behavioral dissociation would be mirrored in the brain anatomy, and each behavioral measure would correlate with distinct components of brain structure. In line with these predictions, we found moderate correlations between our behavioral measures and brain structure in regions consistent with previous fMRI research. Furthermore, each task correlated with distinct aspects of brain structure in a non-overlapping fashion. Working memory exhibited consistent positive correlations with cortical thickness, primarily in prefrontal and medial regions (e.g., DLPFC). Switch costs, by contrast, were associated with cortical surface area in parietal and premotor areas (e.g., precuneus), and the white matter volume underlying those regions. Consistent with previous findings showing clinical and ontogenetic dissociations between cortical thickness and surface area (e.g., Rakic et al., 2007; Rosas et al., 2002), these structural parameters appear to underlie these dissociable functions of executive control.

G55

A COMBINED ALZHEIMER'S RISK GENOTYPE ADDITIVELY AFFECTS MEDIAL TEMPORAL ACTIVITY DURING EXECUTIVE ATTENTION IN YOUNG ADULTS Jessica L. Ihne[1], Megna P. Raksit[1], Jeremy R. Gray[2], Colin G. DeYoung[3], Robert Padilla[4], Timothy R. Mhyre[4], G. William Rebeck[4], Adam E. Green[1]; [1]Georgetown University, [2]Yale University, [3]University of Minnesota, [4]Georgetown University Medical Center — A recent history of failed clinical trials suggests that waiting until even the early stages of onset of Alzheimer's disease may be too late for effective treatment, pointing to the importance of early intervention in young people. Early intervention will require markers of Alzheimer's risk that track with genotype but are capable of responding to treatment. Here, we sought to develop a novel neurocognitive marker for Alzheimer's risk in young people using a task of executive attention during functional MRI in a sample of 160 participants genotyped for two Alzheimer's risk alleles: APOE-ε4 and CLU-C. Executive attention is a sensitive indicator of the progression of Alzheimer's even in the early stages of mild cognitive impairment, but has not yet been investigated as a marker of Alzheimer's risk in young adults. Functional MRI revealed that both APOE-ε4 and CLU-C were associated with decreased neural activity during executive attention. Possession of CLU-C augmented the effect of APOE-ε4 in parahippocampal gyrus, a brain area affected early in Alzheimer's pathogenesis. Behavioral performance also differed by APOE-ε4 status, indicating that executive attention may be a sensitive marker of the effects of Alzheimer's risk alleles on neurocognitive function in young people.

G56

GREATER DEFICITS OF COMPLEX ACTION PLANNING WITH EVERYDAY OBJECTS IN PATIENTS WITH ANTERIOR COMPARED TO POSTERIOR LEFT BRAIN DAMAGE Arianne Johnson[1], Laurel Buxbaum[2], Scott Grafton[1]; [1]University of California, Santa Barbara, [2]Moss Rehabilitation Research Institute — The present study assessed whether patients with left frontal lobe damage make qualitatively different types of sequential planning errors with everyday objects than patients with left parietal lobe damage. Seven subjects with left parietal brain damage (POST) and 6 subjects with left frontal brain damage (ANT) completed a computerized grocery bagging task on a touchscreen that required bagging 6 items according to object properties (weight, temperature, fragility). There were 3 conditions: nesting, parse-hard, and parse-easy. The nesting condition required separating cold items from non-cold items while ordering the cold items according to weight, the parse-hard condition required keeping three item properties in mind and greater look-ahead planning, while the parse-easy condition required keeping two item properties in mind. Both groups showed increased errors in the nesting and parse-hard conditions relative to the parse-easy condition. Overall mean percent error was similar for both groups: 21.7% for POST and 21.5% for ANT. However, the ANT and POST groups showed significant differences in the proportion of types of errors made. Specifically, on average, 36% of errors made in the ANT group were in the parse-hard condition, whereas the POST group made an average of only 15% errors in this condition. Both groups had a similar proportion of errors in the other two conditions. Thus, while overall performance on a sequential planning task may be similar in patients with anterior and posterior brain damage, anterior damage may result in particularly higher proportion of errors in trials involving increased number of item properties and look-ahead.

G57

FRONTOPARIETAL ACTIVATION DURING PROCESSING OF GUILTY KNOWLEDGE: A CORTICAL SOURCE LOCALIZATION STUDY Eun Kyung Jung[1], Young Youn Kim[1]; [1]Kyonggi University — Standardized low-resolution electromagnetic tomography (sLORETA) analysis was applied to localize cortical source during guilty knowledge processing. Guilty group (n=15) and innocent group (n=15) performed a guilty or an innocent scenario. P300-based guilty knowledge test (GKT) with 64 channels electroencephalogram (EEG) was used to test the participants' memory about the mock crime scenario they experienced. During the EEG recording, target (task-relevant), probe (crime-relevant), and irrelevant sentences were presented on a computer screen. Each sentence had a 'subject-object-verb' or an 'object-complement-verb' structure, and each sentence element was presented separately. It was hypothesized that a guilty participant would respond to probe, a crime-relevant stimulus, as to target, which was a task-relevant stimulus. It was also hypothesized that the verb of a probe sentence would elicit distinct cortical activation compared to the verb of a target or an irrelevant sentence. As a result, P300 amplitude evoked by probe stimulus was larger than irrelevant in the bilateral frontoparietal region in the guilty group. In addition, sLORETA analysis for probe found significant activation increases in frontal and parietal region in the guilty group compared to the innocent group: the guilty group had parietal maximum for the complement and the object element of a probe sentence, and had frontal maximum for verb elements of the probe sentence. In summary, the frontal source activity for verb elements seems to reflect a working memory process, episodic memory retrieval, and response inhibition, while parietal activation for complement and object elements seems to reflect selective attention and target discrimination.

G58

REGIONAL BRAIN FDG PET IN ADULT SURVIVORS OF CHILDHOOD CANCER TREATED WITH CRANIAL RADIATION Kevin Krull[1], Satoshi Minoshima[2], Tara Brinkman[1], Michelle Edelmann[1], Leslie Robison[1], Melissa Hudson[1], Barry Shulkin[1]; [1]St. Jude Children's Research Hospital, [2]University of Washington — The goal of this study was to examine associations between regional brain metabolism, as measured by positron emission

tomography with fluorodeoxyglucose (FDG-PET), and neurocognitive outcomes in adult survivors of childhood cancer treated with cranial radiation. Fifty-six adult survivors of acute lymphoblastic leukemia (ALL) or medulloblastoma (MB) were randomly selected from a large cohort treated with cranial radiation (19 ALL survivors treated with 18 Gy, 19 ALL survivors treated with 24 Gy and 18 MB survivors treated with 35Gy whole brain radiation). At a mean age of 27.3 years, and 21.9 years since diagnosis, patients underwent comprehensive neurocognitive evaluations and brain FDG-PET imaging in a resting condition. Predefined regions-of-interest analysis and voxel-based correlation analysis between brain activity and neurocognitive scores were performed. Compared to national norms, survivors demonstrated lower performance in multiple cognitive domains, including verbal intelligence ($p<0.001$), focused attention ($p=0.006$), working memory ($p<0.001$), verbal fluency ($p=0.02$) and cognitive flexibility ($p<0.001$). MB survivors had lower metabolic activity in parietal cortex and cerebellum, but higher metabolic activity in basal ganglia and thalami. Metabolic activity was positively correlated with verbal intelligence (rho=0.37, $p=0.02$) and working memory (rho=0.38, $p=0.02$) in temporal brain regions, and negativity correlated with cognitive flexibility (rho=-0.45, $p=0.005$) and activity in the thalami was associated with verbal fluency (rho=-0.43, $p=0.008$). Results suggest adult long-term survivors of childhood cancer treated with cranial radiation are at risk for neurocognitive impairment, which appears associated with increased activity in subcortical regions, possibly due to decreased regulatory input from cortical structures.

G59

SPATIAL ATTENTION PLAYS NO FUNCTIONAL ROLE IN COLOR WORKING MEMORY MAINTENANCE: AN ERP STUDY

Motoyuki Sanada[1], Koki Ikeda[1], Toshikazu Hasegawa[1]; [1]The University of Tokyo — Previous research has indicated that spatial attention plays an important role to retain spatial working memory (Awh et al., 1998; 2000), whereas it may not be necessary for the maintenance of feature-based working memory (Wheeler & Treisman, 2002). There has been, however, little evidence supporting the latter argument. To test this, we investigated early visual attention in color working memory, utilizing P1/ N1 event related potential (ERP) components. It is well known that stimuli presented in spatially attended locations enlarge P1/ N1 amplitudes as compared to those unattended (Mangun et al., 1993). We presented probes (white dots) during the retention interval of a color working memory task and examined P1/ N1 elicited by the probes. If spatial attention is necessary for color working memory maintenance, a larger P1/ N1 effect should be observed for probes presented in the same locations as to-be-remembered targets. Our results suggested that this is not the case, indicating that spatial attention plays no functional role in color working memory maintenance.

G60

WORKING MEMORY TRAINING EXERTS STRONGER EFFECTS ON RISK AVERSION THAN STIMULATION OF PREFRONTAL CORTEX.

B. Sarbone[1], P.M. Greenwood[1], J. Smelser[1], R. Parasuraman[1]; [1]George Mason University — A critical component of decision-making is the ability to assess risk, especially when consequences might be dire. Lesion and imaging data indicate that dorsolateral prefrontal cortex (dlPFC) plays an important role in risk assessment. People become risk averse following transcranial direct current stimulation (tDCS) of dlPFC in the Balloon Analog Risk Task (BART, Fecteau et al., 2009). However, dlPFC also has a role in control processes of working memory (WM). We hypothesized that risk assessment depends on WM, and predicted that WM training would exert effects similar to tDCS on the BART. We directly compared effects of WM training with effects of PFC tDCS. Participants were paid per balloon "pump," but lost it all if the balloon popped. We predicted PFC tDCS would heighten memory of experiences with previous balloons. Healthy young participants were randomly assigned to one of 3 conditions, each with 30 min "Training" followed by 30 min of BART with tDCS: 1. Sham (easy) WM training followed by 2mA PFC tDCS; 2. Adaptive (difficult) WM training followed by Sham PFC (.01mA) tDCS; or 3. Sham WM training followed by 2mA M1 tDCS (motor control). Risk aversion was measured in the number of pumps to 120 virtual balloons. The greatest increase in risk aversion (decreased number of pumps over trials) was seen following the adaptive WM training condition. The weakest effect was seen following M1 stimulation. These results indicate that better WM is associated with greater risk aversion, presumably due to more accurate memory for previous relevant events.

G61

DOES CHEMOTHERAPY ALTER VISUOSPATIAL WORKING MEMORY? AN FMRI STUDY.

Carole Scherling[1,2], Barbara Collins[2,3], Joyce MacKenzie[3], Rocio Lopez[2], Andra Smith[2]; [1]University of California, San Francisco, SF (CA), USA, [2]University of Ottawa, Ottawa (ON), Canada, [3]Ottawa Hospital, Ottawa (ON), Canada — Working memory is a commonly reported impairment manifesting after chemotherapy-treatment in cancer patients. In particular, visuospatial memory is important in everyday functioning and has not yet been studied in this population. Breast cancer patients and individually-matched non-cancer controls were scanned prior to- and after-chemotherapy (time 1 and time 2) during a visuospatial working memory N-back task. Task error rates and reaction times, as well as neuropsychological tests, hospital records, and salivary biomarkers were also examined. Patients show increased activity in the right insula compared to controls, along with slower reaction times. This activation pattern is modulated by covariates such as depression and anxiety scores, as well as task reaction times. At time 2, patients increasingly activate right frontal and left parietal/temporal gyri while controls show increased activity in bilateral frontal, bilateral parietal and right temporal. Regression analyses reveal an opposite relationship between brain activity and reaction time, with controls revealing decreased activity with longer reaction times and patients showing increased activity with slower responses. Additionally, patients reveal increased brain activations with larger depression scores and with longer time post-surgery. Results indicate that there are post-treatment effects that may not be apparent when simply investigating performance markers such as error rates and reaction times. Patients consistently reveal increased neural activity compared to controls which may help explain cognitive fatigue and memory complaints often expressed as a concern in this chemotherapy-treated population.

G62

VISUAL SHORT TERM AND WORKING MEMORY ARE BEHAVIORALLY AND NEURALLY SEPARABLE

Alexander Schlegel[1], Peter J. Kohler[1], Sergey Fogelson[1], Peter Tse[1]; [1]Dartmouth College — Ask a bonobo what you get when you cross an elephant with a rhino and he likely won't have the slightest clue. But if you ask me, I can vividly imagine an elephino with two tusks and horns charging through the savanna. Humans have evolved robust machinery for synthesizing new concepts that we can use for a range of pursuits including art and science. However, we know little about the neural basis of this machinery. Here we use functional magnetic resonance imaging to investigate visual working memory, defined as the manipulation of the contents of visual short term memory. We developed a set of abstract parts that could be assembled into 2x2 arrays to generate figures of varying complexity. Subjects performed two types of tasks: they either held stimuli in short term memory for later recall or mentally manipulated stimuli using working memory. Behaviorally, performance among the tasks was only partially correlated, suggesting that they rely on different neural machinery. This was supported by our neuroimaging data: a univariate analysis revealed a network of 11 cortical and subcortical brain regions with differing activity between short term and working memory tasks. Multivariate pattern classification within these regions revealed a subset of mainly fronto-parietal areas whose informational structure could distinguish between different working memory tasks. Functional connectivity between these regions differed across the tasks as well. Thus, a multi-region network of areas dominated by fronto-parietal connections underlies visual working memory.

G63

CAN REPEATED TRANSCRANIAL DIRECT CURRENT STIMULATION CONTINUE TO IMPROVE WORKING MEMORY PERFORMANCE?

Lotte J. Talsma[1], Heleen A. Slagter[1]; [1]University of Amsterdam, The Netherlands. — Transcranial Direct Current Stimulation (tDCS) is a new, promising method to non-invasively and painlessly modify neuronal activity and thereby alter cognitive functioning in the working brain. For example, several studies have shown that anodal tDCS (atDCS) applied over the left dorsolateral prefrontal cortex (lDLPFC) can improve working memory (WM) performance. Although promising, recent studies have only looked at the effects of one single stimulation session on WM. To see if we can continue to improve WM functioning with repeated stimulation, we examined

the effects of multiple session atDCS on WM performance. Healthy adult participants received three sessions (on consecutive days) with either active (1 mA, 20 min) or sham (1 mA, 1 min) anodal stimulation over the lDLPFC, while simultaneously performing a visual letter N-back task. We explored the effects of repeated atDCS on WM performance by comparing groups before, during and after stimulation at each session. Additionally, in separate pre- and post sessions, we also administered a spatial N-back task and an Operation Span task. This allowed us to investigate possible transfer of effects to different tasks of WM, as well as explore whether stimulation-induced changes in WM may be retained after on-line effects of stimulation have washed out (48 hrs after stimulation). Initial findings showed continuous improvements in WM performance with repeated atDCS, providing preliminary evidence that tDCS may improve cognitive functioning in a cumulative manner. Results of this study may shed further light on the possibilities to use atDCS as method to effectively enhance cognitive functioning.

G64

WORKING MEMORY IN PARKINSON'S DISEASE UNDER DISTRACTION: THE ROLE OF THE BASAL GANGLIA ACROSS VERBAL AND SPATIAL DOMAINS

Mitchell G. Uitvlugt[1], Susan M. Ravizza[1]; [1]Michigan State University — Distractions are ubiquitous; our brains receive a plethora of task-irrelevant information. Thus, to remember successfully, one must actively maintain relevant information and prevent distracting information from entering working memory (WM) (Vogel et al., 2005). Some researchers suggest the basal ganglia-prefrontal pathways are vital to this process; the basal ganglia may act as a gatekeeper of WM—allowing in relevant information and excluding distracters (McNab & Klingberg, 2008). The present study aims to better understand the cognitive and neural mechanisms of this process by using Parkinson's disease (PD) as a model of frontostriatal functioning. Medication status was manipulated to assess the contribution of "Go" and "NoGo" pathways on WM tasks with and without distraction. Given that dopaminergic medication is believed to increase functioning of the "Go" pathway over the "NoGo" pathway, we predicted that patients tested on medication would be more susceptible to distraction than those tested off medication. Moreover, as a domain-general process, this should occur regardless of the type of information maintained—verbal or spatial. PD patients and age-matched controls were given a verbal and a spatial WM task consisting of three conditions: low-load with no distraction; low-load with distraction; and high-load with no distraction. Patients were tested both on and off dopaminergic medication with the order counterbalanced. Results supported the hypothesized pattern across verbal and spatial domains, in which PD patients off medication handled distraction better than on medication. This evidence provides strong support for a model in which frontostriatal pathways gate information into WM, regardless of domain.

G65

HOME LITERACY EXPOSURE MITIGATES THE EFFECT OF FAMILY HISTORY OF DYSLEXIA REFLECTED IN THE EEG MISMATCH NEGATIVITY RESPONSE

Sara D. Beach[1], Elizabeth S. Norton[1], Ola Ozernov-Palchik[2], Candice M. Coulter[1], Abigail B. Cyr[1], Nadine Gaab[2], John D.E. Gabrieli[1]; [1]Massachusetts Institute of Technology, [2]Boston Children's Hospital — Developmental dyslexia (DD) is characterized by difficulty learning to read despite adequate reading instruction. Recent work has focused on identifying genetic, early behavioral, and neural risk factors for DD. Individuals with DD, as well as infants with a family history of DD, show attenuated EEG mismatch negativity (MMN), an automatic, pre-attentive response to deviant auditory stimuli. However, it is not known whether environmental factors such as language and literacy exposure (LLE) may affect the MMN in young children. Here, we examined how home LLE relates to the MMN signal in kindergarten children with or without a familial risk for DD, and what role socio-economic status (SES) plays within this relationship. We examined 73 pre-k and kindergarten children with and without a familial risk for DD (FHD+/FHD-) using 64-channel EEG while children listened to syllables "ba" and "da" (90% standards/10% deviants). Parents completed SES and home literacy/language questionnaires. Results indicate that in the whole sample, LLE, particularly weekly hours spent reading to the child, was significantly correlated with a stronger MMN response. An ANOVA with MMN amplitude over frontal electrode sites as the dependent variable revealed an interaction effect: LLE did not affect MMN amplitude in FHD- children, but FHD+ children who had greater LLE had a stronger MMN relative to children with less LLE. SES measures of parental education and occupation were not related to the MMN. These results suggest that home literacy behaviors may be a protective factor for children at familial risk of reading difficulty.

G66

BUILDING A BETTER MODEL OF WHITE MATTER CHANGES IN AGING: THE MYELODEGENERATIVE HYPOTHESIS AND LANGUAGE PROCESSING

Simon W Davis[1], Kaustuv Joshi[1], Lorraine K Tyler[1], CamCAN; [1]University of Cambridge — Proponents of the myelodegenerative hypothesis of aging claim that age-related changes in white matter (WM) are driven by changes in the neuroglia supporting the formation of myelin, and that this degeneration has negative consequences for cognition. This claim is largely based upon studies using diffusion-weighted imaging (DWI) metrics such as radial diffusivity (RD), which measures the diffusion of water and should increase as myelin degrades. However, this inference is poor because RD reflects only one aspect of myelin's imaging profile. This analysis addressed this problem by comparing RD to the magnetization transfer ratio (MTR), which measures the myelin-bound proton pool, and represents information normally invisible to conventional MRI or DWI. Therefore, if MTR and RD capture the same underlying physiological characteristic they should show similar morphology and similar consequences for cognition. MTR, DWI, and behavioral performance in an array of cognitive measures were collected from a population-representative sample of adults (aged 20-85). We found a high degree of voxelwise similarity ($r > 0.6$) between MTR and RD images across 44 of 48 WM regions. Furthermore, MTR/RD measures in similar regions mediated age-related declines in cognitive performance. Both MTR and RD in anterior callosum mediated declines in fluid intelligence, while MTR/RD in posterior temporal regions mediated declines in semantic comprehension, face matching, and famous face recognition. Taken together these results support the idea that RD and MTR measure the same underlying physiological characteristic, and provide convergent evidence that age-related declines in WM health reflect a myelodegenerative pattern with important cognitive consequences.

G67

DIFFUSION TENSOR IMAGING (DTI) OF CEREBRAL WHITE MATTER INTEGRITY: GLOBAL VERSUS TRACT-SPECIFIC EFFECTS AND MEDIATION OF AGE-RELATED SLOWING

Micah A. Johnson[1], Michele T. Diaz[1], David J. Madden[1]; [1]Duke University Medical Center — Although both global (brain-general) and regional (tract-specific) variations in cerebral white matter properties have been well documented, research to date has not fully defined their relative contribution or their mediational roles in age-related differences in cognition. Towards these goals, we used DTI to collect four measures of white matter: fractional anisotropy (FA), and axial, radial and mean diffusivities (AD, RD, MD) within eight tracts (bilateral superior longitudinal fasciculi [SLF], corticospinal tracts [CST], optic radiations [OR], plus the genu and splenium of the corpus callosum) from 125 participants 18-85 years of age. To assess global versus specific effects, we submitted each DTI measure to principal component analysis (PCA), using the individual tracts as dependent variables. The results yielded two significant components for FA: the first comprised high loadings from the SLF and CST tracts, and the second comprised high loadings from the genu, splenium, and OR tracts. However, variation in AD, RD, and MD was primarily global and yielded a single-component solution in each case. Further analyses suggested that individual differences in these components of the DTI measures do not have a mediational role in the relation between adult age and elementary perceptual speed (digit symbol substitution). However, age was a significant mediator of the relation between the second FA component and perceptual speed. These data suggest that a slowing of perceptual speed is associated with decreasing FA in the genu, splenium, and ORs because the speed-FA relation in these tracts is particularly pronounced for older adults.

G68

GROWTH IN READING SKILLS MEASURED WITH BRAIN ACTIVATION DURING PHONOLOGICAL FMRI TASKS IN CHILDREN WITH DEVELOPMENTAL DYSLEXIA

Emily Farris[1], Timothy Odegard[2], Jeremiah

Ring[3], Jeff Black[3], Reid Lyon[2]; [1]University of California San Francisco, [2]University of Texas at Dallas, [3]Texas Scottish Rite Hospital for Children — Children with developmental dyslexia exhibit deficits in a wide variety of reading skills that are attributable to underlying deficits in phonological processing. Functional neuroimaging studies show that these children exhibit differences in the activation of a distributed network of brain regions during reading tasks when compared to children without reading impairments. Furthermore, research has shown that activation of a distributed network of brain regions during reading tasks can be used to predict changes in children's reading skills over time. The present study extends this research to a sample of children who completed a multisensory reading intervention. Specifically, the present study predicts children with dyslexia's growth in word reading and reading comprehension following a 2-year multisensory intervention through analyses of activation during two functional magnetic resonance imaging (fMRI) tasks completed prior to the intervention. One task required the child to match phonemes and graphemes and the other task required the child to indicate if pictures representing real words rhymed. Analyses suggested that the children with dyslexia exhibited significant growth in their reading skills. Brain activation across both tasks was associated with growth in reading skills throughout the intervention. A general pattern emerged from the fMRI analyses such that negative correlations with growth in reading were more likely to occur in occipito-temporal regions and positive correlations with growth in reading were more likely to occur in prefrontal regions. These analyses help to further identify pre-intervention factors that may facilitate reading skill improvements in children with developmental dyslexia.

G69

FUNCTIONAL AND BEHAVIORAL AGE-RELATED CHANGES IN PHONOLOGICAL AND SEMANTIC PROCESSES UNDER DISTRACTING CONDITIONS

Michele T. Diaz[1], Micah A. Johnson[1], Anthony Peccoraro[1], Deborah M. Burke[2], David J. Madden[1]; [1]Duke University Medical Center, [2]Pomona College — At the behavioral level, the pattern of age-related differences within the domain of language is marked by both retention (e.g., semantic processing) and decline (e.g., phonological processing), although the neurobiological basis of this pattern is not clear. Previously, we have shown that an age-related decline occurs in phonological but not semantic retrieval efficiency, and that phonological and semantic retrieval are associated with distinct patterns of neural activation. Further, individual differences in phonological activation accounted for a substantial portion of age-related variance in phonological retrieval. In the present study we examined phonological and semantic processes in the presence of task-irrelevant information. Previous studies have reported age-related decline in the ability to ignore task-irrelevant information, but how this interacts with language processes is unclear. In the present study, older and younger adults made semantic and phonological decisions about pictures in the presence of either semantically-related or phonologically-related words that were unrelated to the decision. Behaviorally, there was a main effect of age (older > younger) and a main effect of condition (phonological > semantic). Additionally, older adults elicited less activation than younger adults for the phonological task, but not for the semantic task. Response times from the current experiment were slightly faster overall than our previous experiment. These findings support greater age-related differences in the neurobiological bases of phonological processes compared to semantic processes and suggest that older and younger adults respond to task-irrelevant information similarly.

G70

MISMATCH NEGATIVITY TO LANGUAGE OF ADOPTION AND LANGUAGE OF ENVIRONMENT SPEECH-SOUNDS IN CHILDREN WHO ARE INTERNATIONALLY ADOPTED

Reem Khamis-Dakwar[1], Kathleen Scott[2]; [1]Adelphi University, [2]Hofstra University — Interest in the language acquisition of children who are internationally adopted (CWIA) has increased greatly over the last several years due to the increase in the numbers of children who are adopted from foreign countries into the US (U.S. Department of State, 2011). Despite rapid language acquisition in the early years postadoption, children who are internationally adopted (CWIA) appear to present with language difficulties when they reach the school-age years (Scott, Roberts, & Glennen, 2011, Beverly, McGuinness, & Blanton, 2008). To evaluate whether later language difficulties can be related to differences in phonemic system organization, we investigated auditory MMN responses from three CWIA (3 -5 years old) adopted from China and exposed to LE for at least 2 years, and one non- adopted monolingual English speaking child. The participants' selection enables control for the effect of age of adoption and time in US on children's' MMN responses in comparison to the control. Participant 1 shared age of adoption (8 month) with participant 2, while sharing time spent in US (exposure to English) with participant 3. Words were presented in randomized order in passive listening oddball paradigms in three conditions. Chinese only, English only phonemic contrast, and phonemic contrast evident in both languages. The MMNs to different speech contrast deviants were elicited within an auditory oddball paradigm and recorded by a 32-channel. Differences in MMN presence, latency and amplitude reveal differences in the phonological representations in CWIA children, depending on time of adoption in interaction with amount of exposure to LE.

G71

TONE-EVOKED BRAIN RHYTHMS IN INFANTS

Gabriella Musacchia[1], Naseem Choudhury[1,2], April Benasich[1]; [1]Rutgers University, [2]Ramopo College — Learning to speak and understand language is a complex and challenging task, requiring representation of rapid (e.g. formant transitions) and also slowly-changing (e.g. segmental and prosodic) acoustic features. In order to understand the developmental mechanisms of auditory processing over several temporal scales, we recorded infant EEG brain responses to repeated tone pairs of different rates as well as during a stimulus-free epoch. Typically developing infants were fitted with a 128-electrode net while seated in the parent's lap and silently entertained. Tone pairs (800 Hz, 70ms duration for each tone) in two rate conditions (70 or 300ms ISI) were presented in free-field. Stimulus onset asynchrony between pairs was 915 or 1140ms, respectively. The event-related spectra of individual ERPs were averaged after visual inspection and artifact removal, (EEGLAB, ERPLAB). Co-registered, age-appropriate MRIs were used to model a two-dipole source solution for each individual and for the grand average ERP (BESA, Inc.). This model localized left and right auditory centers. Preliminary results show differential processing for left and right dipole activity for the control rate and decreased hemispheric differences during rapid presentation. A hierarchy of theta, beta and gamma oscillations in discrete frequency bands was also observed in both conditions, with rapid tone presentation increasing the time course and power of theta oscillations. Activity in the gamma frequency band was preserved across conditions. These data indicate differential tone processing in left and right auditory areas and suggests how developing brain mechanisms may encode auditory changes over different temporal scales.

G72

RAPID AUTOMATIZED NAMING SKILL IS ASSOCIATED WITH BRAIN ACTIVATION FOR ORTHOGRAPHIC PROCESSING IN KINDERGARTEN CHILDREN

Elizabeth S. Norton[1], Sara D. Beach[1], Ola Ozernov-Palchik[2], Abigail B. Cyr[1], Nadine Gaab[2], John D. E. Gabrieli[1,3]; [1]Massachustetts Institute of Technology, [2]Laboratories of Cognitive Neuroscience, Boston Children's Hospital, [3]Harvard-MIT Division of Health Sciences and Technology — Individuals with developmental dyslexia (DD) show reduced brain activation in left-hemispheric regions such as the occipito-temporal and temporo-parietal areas. It has been suggested that these deficits predate reading onset and correlate with pre-reading skills. Rapid automatized naming (RAN), a pre-reading skill, is correlated with word reading ability and difficulty with RAN is thought to be a core deficit in many individuals with DD. RAN skill may represent the efficiency of visual, linguistic, and executive functioning systems which also underlie reading. Here, we investigated whether performance on RAN is associated with orthographic processing within the reading network in pre-k and kindergarten children. Sixty-four children (age 4;10-6;2) completed behavioral assessments and functional MRI (fMRI). During fMRI, children completed a one-back task using letters and false-font letters. A whole-brain correlation was conducted between the mean standard score for RAN objects and colors and activation for letters >false fonts. Furthermore, a region-of-interest (ROI) analysis was performed using literature defined, independent ROIs which have been shown to differentiate proficient from struggling readers. Whole-brain analysis revealed that RAN scores significantly correlated with activation in left temporo-parietal cortex ($p<.001$, cluster-level corrected). Furthermore, the

mean RAN standard score was significantly correlated with activation in the literature-defined left temporo-parietal ROI (r=.51, p<.001), whereas performance on RAN and activation within the left fusiform gyrus was not related. Multiple regression revealed that RAN accounts for significant unique variance in ROI activation. These findings suggest that RAN may contribute to the development of orthographic processing within left temporo-parietal cortex in beginning readers.

G73

THE HUMAN BRAIN PROCESSES SYNTAX IN THE ABSENCE OF CONSCIOUS AWARENESS

Laura Batterink[1], Helen Neville[1]; [1]University of Oregon — Syntax is the core computational component of language. A longstanding idea about syntactic processing is that it is generally not available to conscious access, operating autonomously and automatically. However, there is little direct neurocognitive evidence on this issue. Using event-related brain potentials and a novel cross-modal distraction task, we demonstrated that syntactic violations that were not consciously detected nonetheless produced a characteristic early neural response pattern, and also significantly delayed reaction times to a concurrent task. This early neural response was distinct from later neural activity that was observed only to syntactic violations that were consciously detected. These findings provide direct evidence that the human brain reacts to violations of syntax even when these violations are not consciously detected, indicating that even highly complex computational processes such as syntactic processing can occur outside the narrow window of conscious awareness.

G74

LANGUAGE RECURSION OVERLAPS WITH MOTOR RECURSION: BRAIN POTENTIALS EVIDENCE OF EMBODIED SENTENCE PROCESSING

Pilar Casado[1,2], Manuel Martin-Loeches[1,2], Manuel de Vega[3], Inmaculada Leon[3], Laura Jimenez-Ortega[1,2], Sabela Fondevila[1], David Hernandez-Gutierrez[1]; [1]Center for Human Evolution and Behavior (UCM-ISCIII), Madrid, Spain, [2]Complutense University of Madrid, Madrid, Spain, [3]University of La Laguna, La Laguna, Spain — Theories of embodied cognition claim that symbols supporting human cognition are grounded on perceptual, motoric, and emotional experience. When language is concerned, this applies to both syntax and semantics. This contrasts with traditional views of language, that consider that syntax is amodal in generating hierarchical, recursive structures. In this study, we used Event-Related Potentials (ERPs) in order to find support for the theories of embodied language, exploring whether the syntactic processing of sentences in the brain overlaps with areas devoted to organize hierarchical and recursive non-linguistic motor movements. ERPs were recorded while subjects read sentences with a center-embedded subject-relative clause and their unacceptable versions –with a word-category violation, that is, the verb of the main clause was replaced by a noun-. Prior to a set of sentences, subjects performed one of either two motor tasks. One consisted on pressing a series of buttons in a sequential order, the other being the same but also including a recursive sequence. As expected, syntactic violations elicited LAN and P600 components. Importantly, the amplitude of both components was modulated by the previous performance of the motor task with the recursive structure. These findings add to growing evidence supporting models of embodied language processing.

G75

HEADLESS COWS ARE HARD TO PROCESS: AN ERP STUDY OF MANDARIN CLASSIFIERS

Shiao-hui Chan[1], Chia-hsuan Liao[1], Li-chuan Ku[1]; [1]National Taiwan Normal University, Taipei, Taiwan — Mandarin has around 400 classifiers (Huang et al., 1997), many of which can only be paired with certain nouns (e.g. "one-CL(head)-cow" is fine, but not "one-CL(head)-horse") ("CL" stands for classifier and "head" is the literal meaning of the classifier). Some researchers claimed that such arbitrary pairing was similar to agreement morphology in Indo-European languages (Sproat & Shih, 1993). However arbitrary, previous studies (Zhou et al., 2010; Zhang et al., 2012) indicated that mismatched Classifier-Noun pairings induced an N400 effect, suggesting that these combinations were analyzed semantically, rather than syntactically. The goal of the current ERP study was to examine whether processing Mandarin classifiers was indeed semantic in nature by studying two types of materials not previously examined: (1) the ungrammatical omission of classifiers and (2) the inappropriate use of the general classifier Ge, which could replace classifiers and be paired with nouns in many, but not all, cases. Twenty-one subjects were recruited to judge the grammaticality of 3 types of consecutively-presented visual word pairs: grammatical Classifier-Noun combinations ("seven-CL(head) + cow"), ungrammatical GE-Noun combinations ("seven-GE + cow"), and ungrammatical omission of classifiers ("seven + cow"). The results revealed that the two ungrammatical conditions induced a stronger N400 effect than the grammatical one, although the scalp distribution was more anterior and bilateral than would normally be expected. This finding was in line with earlier research that Classifier-Noun processing was semantic in nature. Future research using current materials in sentence context is needed to verify if the effect still holds.

G76

THE ROLE OF SYNTACTIC CATEGORY IN LEXICAL ACCESS: AN ERP STUDY OF CHINESE HOMOGRAPH

Chih-Ting Chang[1], Chia-Ying Lee[1,2], Chia-Lin Lee[3], Jie-Li Tsai[4], Chia-Ju Chou[1]; [1]National Yang-Ming University, [2]Academia Sinica, [3]National Taiwan University, [4]National Chengchi University — Whether syntactic properties are processed during isolated word recognition has been a matter of debate. While the syntactic mediation model claims that syntactic processing is obligatory and occurs prior to meaning processing, the semantic mediation model holds that syntactic properties of a word are not specified in the lexicon and syntactic category information is made available only during sentence integration. The present event-related potential study aims to investigate the processing of syntactic and semantic information in isolated word recognition by utilizing the characteristics of homographs. Homograph is a word has two or more semantically unrelated meanings which may associate with different word classes. Two kinds of ambiguity (semantic and word-class) were orthogonally manipulated in a set of Chinese two-character words. Participants were instructed to judge the semantic relatedness between the target word and its following probe. Our results showed an interaction between word-class ambiguity and semantic ambiguity during the time windows of N1 (100 to 135 ms) and P200 (200 to 250 ms). The word class effect, in which the word-class unambiguous words elicited a more negative N1 and a less positive P200 than the word-class ambiguous words did, was only observed in reading the semantic unambiguous words. In the N400 time window, only the main effect of semantic ambiguity was found. The semantic ambiguous words elicited a greater N400 than the semantic unambiguous words. These finding support that both semantic and syntactic information are processed during isolated word recognition.

G77

EXPLORING FIGURATIVE LANGUAGE PROCESSING IN MANDARIN-ENGLISH BILINGUALS: AN FMRI STUDY

Yu-Chen Chang[1], Fan-pei Yang[1]; [1]National Tsing Hua University, Hsinchu, Taiwan — The present study investigated the neural network of similes, anomalous and literal language processing in Mandarin- English bilinguals during interpretation of English comparison statements. We characterized the neural networks involved for processing English similes. We also compared the neural activations of similes with those of anomalous and literal sentences to see whether processing of anomaly and literal sentences involves different networks. Eleven healthy bilingual speakers (6 females, 5 male) participated in the fMRI experiment. Images were acquired on a 3 T MR scanner (Brucker, Germany). Stimuli consisted of 200 short English sentences created for three conditions: literal sentences (e.g., he is a donor), anomalous sentences (e.g., a school is like a sandwich), and similes (e.g., jealousy is like acid). In the simile>literal condition, significantly higher activations were evoked in the left medal frontal gyrus, middle occipital gyrus, middle frontal gyrus, in addition to the cingulate and fusiform gyrus in the right hemisphere. In the anomalous>literal condition, significantly higher activations in the bilateral superior frontal gyrus, left middle gyrus, as well as the inferior frontal gyrus and fusiform gyrus were observed. In the anomalous>simile condition, significantly greater activations were observed in the superior and middle frontal gyrus, and anterior cingulate in the right hemisphere. Our findings suggest that comprehension of anomaly demands the greatest cognitive resources among the three conditions as several regions were significantly activated in the right hemisphere. Comprehension of similes is different from comprehension of anomaly in that it evokes regions that are related to inference making.

G78

NEURAL CORRELATES OF AFRICAN AMERICAN ENGLISH SYNTAX: AN ERP PILOT STUDY Felicidad Garcia[1], Reem Khamis-Dakwar[2], Karen Froud[1]; [1]Teachers College, Columbia University, [2]Adelphi University — This experiment compares event-related potential (ERP) responses to syntactic differences between African American English (AAE) and Standard American English (SAE). Recent research has shown that distinct ERP signatures are associated with switching between languages compared to switching between dialects or registers (Khamis-Dakwar & Froud, 2007; Moreno et al., 2001). The current investigation builds on these findings to investigate whether AAE syntax elicits differing neural responses in bidialectal speakers of AAE and SAE, compared to monolingual speakers of SAE. ERP responses in this investigation were measured in two experiments: Experiment 1 recorded ERP effects for auditorily presented sentences in each of two syntax types in its use or omission of a third-person singular agreement on a present tense verb (e.g., The young child lights/light the fire). Experiment 2 served to confirm the presence of similar ERP effects in both participant groups for grammaticality violations shared between both language varieties (e.g. The distant fire reaches them/*they in the morning). Initial results were compared between a bidialectal speaker of AAE/SAE and a monolingual SAE speaker. In experiment 1, monolingual speakers showed a P600 response to stimuli violating the 3rd person agreement restriction, but no such response was observed for the speaker of AAE. Experiment 2 produced P600 effects in both participants. Results of this preliminary study warrant further investigation of brain responses to syntactic variation in SAE and AAE. Implications include potential for greater understanding of language processing in AAE, that could influence appropriation of therapy and educational resources (Cole & Taylor, 1990).

G79

DISCOURSE MODULATIONS OF SYNTACTIC PROCESSING: AN EVENT-RELATED BRAIN POTENTIALS STUDY David Hernández-Gutiérrez[1], Manuel Martín-Loeches[1,2], Laura Jiménez-Ortega[1,2], Sabela Fondevila[1], Pilar Casado[1,2]; [1]Center for Human Evolution and Behavior, UCM-ISCIII, Madrid, Spain, [2]Complutense University of Madrid, Spain — For almost 20 years, there has been a debate on the nature and specificity of the working memory resources employed in language processing. Whereas Just and Carpenter (1992) proposed the existence of a general pool of working memory resources, common to all levels of language processing, Waters and Caplan (1996) endorsed instead a partition between working memory resources specifically used for syntactic processes, and more general linguistic resources. The aim of this research was to test how the processing of gender and number agreement is affected by working memory load occurring across discourse processing, this manipulated as the amount of elements (ideas) stored as well as difficulty of processing (global coherence). To this end, we compared the performance and ERP (event-related potentials) results of a group of 24 participants while they read and memorized coherent and incoherent short stories containing morphosyntactic violations. Morphosyntactic agreement mismatches elicited LAN and P600 effects. Only the P600 was however modulated by the amount of "idea units" that participants held in memory, a measure of working memory load. Increases in P600 amplitude were positively related to the reorganization and incorporation of a larger amount of information to the mental model of the stories. Taken together, these results would agree with the idea of a common working memory store for language processing. We have interpreted the data in the frame of more recent connectionist approaches to the debate by MacDonald and Christiansen (2002).

G80

METAMEMORY INTO MEMORY: THE NEURAL CORRELATES OF ADAPTIVE ENCODING Natalie Mandel[1], Rebecca Shukhman[1], Laura Endris[1], Izabelle Rymut[1], Krishna L. Bharani[1], Robert Hurley[2], Robert G. Morrison[1]; [1]Loyola University of Chicago, [2]Northwestern University Feinberg School of Medicine — Pathologic and exceptional memory studies in older adults have pointed to executive processes as important for good memory functioning. Older adults with better memory monitoring may adjust executive processes to maximize acquisition during subsequent encoding opportunities. Herein, we used face-name associations as the basis for an EEG memory paradigm utilizing retrieval practice to optimize learning. After attempting to recall the name of a specific face, younger adults made a prospective memory judgment (Judgment of Learning, JOL) intended to predict their subsequent memory recall performance. Following the JOL, they saw the correct face/name combination again thereby providing another study opportunity. Recall was high (M = 92.3%) with correspondingly good preceding JOLs (M = 3.1); however, participants used the full range of ratings (1-4) across trials allowing us to compare event-related potentials (ERPs) for high and low JOLs. A late-positive complex (LPC) ERP, associated with explicit long-term memory, was reliably more positive on successful than unsuccessful recall trials. We also calculated ERPs during face/name study after a JOL. This ERP was more positive on lower than higher JOLs in frontal and parietal electrodes suggesting that participants engaged their fronto-parietal network more during subsequent study when they deemed their prospective memory for the face-name pairings to be poor. We believe this paradigm offers an effective way to look at the influence of memory monitoring on adaptive encoding in older adults as we try to understand how executive processes can contribute to resilience in memory functioning during cognitive aging.

G81

INDIVIDUAL DIFFERENCES IN COGNITIVE ABILITY DIFFERENTIALLY AFFECT NEURAL MODULATION ACROSS THE LIFESPAN: A MULTIVARIATE SPATIO-TEMPORAL PATTERN ANALYSIS Ian McDonough[1], Jenny Rieck[1], Andrew Hebrank[1], Patricia Reuter-Lorenz[2], Denise Park[1]; [1]Center for Vital Longevity, University of Texas at Dallas, [2]University of Michigan — A fundamental question in cognitive aging research is how aging affects neural recruitment with increasing task demands. Brain activity often increases in frontal-parietal regions with increasing demands, but this modulation depends on individuals' processing capacity (Nagel et al., 2009; Reuter-Lorenz & Cappell, 2008). The present study investigated the extent that processing capacity influences neural recruitment across the adult lifespan. Participants from the Dallas Lifespan Brain Study (N = 316) were divided into higher and lower ability subgroups within each of four age spans (20-39, 40-59, 60-79, and 80-89) with the assumption that lower cognitive ability and older age would be associated with lower processing capacity. Cognitive ability was based on speed, working memory, and fluid reasoning. From each age span, we identified the 20 highest performers and the 20 lowest performers, matched on age, sex, and education. The fMRI task required living/non-living judgments to easy (cat) or hard (virus) words. Partial least squares (PLS) analysis, a multivariate technique, was used to assess patterns of brain activity that distinguished easy from hard trials. The expression of brain activity patterns associated with increasing task demands peaked earlier in the lifespan and showed greater age-related declines for lower compared with higher ability individuals. Differences between ability groups were due to greater activity during easy trials and lower peak activity during harder trials. Thus, older adults with higher cognitive ability were able to maintain "youth-like" patterns of neural modulation in response to task demands until late adulthood.

G82

LEARNING SUNG INSTEAD SPOKEN LYRICS ENHANCES CONSOLIDATION IN MEMORY IN NORMAL AGING AND MILD ALZHEIMER'S DISEASE Aline Moussard[1], Emmanuel Bigand[2], Sylvie Belleville[3], Isabelle Peretz[4]; [1]Rotman Research Institute, [2]University of Burgundy, [3]University of Montreal, [4]Geriatric Institute of the University of Montreal — The aim of this study is to investigate if mild Alzheimer's participants (N = 8) and elderly controls (N = 7) better memorize lyrics whether they are presented in a spoken or a sung mode. Each participant learned four new lyrical excerpts, randomly assigned to one of these conditions: (1) spoken, (2) sung on an unfamiliar melody, (3) sung on an unfamiliar melody previously learned (before adding the lyrics), and (4) sung on a life-long familiar melody. Each excerpt was learned during separate sessions, presented randomly. The percentage of words correctly recalled was measured with a free recall task in immediate and delayed recall (after 10 minutes). In immediate recall, lyrics sung on an unfamiliar melody were more difficult to learn than spoken ones. Performance increased with melodic familiarity, but did not surpass the spoken condition. This pattern was the same for both normal elderly and AD participants. In delayed recall however, Controls performed better in the life-long familiar sung condition, and AD participants recalled more words for the sung lyrics – independently of the melodic familiarity – with

very poor recall for the spoken condition. Our results show that learning both lyrics and melody at once is more difficult than spoken lyrics only, or than lyrics sung on an already familiar melody. However, music may reinforce the consolidation process, even despite memory impairment of ADs. The specificity of music in these findings, as well as the possibility to use them in clinical applications will be investigated in further studies.

G83

A LONGITUDINAL STUDY OF MEMORY DECLINE IN ELDERLY WOMEN WITH AND WITHOUT HORMONE REPLACEMENT THERAPY

Beth A. Ober[1], Gregory K. Shenaut[1]; [1]University of California, Davis — The well-known, nationwide WHI-SCA (Women's Health Initiative Study of Cognitive Aging) tested 2302 women aged 66-84 annually on a cognitive battery, starting three years after beginning the double-blind WHI hormone replacement therapy (HRT: estrogen and progesterone) study, until the WHI-HRT ended prematurely two years later. This poster summarizes data from an independent, exploratory WHI ancillary study carried out at U.C. Davis alone, that tested 100 WHI-HRT enrollees aged 65-85 on a different cognitive battery, starting 0-6 weeks after beginning HRT, with 1-7 annual follow-ups. Based on then-available observational data on HRT and cognition, we hypothesized that HRT would reduce the normal aging-based decline of episodic memory, attention, and working memory, but not that of language and semantic memory. Overall (3-8 annual sessions), the placebo group (N=47) displayed negative slopes for the Positive and Negative Affect Schedule (PANAS) positive score, and Category Fluency, whereas the HRT group (N=36) displayed negative slopes for Letter Fluency, and positive slopes for PANAS negative, Memory Assessment Clinics Self-rating (MAC-S) frequency of occurrence score, and immediate Story Recall. The between-group difference in slope approached significance for PANAS negative. Neither group's slopes differed from zero for MAC-S ability, delayed Story Recall, Computation Span, Digit Vigilance, Digit Span (forward, backward), Self-Ordered Pointing, or the Repeatable Episodic Memory Test (unrelated word lists). In contrast to the WHI-SCA findings of a detrimental effect of HRT on episodic memory, our results suggest that HRT may facilitate episodic memory for conceptually structured material, such as stories, but not for unstructured word lists.

G84

EFFECTS OF AGING AND BETA-AMYLOID DEPOSITION ON EPISODIC ENCODING BRAIN ACTIVITY IN COGNITIVELY NORMAL ELDERLY

Hwamee Oh[1], Elizabeth C. Mormino[2], William J. Jagust[1,3]; [1]University of California- Berkeley, [2]Harvard Medical School, [3]Lawrence Berkeley National Laboratory — About 30% of cognitively normal older adults harbor β-amyloid (Aβ), a prominent feature of Alzheimer's disease that often relates to functional and structural changes as well as episodic memory decline in aging. In this study, we sought to tease apart effects of aging and Aβ deposition on brain activity and functional connectivity during episodic encoding using [11C] Pittsburgh compound B (PIB) positron emission tomography (PET) and fMRI. Fifteen young and 36 older adults were scanned during an episodic encoding task with visual scenes and later performed an unscanned surprise recognition task with old/new judgment and confidence rating. Based on PIB index quantifying brain Aβ deposition, older adults were classified as either PIB−Old or PIB+Old groups. For successfully encoded (high confidence hit: HC) compared to forgotten (INCORRECT) items, YOUNG subjects showed increased activity in frontal, parietal and visual association (VA) areas compared to PIB−Old. PIB+Old showed increased activity in frontal, hippocampus/parahippocampal gyri (PHG), and VA areas compared to PIB−Old. Psychophysiological interaction (PPI) analyses revealed stronger coupling between the right PHG (rPHG) and medial and lateral prefrontal cortex (PFC) in PIB−Old than YOUNG for HC compared to INCORRECT items. Stronger coupling between the rPHG and the right/medial PFC and VA areas was seen in PIB−Old than PIB+Old for the same contrast. Our results suggest that aging-related decreases in brain activity are compensated by increased functional connectivity between rPHG and PFC and VA in support of successful visual encoding while Aβ deposition relates to aberrant increases in regional activity with disrupted functional connectivity.

G85

BEHAVIORAL AND ERP CORRELATES OF UNITIZATION IN ASSOCIATIVE MEMORY IN YOUNG AND OLDER ADULTS

Amy A. Overman[1], Ursula G. Saelzler[1], Joseph D. W. Stephens[2]; [1]Elon University, [2]North Carolina A&T State University — Research has demonstrated that older adults have more difficulty than young adults in linking together pieces of information into one unit, a problem known as the associative deficit (Naveh-Benjamin, 2000). This study investigated the associative deficit by examining differences in the strength of associations between paired items in young and older adults, as indexed by the N400 ERP component. Prior research has found that unitization of pairs influences the strength of the N400 difference between intact versus rearranged pairs (Rhodes & Donaldson, 2007). The present experiment manipulated unitization by presenting pairs of items (faces and names) that were congruent or incongruent in terms of gender. The experiment consisted of 10 study/test phases. Each study list consisted of 32 face-name pairs, which was immediately followed by a test phase in which participants were asked to identify previously-presented pairings, while ERPs were recorded. Study lists consisted of congruent (female face/female name, male face/male name) pairs, and incongruent pairs (female face/male name, male face/female name), and test lists consisted of target pairs (intact pairs from study list) and lure pairs (items from study rearranged into new pairs) for all four conditions. ERP waveforms for each participant were compared between intact and rearranged pairs in the congruent and incongruent conditions in order to compare the size of the N400 based on congruency. Comparisons between age groups suggest that the ERP correlates of pair recognition and unitization differ between young and older adults, providing evidence regarding the neural basis of the associative deficit.

G86

LONGITUDINAL EFFECTS ON EPISODIC MEMORY OF BODY MASS INDEX, CATECHOL-O-METHYLTRANSFERASE (COMT), AND BRAIN-DERIVED NEUROTROPHIC FACTOR (BDNF)

Ninni Persson[1,2,3], Åke Wahlin[1,2,4]; [1]Department of Psychology, Stockholm University, Sweden, [2]Stockholm Brain Institute, Sweden, [3]Institute of Gerontology, Wayne State University, USA, [4]School of Medicine, University of Queensland, Brisbane, Australia — Normal cognitive aging is heterogeneous and characterized by both fluctuation and change. Health and genetic factors are important determinants of such individual differences in cognitive development. Genetic polymorphisms may play different roles throughout the lifespan and single-nucleotide polymorphisms (SNPs), important for cognitive functions, are also involved in the regulation of peripheral body functions. Catechol-O-methyltransferase (COMT), and Brain-derived neurotrophic factor (BDNF), have been associated with both cognitive performance, and Body mass index (BMI). We wanted to explore moderator effects on cognitive development of such agents. Data from 1 034 non-demented subjects (35-80 years at base-line), participating in the Betula study in the northern part of Sweden, were analyzed using a growth curve model approach. First, we investigated effects of epistasis on cognitive growth trajectories. Second, we examined if higher BMI at base-line moderates the effects of COMT × BDNF on cognitive growth-trajectories over time. We found that possession of two copies of the COMT 158 Met allele combined with the BDNF 66 Val/Val variant had protective effects on development in episodic memory performance. Further, we found BMI × COMT × BDNF × time effects, such that higher baseline BMI was associated with steeper decline over 10 years in episodic memory slopes among carriers of COMT 158 Val and BDNF 66 Met/Met variants, independent of sex, education, and cardiovascular diseases. The semantic memory domain was spared from such effects.

G87

MODIFYING MEMORY: SELECTIVELY ENHANCING AND UPDATING PERSONAL MEMORIES FOR A MUSEUM TOUR BY REACTIVATING THEM

Peggy L. St. Jacques[1], Daniel L. Schacter[1]; [1]Harvard University — Memory can be modified when reactivated, but little is known about how the quality of reactivation modulates its influence on subsequent memory. We developed a novel paradigm to investigate reactivation-induced plasticity in personal memory. Participants reactivated memories triggered by photos taken from a camera they wore during a museum tour and made relatedness judgments on a novel photo taken from a different

tour of the same museum. Across two behavioral studies we found that subsequent recognition memory for events conducted at the museum was better for photographs depicting events that were highly reactivated, but reactivation also increased endorsement of novel museum photographs. In a functional MRI (fMRI) study, we found that subsequent true and false memory were both predicted by neural activity in retrieval-related regions sensitive to parametric variation in reliving, a finding that is consistent with our behavioral studies linking these effects to the quality of retrieval. Both true and false subsequent memory effects were observed in retrosplenial cortex, posterior parietal cortex and posterior parahippocampal cortex, a network of regions that mediates processing of contextual associations. In sum, our results suggest that reactivation-induced changes in memory are modulated by the quality of reactivation and supported by a subset of regions involved in the retrieval of contextual associations.

G88

THE PRECUNEUS MAKES THE DIFFERENCE: PRECUNEAL ACTIVITY DURING RECOLLECTION OF CONCRETE COMPARED TO ABSTRACT NOUNS IS LINKED TO RETRIEVAL SUCCESS Eva Stening[1], Jonas Persson[1], Johan Wikström[2], Hedvig Söderlund[1]; [1]Uppsala University, [2]Uppsala University Hospital — Episodic memory is widely known to depend on the hippocampus, with especially the left hippocampus being implicated in verbal memory and retrieval. More recent research suggests that also the precuneus might be involved in episodic memory processing in general and episodic retrieval in particular. Being important for mental imagery, it may, together with the hippocampus, be part of an episodic memory retrieval network, enhancing memory detail. It is unclear, however, whether the precuneus is differentially active as a function of the concreteness of the material, or engaged regardless of imaginability. To assess this, we had twenty-one participants (24.9±3.02) encode and retrieve a list of abstract and concrete words while being scanned with fMRI. During encoding, participants categorized words as either concrete or abstract, and thereafter took a yes/no recognition test. During recognition of previously presented words (hits), those previously categorized as concrete showed increased activity in the left anterior hippocampus and the bilateral precuneus compared to those categorized as abstract. This was not due to better recollection, as words from both categories were equally well recalled. Rejections of previously seen concrete words (misses) as compared to abstract misses activated only the left hippocampus, suggesting the hippocampus is engaged during the presentation of previously seen items, but the precuneus is specifically engaged during correct recognition of these items. Overall, these findings suggest a particular role for the precuneus in correct recollection of concrete words, which may be especially susceptible to mental imagery.

G89

THE EFFECTS OF CAFFEINE AND EXERCISE ON IMPLICIT AND EXPLICIT MEMORY PERFORMANCE IN YOUNGER ADULTS: AN INVESTIGATION OF PHYSIOLOGICAL AROUSAL Timothy Buckley[1], Stephanie Sherman[2], Elsa Baena[1], Lee Ryan[1]; [1]University of Arizona, [2]University of Texas at Austin — Memory performance is best during an individual's optimal time-of-day, when physiological arousal is naturally highest, and decreases significantly during the non-optimal time-of-day when arousal declines. Previous research suggests that the time-of-day at which a memory task is completed may contribute to age-related disparities in memory performance. Ryan et al. (2002) found that this deficit could be eliminated in older adults by administering caffeine during their non-optimal time-of-day, the late afternoon. It remains unclear whether the same enhancement in memory would be seen in younger adults during their non-optimal time-of-day, early morning. Experiment 1 examined whether caffeine enhanced memory in the early morning. Thirty minutes after consuming a cup of coffee (caffeinated or decaffeinated), participants completed implicit explicit versions of a word-stem completion task. Young adults who consumed caffeinated coffee demonstrated significant improvements in explicit memory, but not implicit memory. Experiment 2 examined whether exercise would also ameliorate time-of-day deficits. Participants complete 15 minutes of either cardiovascular exercise or gentle stretching. Heart rates were taken throughout the experiment to measure physiological arousal. While exercise increased physiological arousal, exercise had no effect on either explicit or implicit memory. Taken together, these results suggest a unique mechanism for caffeine-induced arousal that compensates for time-of-day memory deficits. These findings have real-world application for classroom settings where students are expected to perform optimally during early morning testing sessions.

G90

AGING'S IMPACT ON THE NEURAL CORRELATES OF MENTAL REPLAY Marie St-Laurent[1], Bradley R. Buchsbaum[1,2]; [1]Rotman Research Institute at Baycrest, [2]Department of Psychology, University of Toronto — Recent work indicates that aging can reduce the specificity of brain activity patterns elicited by a variety of cognitive states. In the current study, we investigated how aging affects the neural specificity of mental replay, the act of conjuring up vivid stimuli in one's mind from memory. We used functional magnetic resonance imaging (fMRI) to quantify brain activity in young and older adults as they viewed short videos, and mentally replayed them. We used a set of 11 videos, each of which was viewed and recalled multiple times. Overall brain activity elicited by the viewing condition did not differ between age groups. During mental replay, young adults suppressed activity in the auditory cortex to a greater extent than older adults; no other brain regions showed significant age differences in activation levels. We then performed a multivariate searchlight analysis to identify brain regions whose activity showed the highest correlation between encoding and recall. High correlations indicated the reactivation of stimulus-specific patterns of activity during mental replay. Comparisons between patterns of correlations in young and older adults revealed higher correlations in cortical regions involved in visual, spatial, somatosensory and auditory processing in young adults. Although the univariate analysis did not reveal age differences in activity levels among these perceptual cortical regions, the searchlight analysis indicates reduced cortical reinstatement in the seniors. Our results are consistent with evidence that the specificity of memory's neural signature declines with old age.

G91

REPRESENTATIONAL SIMILARITY IN CA3/DG TRACKS CHANGES IN SPATIAL CONTEXT Jared Stokes[1], Arne Ekstrom; [1]University of California - Davis — While the hippocampus plays a role in processing the spatial aspects of our environment, the exact role of different subregions within the hippocampus in this process remains unclear. Based on previous rodent studies suggesting that CA3 is particularly sensitive to environmental changes compared to CA1, we hypothesized that CA3 would differentiate small changes in spatial context compared to CA1. To address this, participants viewed a series of randomized video clips taken from distinct virtual cities. Each of the four cities involved a parametric change in spatial geometry; all four cities though involved the same buildings. While viewing video clips of the different cities, participants indicated whether the video was taken from the same or different city as the preceding video. Participants underwent high-resolution structural (.4 X .4 X 2mm3) and fMRI (1.6X1.6X2mm3) during the task in order to discriminate hippocampal subfields. To evaluate changes in underlying representations of spatial context, we utilized representation similarity (RS) analyses to assess information conveyed through subfield specific activation patterns. We found significantly lower RS scores for correctly differentiated dissimilar compared to the identical cities, an effect that was significant in CA3/DG ($t(10)=2.24, P<.05$) but not CA1. Additionally, we created a distance score that assessed the rate of RS change as a function of environmental geometry; changes in RS in CA3/DG but not CA1 correlated negatively with environment change ($T(10=-5.64, P<.001$). Our results support the idea that CA3/DG plays a specific role in sensitivity to changes in spatial context, possibly contributing to pattern separation.

G92

DOPAMINERGIC MODULATION OF REWARD-MOTIVATED MEMORY Elizabeth Sumner[1], Kristin Duffy[1], R. Alison Adcock[1]; [1]Duke University — A fundamental question about the selectivity of episodic memory is how neural states like motivation influence memory encoding. Our previous fMRI study using the monetary incentive encoding (MIE) task provided early support for the hypothesis that motivation shapes memory via the effects of dopamine on encoding in the hippocampal memory system. The MIE task incorporates high and low value reward cues into an intentional memory-encoding paradigm, allowing the demonstration of an encoding

enhancement for scenes preceded by high-value cues. Coactivation of the ventral tegmental area and hippocampus occurring after these cues predicted lasting episodic memory formation. This finding, together with the convergence of animal data highlighting dopaminergic enhancement of hippocampus-dependent memory, suggests a role for dopaminergic neurotransmission in the modulation of reward-motivated episodic memory in humans. To further investigate this potential role, we tested the effects of the dopamine precursor levodopa (L-DOPA) and placebo on motivated episodic memory encoding in a double-blind crossover study. Participants completed the MIE task after administration of L-DOPA or placebo and returned the following week to complete the task with the other agent. Results revealed an enhancement of the motivated memory effect with L-DOPA. Consistent with literature on dopamine in working memory tasks, there was an interaction with baseline performance: poor baseline performers (by median split) showed significant overall encoding enhancements, and this overall enhancement was driven by enhancements for high-value trials. Together these results suggest that increased dopamine levels selectively enhance memory for valuable information in individuals who would most benefit from memory enhancement.

G93

REWARD-MOTIVATED ENHANCEMENT OF PATTERN SEPARATION IN RECOGNITION MEMORY Nanthia Suthana[1], Nicole Yap[1], Wesley Wong[1], Barbara Knowlton[1]; [1]Department of Psychology, University of California, Los Angeles — The hippocampus may use a mechanism of pattern separation to distinguish overlapping memory representations. We investigated whether pattern separation performance is affected by reward motivation, or if reward generally enhances recognition memory. Thirteen participants learned photographs (targets) of faces in 3 blocks. Half of the targets were cued with a high ($1.00), or a low ($0.05) monetary value, and subjects would be able to earn the corresponding amount by subsequently recognizing these items. Targets varied in face direction (0 degrees, and 45 degrees left or right). For every target learned, a similar (view angle changed by 45 degrees) photograph of the same face (lure) and a completely new face (foil) were presented during recognition. During recognition, subjects determined whether photographs were old (targets) or new (lures and foils). Subjects were penalized $0.15 for false alarms. Performance was measured by calculating the pattern separation bias score, which subtracts subjects' false alarm rate to foils from correct rejection rate to lures. In addition, we calculated a familiarity score (percent hits across targets and lures). Pattern separation bias scores were significantly higher during blocks 2 and 3 for high vs. low value items ($p<0.05$). However, there was no difference in performance measured by the familiarity score for high and low value targets (p=n.s.). Overall, our results show that the ability to discriminate between highly similar instances in memory can be influenced by reward. Because the effects of reward developed across blocks, subjects appear to learn to encode distinctive memory representations with practice.

G94

DIFFERENTIAL MODULATION OF POST-ENCODING RESTING CORRELATIONS FOLLOWING ENCODING OF NEUTRAL AND EMOTIONAL COMPLEX SCENES Arielle Tambini[1], Ulrike Rimmele[1], Eyal Bar-David[1], Elizabeth Phelps[1,2], Lila Davachi[1]; [1]New York University, [2]Nathan Kline Institute — Long-term memory storage is thought to be mediated by off-line hippocampal-cortical and cortico-cortical interactions. Numerous rodent studies provide evidence for coordinated activity across large-scale networks during off-line periods. In humans, we and others have provided evidence for enhanced connectivity during post-encoding rest periods that was related to memory for pre-rest experiences. In the present study, we asked whether post-encoding connectivity is enhanced following exposure to emotional stimuli, a factor known to enhance memory encoding and consolidation processes. To this end, we collected fMRI data while subjects rated the complexity of neutral and emotional scenes during separate scans and during pre- and post- task rest scans. The order of the emotional and neutral scans was counterbalanced across subjects. Subjects' memory for complex scenes was queried in a surprise memory test. Interestingly, the typical enhancement in emotional vs. neutral memory was found for subjects that encoded neutral scenes before emotional scenes, but was not seen when neutral scenes were encoded after emotional scenes. Follow-up analyses suggest that neutral scene encoding may be influenced by a carry-over of heightened arousal from emotional encoding when emotional encoding precedes neutral encoding. In the fMRI rest data, we replicated our prior work finding enhanced correlations between regions engaged during encoding during post-neutral-encoding rest. Furthermore, we found that post-encoding resting connectivity within distinct hippocampal and amygdala networks was related to subjects' later neutral and emotional memory, respectively. These results suggest that emotional and neutral memory may be mediated by distinct patterns of connectivity during post-encoding rest periods.

G95

THE HIPPOCAMPUS IS SENSITIVE TO THE DISJUNCTION BETWEEN ITEM AND CONTEXT REPETITIONS Preston P Thakral[1], Michael D Rugg[1]; [1]Center for Vital Longevity and School of Behavioral and Brain Sciences, University of Texas, Dallas — Previous fMRI studies of continuous recognition memory have reported that new items elicit greater hippocampal activity than old (repeated) items (i.e., hippocampal 'novelty effects'). The current fMRI study was conducted to assess whether these effects are modulated by the context with which a test item is associated. We employed a continuous recognition paradigm where, within a single list, new and old items (words) and new and old contexts (objects) were intertwined. Each trial was comprised of a presentation of a word-object pair. Words were repeated after between 2 and 31 intervening items (with a mean lag of 15 items). The repeated words were paired with either the same object as on their first presentation (old-old), a different but previously presented object (old-old') or a new object (old-new). The task was simply to judge whether each word was old or new. Behaviorally, accuracy was higher for old-old trials than for old-old' or old-new trials, whereas accuracy between the latter two trial types did not significantly differ. Thus, subjects successfully encoded word-object associations. Greater hippocampal activity was evident for old-new trials relative to all other trial types, including 'new-new' trials (initial presentations). These findings suggest that the hippocampus is sensitive not necessarily to the absolute novelty of a stimulus event, but rather to disjunctions in the novelty of the components of an event.

G96

WHAT COUNTS AS 'REST'?: LOW–FREQUENCY CORRELATIONS WITHIN THE MEDIAL TEMPORAL LOBE DURING AN UNRELATED TASK PREDICT MEMORY Alexa Tompary[1], Katherine Duncan[2], Lila Davachi[1]; [1]New York University, [2]Columbia University — Previous investigations of resting connectivity have shown that low frequency correlations within the medial temporal lobe (MTL) can predict individual differences in performance on standardized memory tasks (Wig et al., 2008). However, it is unclear whether MTL correlations during an unrelated cognitive task, where the MTL may act as if at rest, are also related to memory performance. We used hi-resolution fMRI to investigate whether MTL connectivity during a math task predicts associative memory for object-pairs presented in a separate block. Subjects first completed a 'baseline' math task, and then performed 4 runs comprised of blocks of encoding, more math, and retrieval. During the encoding block, subjects were asked to form vivid mental images of pairs of objects. They then solved a block of math problems, and then performed a cued recall task for the object associations. Long-term item and associative memory was also tested after a 24-hr delay. Preliminary results show that individual differences in connectivity between parahippocampal cortex and hippocampal subregions during the baseline math task predict long-term item memory, while connectivity between CA3 and MTL cortical areas predicts immediate associative memory. Given that recent work has provided evidence for enhanced resting connectivity after learning (Albert et al., 2009), and shown that post-encoding resting connectivity predicts memory (Tambini and Davachi, 2010), further analysis will investigate how changes in hippocampal-cortical connectivity during post-encoding math predicts memory. Representation similarity analysis will also be used to characterize the activity of MTL regions as they relate to memory.

G97

ASSESSING THE TIMING OF MEMORY REACTIVATION USING MEG Shannon Tubridy[1], Aaron Apple[1], Lila Davachi[1,2]; [1]Dept of Psychology, New York University, [2]Center for Neural Science, New York University — Retrieval of episodic associations is hypothesized to be supported by the hippocampally mediated reactivation of information processed in content-specific

cortical regions. Accumulating fMRI and neurophysiological data indicate a role for the hippocampus during episodic retrieval and neuroimaging studies have shown cortical responses consistent with the reactivation of specific representations. However, the temporal resolution of fMRI does not allow specification of the within trial temporal dynamics of responses in hippocampus, medial temporal lobe, and other cortical regions. Here, we leverage the temporal resolution of magnetoencephalography (MEG) to explore the timing of content-specific reactivation signals and their relationship to medial temporal lobe memory mnemonic responses. During MEG recording, participants learn and are tested on a series of word-picture and word-sound associations. During retrieval trials, participants are presented with a word and asked to report the presentation modality associated with its prior encounter. Participants learned the associations, with behavioral memory performance well above chance on retrieval trials. MEG data identify expected differences during encoding of sound relative to picture association trials. Differences in the signal topography are also observed during retrieval trials for which the presented stimuli (words) are matched but the retrieved association differs (sound or picture), indicative of content-specific activity during associative retrieval. The timing of these cortical signal differences will be related to memory signals in the MTL to address predictions of standard models of episodic memory retrieval.

G98

DISSOCIATING MEMORY PROCESSES BY THEIR DIFFERENCES IN NEURAL STABILITY

Benjamin O. Turner[1], Christa-Lynn Donovan[1], Michael B. Miller[1]; [1]University of California, Santa Barbara — Recently, the issue of reliability in fMRI (e.g., Bennett & Miller, 2010; McGonigle, 2012) has gained substantial attention. However, this work has generally focused on fMRI methodology, rather than on asking any particular cognitive neuroscientific question. Although it has been observed that reliability varies across tasks, there has been little interest in asking if we can learn anything meaningful about the underlying processes themselves by looking at the reliability of their concomitant activity patterns. Here, using a rich data set with repeated measurements within individuals across a year, including encoding, retrieval, and resting state scans for each session, we investigate the stability of activity accompanying various processes in a recognition memory task. We find systematic differences in intra-subject stability across these processes, even after accounting for a variety of other nuisance variables. Moreover, we demonstrate that the relationship between behavioral stability (using measures such as reported strategy or response bias) and activity-pattern stability varies across processes. These results support the assumption that performance during a recognition memory task reflects the operation of multiple distinct cognitive processes. They also shed light on the influence of factors including mood and resting state activity on such processes, which in turn informs our theoretical understanding of the processes in a manner distinct from the mapping of functions to regions or networks (often followed by reverse inference to draw theoretical conclusions) that is the end goal of much fMRI research. Funding statement: this research was supported by the Institute for Collaborative Biotechnologies under grant W911NF-09-D-0001.

G99

CONTEXT-DEPENDENT SAVINGS IN PROCEDURAL CATEGORIZATION

Matthew Crossley[1], Todd Maddox[2], Greg Ashby[3]; [1]University of California, Berkeley, [2]University of Texas, Austin, [3]University of California, Santa Barbara — Evidence suggests that information-integration (II) category learning recruits procedural memory and requires reinforcement learning mediated within the striatum. We have recently demonstrated savings in II category learning after several hundred trials of random feedback (Crossley, Maddox & Ashby, 2012, J. of Experimental Psychology: General). Specifically, we showed that while accuracy dropped to near chance during random feedback, it was fully recovered in fewer trials than was required for initial learning. Here, we show that the amount of savings (i.e., the number of trials required to recover from chance performance during random feedback) depends on environmental contextual cues. Each condition included an acquisition, intervention, and reacquisition phase, which occurred in different environmental contexts (i.e., with different background colors). Participants received veridical feedback during the acquisition and reacquisition phases, and they received random feedback during the intervention phase. We found the most savings when acquisition and reacquisition occurred in one context, and intervention occurred in a different context. On the other hand, we found the least savings when acquisition and intervention occurred in one context, and reacquisition occurred in a different context. To account for these results, we augmented our published model - which assumed that II category learning is instantiated via plasticity at cortico-striatal synapses and that this plasticity is gated by striatal cholinergic interneurons (i.e., the TANs) - by assuming that the input to the TANs (e.g., the centre-median and parafascicular nucleus of the thalamus) display context-specific firing (i.e., they fire only when specific features of the environment are present).

G100

LEARNING SKILLS IN DEVELOPMENTAL DYSLEXIA

Cristina Dye[1], Carolina Janacseck[2], Dezso Nemeth[2,3]; [1]Newcastle University, [2]University of Szeged, [3]University of Texas at Austin — Implicit learning underlies the acquisition of various critical skills, including reading. Previous research has reported that certain implicit learning tasks are impaired while others are spared in developmental dyslexia (e.g., Pothos & Kirk, 2004; Vicari et al. 2005; Howard et al. 2006; Russeler et al. 2006). In the present study, we used the Alternating Serial Reaction Time (ASRT) paradigm (Howard & Howard, 1997; Nemeth et al., 2010) to assess implicit probabilistic sequence learning in both children (18 dyslexic and 20 normally-developing 12-year-olds), and adults (15 dyslexic and 22 normal 20-year olds). The ANOVA revealed sequence-specific learning ($p < 0.001$), as well as general skill learning ($p < 0.001$). The two groups (dyslexic and control) did not differ either in overall sequence-specific or in general skill learning, regardless of the age group (all p's > 0.34). However, dyslexic children were generally slower compared to the normally-developing children ($p = 0.015$), though this difference disappeared in the adult groups ($p = 0.71$). Results are discussed with regard to previous findings. In particular, it is suggested that the mixed pattern of results of implicit sequence learning in dyslexia can be accounted for by the type of the sequence, the explicitness of the stimuli, and the nature of the task demands.

G101

EFFORT IN SKILL LEARNING: MORE PERSISTENT BENEFITS FOR CHILDREN

Amy Finn[1], Neil Albert[2], Carla L. Hudson Kam[3]; [1]Massachusetts Institute of Technology, [2]Spencer Foundation, [3]University of British Columbia — Relative to subcortical and cerebellar regions that are associated with skill learning, regions associated with effort and executive function (prefrontal and parietal regions), mature rather late (Lenroot & Giedd, 2006; Ostby et al., 2009). What is the impact of this ongoing maturation for skill learning? Does this change if effort is directed toward skill learning? To investigate this, we used a serial reaction time task in children and adults (19 adults and 10 children (aged 5-12)). Participants were directed to press a button corresponding to the location of an octopus. The octopus would appear randomly and in two distinct sequences: a learning-directed and performance-directed sequence. Participants were only aware of the learning-directed sequence; they were told that when the octopus turned a color (blue or purple), he we would go in the same locations and to try and learn his pattern. Subjects were not told about the performance-directed sequence in which the color of the octopus was the same as the random trials. We observed significant learning (as measured by reaction time relative to random trials) of both sequences in both children and adults. Early on, adults showed a significant learning advantage for the learning-directed sequence, which disappeared over time. In children a significant learning advantage for the learning-directed sequences also occurred initially but remained throughout the experiment. Despite ongoing maturation of effortful abilities, directing children's effort toward learning appears to provide a persistent benefit, as the performance-directed sequence is never learned as well as the learning-directed one.

G102

CROSS-MODAL EFFECTS ON IMPLICIT PERCEPTUAL-MOTOR SEQUENCE LEARNING

Kiersten Reznik[1], Kiley Virag[1], Jamie Connolly[1], Daniel J Sanchez[2], Paul J Reber[2], David Fraser[1]; [1]Chatham University, [2]Northwestern University — Repeated experience with environmental stimuli allows an individual to take behavioral advantage of structural regularities. This is often supported by implicit learning where performance improves despite the lack of any conscious (explicit) awareness of the underlying structure. Using the Serial Interception Sequence Learning (SISL) task, we

tested the effect of cross-modal visual and auditory perceptual stimuli on implicit and explicit learning of a covertly embedded repeating perceptual-motor sequence. In the SISL task, circular cues scroll vertically down four horizontal columns towards ring-shaped target zones. Participants attempt to press a corresponding key when a cue reaches its target zone. Participants were divided into sound (cross-modal) or non-sound (unimodal) groups. Group conditions were identical except that an auditory tone was delivered to the participants in the sound group when a cue reached the target zone. A different tone was used for each of the four target zones and they were delivered irrespective of response accuracy. All participants trained on a 12-item repeating sequence (240 total sequence performances, 80% repeating, 20% novel/non-repeating) and then performed tests of implicit and explicit sequence knowledge. The cross-modal condition failed to provide a significant benefit to implicit learning but this group showed significantly better recognition of the training sequence. This suggests that the addition of the sound modality may encourage the more rapid development of an explicit representation for the trained sequence but that the enhancement of explicit sequence knowledge during learning does not contribute to task performance.

G103

A COMPUTATIONAL COGNITIVE NEUROSCIENCE MODEL OF CRITERION LEARNING IN RULE-GUIDED BEHAVIOR

Sebastien Helie[1], Shawn W. Ell[2], J. Vincent Filoteo[3,4], Brian D. Glass[5], W. Todd Maddox[6]; [1]Purdue University, [2]University of Maine, [3]VA San Diego Healthcare System, [4]University of California, San Diego, [5]Queen Mary University of London, [6]University of Texas, Austin — Rule-guided behavior is essential in adapting to an ever changing environment. Rule learning involves at least two different cognitive operations, namely rule selection and criterion learning. Rule selection consists of selecting one or several stimulus-dimensions to be used to categorize the stimuli (e.g, categorize lines according to their length). Once a rule has been selected, criterion learning consists of defining how stimuli will be grouped using the selected dimension(s) (e.g., if the selected rule is line length, define 'long' and 'short'). Very little is known about the neuroscience of rule learning. Here we propose a biologically-realistic model of criterion learning and apply the model to category-learning data. In the new model, rule cells in lateral prefrontal cortex are used to modulate stimulus-response associations using pre-synaptic inhibition (Helie & Ashby, 2009). Each neuron is implemented using two differential equations to calculate cell voltage at every millisecond (Izhikevich, 2007). Axons delays and neurotransmitter release are modeled using an alpha-function (Ashby & Helie, 2011). Criterion learning is implemented using a new type of heterosynaptic error-driven Hebbian learning at GABAergic (i.e., inhibitory) synapses that uses feedback to drive cell activation above/below NMDA thresholds. The model is used to account for single-cell recordings in monkey rule-guided behavior, and human categorization data showing that participants are more impaired by a shift in rule-relevant dimensions than when both relevant and irrelevant dimensions are changed. Additional results and predictions made by the computational cognitive neuroscience model will also be discussed.

G104

TRAINING OF DIGITS-IMAGES ASSOCIATIONS ENHANCES SHORT-TERM MEMORY PERFORMANCES: A BEHAVIORAL AND ELECTROENCEPHALOGRAPHY (EEG) STUDY

Yixuan Ku[1], Ning Hao[1], Yijie Zhao[1], Yanqiu Wu[1], Di Zhao[1], Lijia Lin[1], Yi Hu[1]; [1]The Key Lab of Brain Functional Genomics (MOE and Shanghai), Institute of Cognitive Neuroscience, School of Psychology and Cognitive Science, East China Normal University, Shanghai, China — Previous studies have revealed that encoding memory materials into meaningful pre-stored units (e.g., images) played a key role in achieving the highest level of memory performance (Hu, et al., 2009; Hu & Ericsson, 2012). However, the effects of associations between digits and images on memory performance for average people, and the neural mechanisms underlying it, remained unknown. In current study, a group of ~12-year-old children was trained to use digits-images associations to help memorize digit sequences. Three memory experiments were performed twice, before and after the training. All behavioral performances improved significantly after the training. In experiment 1, the mean digit-memory-span of the subjects increased from 7.68 to 8.8. In experiment 2, subjects memorized a matrix of 4 X 5 1-digit numbers in one minute, the mean recalled digits increased from 11 to 16. In experiment 3, subjects memorized 80 20-digit sequences, and the average amount of correctly recalled digits increased significantly at ~2 after training. Meanwhile, two ERP components changed significantly after the training in experiment 3: FN400, ~400ms after the stimulus (presenting digits) onset, which indicated the familiarity of recognition memory, increased at frontal recording sites; P600, within the range of 500ms-700ms, which indicated the recollection of recognition memory and visual imagery, increased at parietal recording sites. Furthermore, the improvement of the amount of memorized digits correlated with the change of P600 amplitudes after training. To summarize, subjects' short-term digit memory performances could be enhanced by the training of digits-images associations, which help them recollecting the digits.

G105

TIME-VARYING THE ONSET OF TMS STIMULATION DURING CONCURRENT TMS-FMRI: A METHOD FOR HIGH TEMPORAL RESOLUTION EXPLORATIONS OF THE INTERACTIONS BETWEEN BRAIN REGIONS

Colin Hawco[1], Jorge Armony[1], Marcelo Berlim[1], Bruce Pike[2], Martin Lepage[1]; [1]Douglas Mental Health University Institute, McGill University, [2]Montreal Neurological Institute, McGill University — Concurrent transcranial magnetic stimulation and fMRI (TMS-fMRI) is a method which allows for a direct examination of the functional connectivity between brain regions. When a TMS pulse is fired, it modulates neural activity at the site of stimulation. This then has task-specific effects on activity in regions interacting with the site of stimulation. We performed a TMS-fMRI study in which we time-varied the onset of TMS pulses with regard to trial onset during a memory encoding task. Eighteen participants were presented with pairs of images, and instructed to memorize the pairs (an associative memory task). The images could either be semantically related or unrelated. Three pulses of TMS (ISI 100ms) were presented to the left dorsolateral prefrontal cortex (L-DLPFC) starting either 200ms, 600ms, or 1000ms into the trial. Time-varying the onset of TMS stimulation for different trials makes it possible to examine which regions are interacting with the stimulated region during discrete time windows. Time and condition (related or unrelated pairs) specific effects were observed in several regions. For example, TMS stimulation during the 200ms condition increased activity in the anterior insula and left supramarginal gyrus for related pairs only, while increased activity for related pairs in the 600ms condition was observed in the caudate nucleus and cerebellum, as well as the posterior regions of the left superior temporal gyrus (a region implicated in semantic processing) This suggests that time-varying TMS-fMRI can be used as a highly temporally specific measure of the interaction between brain regions.

G106

THE NEUROIMAGING INFORMATICS TOOLS AND RESOURCES CLEARINGHOUSE (NITRC)

David Kennedy[1], Arnaude Delorme[2], Randy Gollub[3], Nina Preuss[4], Christian Haselgrove[1]; [1]University of Massachusetts Medical School, [2]UCSD, [3]Harvard Medical School, [4]TCG, Inc. — We report on the use of a neuroimaging informatics knowledge environment for MR, PET/SPECT, CT, EEG/MEG, optical imaging and now clinical neuroinformatics and genetics/genomics imaging tools and resources entitled: Neuroimaging Informatics Tools and Resources Clearinghouse (NITRC). Initiated in October 2006 through the NIH Blueprint for Neuroscience Research, NITRC's mission is to foster a user-friendly knowledge environment for the neuroinformatics community. By continuing to identify existing software tools and resources valuable to this community, NITRC's goal is to support its researchers dedicated to enhancing, adopting, distributing, and contributing to the evolution of neuroimaging analysis tools and resources. Located on the web at www.nitrc.org, this site promotes software tools and resources, vocabularies, test data, and databases, thereby extending the impact of previously funded, neuroimaging informatics contributions to a broader community. NITRC gives researchers greater and more efficient access to the tools and resources they need, better categorizing and organizing existing tools and resources, facilitating interactions between researchers and developers, and promoting better use through enhanced documentation and tutorials—all while directing the most recent upgrades, forums, and updates. In Summary, NITRC facilitates access to an ever growing number of neuroinformatics tools and resources (540 to date). We encourage the community to continue providing design and content

feedback. Averaging monthly 17,000 visits and 82,000 pageviews, NITRC is now an established knowledge environment for the neuroimaging community where tools and resources are presented in a coherent and synergistic environment for the advancement of neuroinformatics research.

G107

CONNECTIVITY MEASURES FOR REAL-TIME FMRI NEUROFEEDBACK.

Yury Koush[1,2], Maria Joao Rosa[3], Fabien Robineau[1,4], Klaartje Heinen[3], Nikolaus Weiskopf[3], Patrik Vuilleumier[1,4], Dimitri van de Ville[1,2], Frank Scharnowski[1,2]; [1]University of Geneva, [2]Swiss Institute of Technology Lausanne, [3]University College London, [4]Geneva Neuroscience Center — Neurofeedback based on real-time fMRI is an emerging technique that can be used to train voluntary control of brain activity. Such brain training has been shown to lead to behavioral effects that are specific to the functional role of the targeted brain area. Recent studies even demonstrated therapeutic effects in specific patient populations. However, real-time fMRI-based neurofeedback so far was limited to training localized brain activity within a region of interest. Here, we overcome this limitation by presenting near real-time dynamic causal modeling in order to provide neurofeedback information based on connectivity between brain areas rather than activity within a brain area. Using a visual-spatial attention paradigm, we show that such a connectivity feedback signal can be used to train voluntary control over functional brain networks. Because most mental functions and most neurological disorders are associated with network activity rather than with activity within a single brain region, this novel method is an important methodological innovation in order to more specifically target such brain networks.

G108

THE CONFIGURABLE PIPELINE FOR THE ANALYSIS OF CONNECTOMES (C-PAC)

Daniel J. Lurie[1], Sharad Sikka[2,4], Ranjit Khanuja[1], Brian Cheung[1], Qingyang Li[1], Joshua T. Vogelstein[3], Chao-Gan Yan[2], Randal Burns[5], Stanley Colcombe[2], Maarten Mennes[6], Clare Kelly[7], Adriana Di Martino[4], F. Xavier Castellanos[2,4], Michael P. Milham[1,2], Cameron Craddock[1,2]; [1]Center for the Developing Brain, Child Mind Institute, New York, NY, [2]Nathan Kline Institute for Psychiatric Research, Orangeburg, NY, [3]Department of Mathematics and Statistics, Johns Hopkins University, [4]Phyllis Green and Randolph Cowen Institute for Pediatric Neuroscience, New York University Child Study Center, [5]Department of Computer Science, Johns Hopkins University, [6]Donders Institute for Brain, Cognition and Behavior, Radboud University Nijmegen, The Netherlands, [7]Phyllis Green and Randolph Cowen Institute for Pediatric Neuroscience, New York University Child Study Center — In order to successfully study the brain's functional architecture (connectome) and its behavioral associations, researchers need tools that facilitate reliable, replicable connectivity analysis. Here we introduce C-PAC, a configurable, open-source, automated processing pipeline for functional MRI data which builds upon a robust set of existing software packages including AFNI, FSL, and FreeSurfer. Users can rapidly orchestrate automated pre-processing and data analysis for multiple subjects, and can easily explore the impact of processing decisions on their findings by specifying multiple analysis pipelines to be run simultaneously. C-PAC can reliably process hundreds or thousands of subjects in a single run, and has been optimized for use on large data sets such as those made public by the International Neuroimaging Data-sharing Initiative (INDI). Preprocessing options include: motion correction, anatomical/functional coregistration, spatial normalization, spatial and temporal filtering, automatic tissue segmentation, slice-timing correction, nuisance signal removal, and volume censoring (motion "scrubbing"). C-PAC also includes a number of advanced analysis methods that facilitate detailed exploration of connectivity patterns, network structure, and brain-behavior relationships. Individual-level measures include: Seed-based Correlation Analysis, Independent Component Analysis, Amplitude of Low Frequency Fluctuations (ALFF) and Fractional ALFF, Regional Homogeneity, Voxel-Mirrored Homotopic Connectivity, and Network Centrality (Degree and Eigenvector). At the group level, C-PAC features Connectome-Wide Association Studies, Bootstrap Analysis of Stable Clusters, and integrated group statistics using FSL/FEAT. Additionally, users can easily extract preprocessed time-series data and connectivity matrices for analysis with other packages.

G109

A PRECISE PROBLEM IN MODEL-BASED FMRI.

Erik Peterson[1], Carol A Seger[2]; [1]University of Pittsburgh, [2]Colorado State University — In a series of Monte Carlo simulations, treating Rescorla–Wagner (RW) reinforcement learning models as a case study, we investigated the precision of model-based fMRI. The RW model is a popular computational model used to predict the magnitude of the BOLD signal in human subjects. We intuitively assumed the temporally variable, trial-level, RW predictions were sufficiently complex such that a predictor reaching significance (in a versus-baseline contrast) strongly suggests the model, or an otherwise very similar pattern of activity, is present in the BOLD data. Our simulations suggest this assumption is invalid. For example, when noisy BOLD timecourses were created based on simulated behavioral accuracy, and regressed onto the two RW predictors (value and reward prediction error) the predictors reached significance about 30% of the time, with over 15% of the 10,000 simulations at $p < 0.005$. Follow-up analyses suggest that this loss of expected precision is due the convolution of RW predictors with the haemodynamic response function (HRF). The HRF temporally blurs each model's predictions, causing otherwise dissimilar models to converge. As a result, we suggest that model-based analyses should be confined to a model comparison framework, focused on degree of fit between alternative hypothetical models. Model comparison approaches are immune to the specificity issue our simulations suggest is possible, even likely, using standard null hypothesis tests.

G110

META-ANALYSIS OF FUNCTIONAL READING SYSTEMS IN READERS WITH AND WITHOUT DYSLEXIA IN DIFFERENT LANGUAGES

Courtney Pollack[1], Joanna Christodoulou[2], Gigi Luk[1]; [1]Harvard University, [2]Massachusetts Institute of Technology — Functional brain activations in readers with and without dyslexia have been based on comparisons of relatively small homogenous groups of readers. While this approach has been informative in identifying signatures of brain activation in dyslexia and typical reading, it is unclear the extent to which findings are consistent across age and language. Using Activation Likelihood Estimation (ALE), two meta-analyses were conducted to investigate the difference in letter processing and word processing between readers with and without dyslexia, spanning all age groups and alphabetic languages. Out of 508 PUBMED results (search criteria: ((dyslexia) OR "reading difficulty") AND ((fMRI) OR (PET))), 13 were retained because they used fMRI or PET, were not case studies, did not apply to special populations (e.g., schizophrenics), used whole brain analysis, reported foci by reader groups, used visual tasks that involved letter or word processing, and only involved alphabetic languages. For letter processing tasks, typical readers showed reliable activation in the middle, inferior and superior frontal gyri, precentral gyrus, cingulate gyrus and thalamus. Readers with dyslexia recruited a smaller left hemisphere frontal region, but larger regions in the right inferior frontal gyrus. For word processing, typical readers showed more bilateral activation in the inferior frontal region while readers with dyslexia showed activation in left inferior and middle frontal regions, left lingual gyrus and cerebellum. The present study increased the heterogeneity of tasks, samples and languages to identify different brain regions supporting letter and word processing in readers with and without dyslexia.

G111

SPATIAL SMOOTHING AND THE FUNCTIONAL LOCALIZATION OF NUCLEUS ACCUMBENS ACTIVITY

Matthew Sacchet[1], Brian Knutson[1]; [1]Stanford University — Neuroimaging suggests that the subcortical striatum plays a critical role in human reward processing. Analysis of FMRI data requires several preprocessing steps, some of which entail tradeoffs. For instance, while spatial smoothing can enhance statistical power, it may also bias localization towards regions that contain more gray than white matter. In a meta-analysis and reanalysis of an existing dataset, we sought to determine whether spatial smoothing could systematically bias the spatial localization of foci related to reward anticipation in the nucleus accumbens (NAcc). An Activation Likelihood Estimate (ALE) meta-analysis revealed that peak ventral striatal ALE foci for studies that used smaller spatial smoothing kernels were more anterior than those identified for studies that used larger kernels. Additionally, subtraction analysis of findings for studies that used smaller versus larger smoothing kernels revealed a significant

cluster of differential activity in the left relatively anterior NAcc (Talairach coordinates: -10, 9, -1). A second meta-analysis revealed that larger smoothing kernels were correlated with more posterior localizations of NAcc activation foci ($p < 0.015$), but revealed no significant associations with other potentially relevant parameters. Finally, repeated analysis of a representative dataset processed at different smoothing kernels (i.e., 0-12 mm) also indicated that smoothing systematically yielded more posterior activation foci in the NAcc ($p < 0.005$). The current results suggest that spatial smoothing can systematically bias the spatial localization of striatal activity. These findings have implications both for historical interpretation of past findings related to reward processing and for the analysis of future studies.

G112

THE EVENT-RELATED POTENTIALS REFLECT THE PERCEPTIVE INTERACTION BETWEEN COLORFUL STIMULI AND RGB-MODULATED BACKGROUND ILLUMINATION

Kwangsub So[1], Myeonghoon Ryu[1], Hyensou Pak[2], Yeonhong Jung[2], Sejin Oh[1], Byoung-Kyong Min[1]; [1]Korea University, [2]LG Electronics Inc. — One's favorance of commercial products would be susceptible to the surrounding illumination condition. However, neurophysiological effects of background illumination on favorance-decision still remain unclear. Therefore, using EEG, we investigated the illumination effect on one's favorance of the RGB-modulated shirt-design with manipulating the RGB values of surrounding illumination. We examined the early dominant event-related potentials. All measures were analyzed with a repeated measures analysis of variance, which included three within-subjects factors labeled as 'illumination' (Red vs. Green vs. Blue vs. White), 'stimulus' (Red vs. Green vs. Blue vs. Gray), and 'favorance'. We observed a significant main effect of 'illumination' ($F(3,24)=4.464$, $p<0.05$) and an interaction effect ('illumination' x 'stimulus'; $F(9,72)=2.461$, $p<0.05$) in the frontal P220. The post-hoc test revealed that the frontal P220 amplitudes were significantly modulated by the RGB ratios of the surrounding illumination when the green ($F(3,27)=2.930$, $p=0.052$) and blue stimuli ($F(3,33)=3.064$, $p<0.05$) were presented. These observations indicate that illumination might be evaluated around the frontal region after 200ms post-stimulus. In addition, the parieto-occipital P270 amplitudes were significantly influenced by the background illumination ($F(3,24)=3.976$, $P<0.05$), and exhibited a three-way interaction ($F(9,72)=2.097$, $P<0.05$), revealing the 'illumination' main effect on the red ($F(3,30)=4.297$, $p<0.05$) and green stimuli ($F(3,30)=3.484$, $p<0.05$) particularly within the favorable design. Presumably, the evaluation of colorful design is considerably dependent on the perceptive interaction with its colorful surroundings. Such neurophysiological reflection of the surrounding illumination indicates the substantial involvement of cognitive processing of the background illumination in the assessment of product-favorance, which potentially affects the purchase intention.

G113

ACTION VIDEO GAMES AS A TOOL FOR IMPROVING VISION IN INDIVIDUALS WITH 'LAZY EYE'

Mor Nahum[1], Indu Vedamurthy[2], Jessica D. Bayliss[3], Daphne Bavelier[1,4], Dennis M. Levi[1]; [1]UC Berkeley, [2]University of Rochester, [3]Rochester Institute of Technology, [4]University of Geneva — Action video games have been shown to improve various aspects of normal vision, including contrast sensitivity, spatial visual acuity, crowding, and visual attention (see Green & Bavelier, 2006, for review). Thus, they may be useful as a therapeutic tool to enhance visual skills in clinical populations. The goal of the current study was to test the effectiveness of action video games as a treatment for amblyopia ('lazy eye'), a developmental visual impairment that is characterized by reduced visual acuity, and (sometimes partial) loss of stereo-vision. Sixteen adults with amblyopia were trained for 40 hours over the course of 10-20 weeks using a custom-dichoptic version of the 'Unreal Tournament' action game, in which the input to the non-amblyopic eye was degraded (Bayliss et al., 2012). Visual acuity (VA) and stereo-vision were assessed at regular intervals and following a two-month no-contact period. Crowding and reading speed were assessed pre- and post-training. We found that VA significantly improved by, on average, 41% ($p<.00001$). VA continued to improve up to at least 26 hours of game play, and plateaued between 26 and 40 hours (post-hoc: $p=.72$). Benefits were retained following two months of no-contact ($p<.0001$; $n=8$). Stereo vision improved for 8 of the subjects ($p<0.04$). Crowding ability improved following training ($p<.005$), and improvements in reading speed approached statistical significance ($p=.09$). We conclude that action video games can help improve vision for individuals with amblyopia. Our results further strengthen the therapeutic potential of action video games as a tool for improving vision in clinical populations.

G114

SPATIAL AND TEMPORAL CHARACTERISTICS OF NEURAL PATTERNS UNDERLYING FACE FAMILIARITY

Vaidehi Natu[1], Alice O'Toole[1]; [1]The University of Texas at Dallas — Humans can recognize familiar faces from challenging viewing conditions. The goal of this study was to investigate differences in brain response patterns as unfamiliar faces become visually familiar. Using a pattern-based classification approach, we examined spatial and temporal characteristics of brain activations across areas implicated in familiar face processing (FFA, OFA, lateral-occipital areas, precuneus, and parietal areas). First, a behavioral paradigm was developed to train participants to acquire high-, medium-, and low-degrees of familiarity, varying exposure levels to multiple views of faces. Recognition performance for naturalistic, whole-body images of the learned faces increased with increasing familiarity. Next, in an fMRI experiment, a new set of participants learned faces in the high, medium, and low familiarization conditions before the scan. Neural data were recorded while participants viewed the familiarized faces, unfamiliar faces, and scenes. The classifier discriminated brain responses to faces from all pairs of familiarity conditions (e.g., high vs. low). The best discrimination was found using a combination of face-selective (FFA-OFA), lateral-occipital, and parietal areas, suggesting coordination across areas for neural coding of familiarity. For FFA-OFA, we found increased neural separability as familiarity-level differences increased. A temporal pattern analysis of FFA-OFA showed that the neural responses to highly familiar vs. unfamiliar faces were discriminated earlier in time than lower familiarity conditions. Thus, larger differences in familiarity status were detectable earlier in the temporal sequence. Finally, neural differences underlying familiar face representations were based on patterns rather than magnitude differences, confirming that brain regions interact during the formation of face codes.

G115

SEX HORMONE INFLUENCES ON GLOBAL-LOCAL PROCESSING

Ourania Petasis[1], Belinda Pletzer[2], Larry Cahill[1]; [1]University of California, Irvine, [2]University of Salzburg, Austria — Few studies have looked at sex differences in the processing of global (e.g. gist) and local (e.g. detail) information. We investigated the effects of sex hormones on global-local processing in the Navon figure visual perception task. Participants included healthy, naturally cycling women in the follicular (low hormone) phase and luteal (high hormone) phase of the menstrual cycle. Subjects were presented with stimuli that consisted of large letters (global level) made up of small letters (local level) and were instructed to indicate whether or not they saw either of two target letters at a specified level (i.e. global level only; local level only). When instructed to attend to targets at the global level ("global targets"), women in the follicular phase reacted more slowly if the target was present at the local level than if no target was present at all (local-to-global interference; $p<0.001$), and this effect was also seen when they were instructed to attend to targets at the local level ("local targets") and the target was present at the global level (global-to-local interference; $p<0.001$). The mean reaction times of women in the follicular phase were comparable for global and local targets (no precedence effect). By contrast, women in the luteal phase responded significantly faster to global targets than to local targets (global precedence effect; $p<0.001$), though they did not show global-to-local or local-to-global interference. These findings suggest that levels of sex hormones can affect global-local processing. Further investigation of this experiment in men and women on hormonal contraception is ongoing.

G116

CHOLINERGIC ENHANCEMENT OF SINGLE SESSION PERCEPTUAL LEARNING IS LOCATION SPECIFIC

Matthew Peters[1], Elizabeth McDevitt[2], Summer Sheremata[1], Sara Mednick[2], Michael Silver[1]; [1]University of California, Berkeley, [2]University of California, Riverside — Perceptual learning is an essential feature of everyday life, allowing people to acquire expertise about the visual details of their environment. The neural processes underlying perceptual learning remain unclear. Previous studies demonstrate that the neurotransmitter acetylcholine (ACh) may modulate the

magnitude and specificity of perceptual learning. The goal of the current study was to determine whether administration of the acetylcholinesterase inhibitor donepezil increases the magnitude and specificity of perceptual learning on a texture discrimination task (TDT). We utilized a double-blind, placebo-controlled crossover design (N=8). On each experimental day, participants took a pill and were trained on the TDT. Perceptual learning was tested the following day. Subjects were also tested for long-term learning effects at the locations trained during donepezil and placebo administrations, as well as a third, untrained location. We found significant perceptual learning for the trained locations under both placebo and donepezil, and long-term perceptual learning was greater for the trained locations compared to the untrained location. There was a trend for greater long-term learning for the location trained under donepezil compared to placebo (p=0.08). These data suggest that increased ACh levels during training influence the magnitude and specificity of perceptual learning within a single training session.

G117

COARSE-TO-FINE CATEGORIZATION OF SCENES WITHIN THE PARAHIPPOCAMPAL PLACE AREA Carole Peyrin[1], Benoit Musel[1], Louise Kauffmann[1], Nathalie Guyader[2], Cédric Pichat[1], Stephen Ramanoël[1,3], Jean-François Le Bas[3], Alan Chauvin[1]; [1]LPNC, CNRS UMR5105, [2]GIPSA-lab, CNRS UMR5216, [3]GIN, INSERM U836 — Neurophysiological, behavioural and computational data indicate that visual analysis may start with a parallel extraction of different elementary attributes at different spatial frequencies, and follows a predominantly coarse-to-fine processing sequence (low spatial frequencies-LSF are extracted first, followed by high spatial frequencies-HSF). In the present fMRI study, we tested whether such processing occurs in scene-selective cortical regions. Fourteen participants were run on functional scans during which they performed a categorization task of indoor vs outdoor scenes, using dynamic scene stimuli. Dynamic scenes were composed of six spatial frequency-filtered images of the same scene, from LSF to HSF or from HSF to LSF, allowing us to mimic a coarse-to-fine (CtF) or the reverse fine-to-coarse (FtC) sequence. In order to determine scene selective regions, participants were run on a localizer scan during which they viewed scenes and faces and performed a □one-back□ task. Participants categorized CtF sequences faster than FtC sequences, supporting the idea that CtF processing is an advantageous strategy for scene categorization. Both CtF and FtC sequences (relative to fixation) activated occipito-temporal areas bilaterally, involving the parahippocampal gyrus. Data from the localizer showed that the contrast between scenes and faced elicited activation within the parahippocampal place area (PPA) and the retrosplenial cortex (RSC). These regions were defined as regions of interest (ROI) and ROIs□ activity was compared between CtF and FtC sequences. Only the PPA was more activated by the CtF than the FtC sequences. The present study suggests the coarse-to-fine strategy as a plausible modus operandi in the PPA.

G118

LOOMING EMOTIONAL FACES MODULATE THE MOTION AFTEREFFECT, BUT RECEDING FACES DO NOT. John Plass[1], Kevin Hartstein[1], Emmanuel Guzman-Martinez[1], Marcia Grabowecky[1], Satoru Suzuki[1]; [1]Northwestern University — Emotional faces help us to orient to behaviorally relevant information and are known to attract attention (e.g., Vuilleumier, Armony, Driver, & Dolan, 2001), but is this true under all circumstances? Looming visual stimuli are also known to attract attention compared to receding stimuli, presumably because looming stimuli are more behaviorally relevant than are receding stimuli (Franconeri & Simons, 2003). These results suggest that emotional faces should produce stronger modulation of visual processing when looming than when receding. We investigated this hypothesis using an indirect measure, a motion aftereffect. Adaptation to a moving stimulus generates a motion aftereffect, the apparent motion of a static stimulus in the direction opposite of that of the adapting stimulus. It is known that attention strengthens motion aftereffects (Huk, Russ, & Heeger, 2001). We compared motion aftereffects generated by looming and receding emotional (angry or happy) faces or neutral faces. Observers adapted to the moving stimulus for 20 sec., and then viewed a static test stimulus that was a scrambled composite of neutral and emotional face parts, and they reported the duration of the motion aftereffect. Motion aftereffects were longer after adaptation to emotional faces (happy or angry) than to neutral faces, but did not differ for receding faces. Our results suggest that emotional stimuli do not always modulate the motion aftereffect, perhaps due to less effective capture of attention by receding emotional faces.

G119

SPATIAL PROGRESSION OF PERCEPTUAL LEARNING IN VISUAL FEATURE CONJUNCTION SEARCH Eric Reavis[1], Sebastian Frank[1], Peter Tse[1]; [1]Dartmouth College — Search for conjunctions of visual features is typically slow and demanding. However, search efficiency can improve with practice. The specific characteristics of this type of learning and the mechanisms underlying it are poorly understood. To investigate the properties of conjunction search learning, we trained observers on a color-location conjunction search task with a variable number of distractors for ten days. Search time increased linearly as a function of the number of distractors. Participants searched a circular array of stimuli containing 4 concentric rings of up to 8 stimuli each while maintaining central fixation. Eye movements were monitored with an eye-tracker. Over the course of the training, search efficiency improved dramatically. Early in training, searches took longer the more distractors were presented, but, by the end of training, the number of distractors had little effect on search times. This increase in efficiency reflects perceptual learning of the different conjunctions of features defining the target and distractors. Here we demonstrate that the perceptual learning of feature conjunctions has a distinct spatial progression. Learning begins near the fovea and gradually spreads outward across the visual field as training proceeds. This spatial progression of learning offers clues about possible mechanisms whereby the brain might alter processing of the stimuli to enable more efficient detection of the search target. Specifically, the gradual spatial spread of the learning suggests that changes in processing within retinotopically organized brain areas may occur with learning, corroborating recent neuroimaging findings (Frank, Reavis, Tse, & Greenlee, Under Review).

G120

THE NEURAL MECHANISMS UNDERLYING PASSIVE AND ACTIVE PROCESSING OF NUMEROSITY Bert Reynvoet[1], Titia Gebuis[1]; [1]University of Leuven — To investigate the difference in passive viewing and active processing of numerosity, we presented participants arrays of dots and concurrently measured their EEG. In the first condition participants, naïve to the subject under study passively viewed the dot-arrays. In the second condition, the participants were informed about the changes in numerosity and had to actively process numerosity. Occasionally, the participants had to judge the number of dots presented. The visual properties of the dot-arrays were controlled and could therefore not explain possible numerosity related effects. The results revealed no numerosity related effects in the passive and active condition. Instead, when the data was reorganized according to visual cue size, strong effects of the visual cues were present at lateral occipital and parietal electrode sites. These electrode sites and time windows correspond to the ERP components often suggested to support numerosity processes. Furthermore, a larger central-parietal P3 amplitude effect was present for active versus passive numerosity processing. This result was not influenced by numerosity itself and could not be explained by response processing. It therefore appears to reflect general cognitive processes. Together, our results show that we do not (automatically) extract numerosity from a visual scene during passive or active processing of numerosity. Instead, these results are consistent with the notion that we rely on the continuous visual sensory properties of numerosity to make numerosity judgments.

G121

ILLUSORY ALIGNMENT ACROSS THE BLIND SPOT DISTORTS PERCEPTION OF NEARBY SPACE Nicholas Root[1], Azaadeh Goharzad[1], Vilayanur Ramachandran[1]; [1]University of California, San Diego — Lettvin (1976) observed that when offset vertical line segments are displayed such that the gap between them falls in the blind spot, an illusory alignment of the segments occurs: when they are perceptually completed across the blind spot, a single vertical line is perceived. It is an open question whether this illusory alignment affects nearby space: can other objects get "dragged along"? To investigate this question, we induced perceptual completion across the blind spot using either collinear or offset line segments. Dot probes, which were either collinear or offset, were presented near, but not on, the line seg-

ments. Subjects indicated whether or not they thought the perceived line was straight, and whether or not they thought the two dots were aligned. Despite being unable to distinguish between collinear and offset line segments (the line always appeared straight), subjects consistently made more errors judging the collinearity of the dots when the line segments were offset. Our results demonstrate that illusory alignment across the blind spot distorts the perception of nearby space, and confirms that the perceptually completed offset lines are perceived as collinear due a true illusory alignment rather than a lack of visual acuity (as previously suggested by Durgin et al 1995).

G122

IS THE CONTRALESIONAL HEMISPHERE HYPERACTIVATED IN NEGLECT? Silvia Savazzi[1], Sonia Mele[2], Debora Brignani[3], Chiara Bagattini[1]; [1]University of Verona and National Institute of Neuroscience, Italy, [2]University of Udine, Udine and IRCCS Eugenio Medea, San Vito al Tagliamento Pordenone, Italy, [3]Cognitive Neuroscience Unit, IRCCS "Centro S. Giovanni di Dio FBF", Brescia, Italy — The dysfunction underlying neglect syndrome is traditionally explained on the basis of "rivalry models" which postulate a pathological hyperactivation of the unaffected hemisphere due to the reduced inhibitory influences from the lesioned hemisphere. The aim of the present study is to test these models analyzing the effect that repetitive Trancranial Magnetic Stimulation (rTMS) exerts on the stimulated and contralateral hemispheres in the processing of visual stimuli. Specifically we aim at assessing the contribution of left and right parietal cortices in an impaired neglect-like functioning induced rTMS in healthy participants. 14 healthy volunteers performed a Line Bisection task and a simple detection task of unilateral checkerboards stimuli. Both tasks were performed either before and after 30 minutes of rTMS (1 Hz) over the right posterior parietal cortex. The EEG signal was continuously recorded throughout the experiment. The efficacy of rTMS in inducing neglect-like phenomena was confirmed by the Line Bisection task where participants showed a rightward deviation after rTMS, a performance comparable to that of neglect patients. Detection task results showed that the effect of rTMS was a lengthening of reaction times for both left and right visual stimuli and a reduction of the amplitude of P200 component registered both on left and right parietal sites. Therefore, our results did not show an hyperactivation of the left hemisphere due to the inhibition of the right hemisphere (as theorized by "rivalry models"). Conversely, the inhibition of the right parietal cortex induced a spreading of the inhibition to the homologous left hemisphere.

G123

GENERALIZABILITY OF LEARNING IN THE VISUAL PERIPHERY OF ADULT HUMANS Danielle Shaked[1], Aaron Levi[1], Anasuya Das[1], Krystel R. Huxlin[1]; [1]University of Rochester — Retraining vision may be an important therapeutic tool for people with vision loss and for the elderly, who can experience difficulties with peripheral discriminations, particularly under visually noisy conditions. Our goal here was to characterize the impact of training the visual periphery with noisy stimuli, and to assess the specificity of visual learning to training parameters related to the stimulus, visual field location, and trained eye. Outcome measures were contrast sensitivity for direction and orientation discrimination – two basic measures of low-level visual performance. Twelve naïve, healthy adults, between the ages of 19-42 were recruited. They were trained on a global direction discrimination task with noisy, random dot stimuli, and their contrast sensitivity was measured before and after training. Training and testing were performed monocularly, while fixation was enforced with an eye-tracker. All subjects demonstrated perceptual learning on the noisy, global direction discrimination task, and that learning transferred across the eyes and to different (untrained) visual field locations, suggesting that it occurred in higher level visual areas. Moreover, training significantly improved contrast sensitivity for direction discrimination of drifting gratings, especially at low spatial frequencies. While learning also transferred to orientation discrimination, it did so to a lesser extent, especially when stimuli were stationary. Thus, training subjects to discriminate noisy motion stimuli in their visual periphery improved visual performance across stimuli, eyes, and visual field locations. These results suggest that there are fundamental benefits of directed visual training for altering the efficacy of visual processing in normal, healthy adults.

G124

INVESTIGATING THE GENETIC BASIS OF LEARNING IN STRATEGIC GAMES: A GENE SET ANALYSIS Eric Set[1], Lusha Zhu[2], Songfa Zhong[3], Daniel Houser[4], Richard Ebstein[3], Soohong Chew[3], Ming Hsu[5]; [1]University of Illinois at Urbana-Champaign, [2]Virginia Tech Carilion Research Institute, [3]National University of Singapore, [4]George Mason University, [5]University of California, Berkeley — Decision-making in the presence of other competitive intelligent agents requires individuals to anticipate and respond to actions of others, in addition to learning about the rewards and punishments available in the environment. There is now substantial evidence that dopamine and frontostriatal circuits are critically involved in such strategic behavior. Our previous neuroimaging data suggest medial prefrontal cortices and the striatum underlie dissociable systems involved in strategic learning. Here we study the impact of variations in genes that differentially impact striatal and prefrontal dopamine function. Using a well-established model of strategic learning, we studied the behavior of 217 individuals in a repeated competitive economic game. To incorporate genetic information, we used principle component analysis to transform SNPs in each gene in the dopaminergic pathway to eigenSNPs. Unlike SNP-level analysis, this procedure retains more of the genetic variation available for analysis, while remaining computationally tractable. We found that variations in the COMT gene, which preferentially modulates prefrontal dopamine degradation, and to a lesser extent, MAO, influences behavioral weighting between belief and reinforcement learning. In contrast, we found that DRD2 and DAT, which differentially affect striatal dopamine functioning, influenced discounting of past experiences. Statistical significance was assessed through both permutation tests and comparison to the empirical distribution of other genes with similar statistical properties. Our results suggest that genes associated with dopamine functioning affects strategic learning in humans. Furthermore, compared to candidate gene and traditional GWAS methods, gene-set analysis is a promising means of combining greater power with existing knowledge of biological mechanisms.

G125

REWARD EXPECTATION AND PREDICTION ERROR IN HUMAN MEDIAL FRONTAL CORTEX: COMPUTATIONAL MODELING AND NEUROIMAGING. Massimo Silvetti[1,2], Elena Nuñez Castellar[1], Clémence Roger[3], Tom Verguts[1,2]; [1]Ghent University, Ghent, Belgium, [2]GIFMI (Ghent Institute for Functional and Metabolic Imaging), Ghent, Belgium, [3]NeuroSpin, Gif/Yvette, France — Various competing theories of human ACC function have been proposed, such as reward computation, error detection, conflict monitoring, error likelihood estimation, and estimation of reward volatility. In nonhuman primates, this area formulates reward expectations (value) and computes differences between reward expectations and the actual outcomes (prediction error). In previous computational and fMRI work, we presented a unifying Reinforcement Learning-based theory for ACC functions (Silvetti et al., 2011, 2012). This theory was instantiated in a biologically plausible computational model (Reward Value and Prediction Model (RVPM)). Here, we used the RVPM to generate predictions on the EEG time course of human ACC during a reinforcement learning task. Independent component analysis (ICA) was used to localize the signal source corresponding to the ACC. The RVPM correctly predicted the ACC activity during both reward expectation (value) and prediction-outcome comparison (prediction error). During the cue period of each trial, the ACC generated a negative slow wave whose amplitude was proportional to the probability of receiving a reward. During the outcome phase, the ACC activity, measured as error related negativity (ERN), correct related negativity (CRN) and feedback related negativity (FRN), was proportional to the prediction error magnitude. This suggests a role for human ACC in the online formulation of reward expectations by mean of prediction errors. More generally, it provides further corroboration to the reinforcement learning-based explanation of the ACC functions.

G126

DORSAL ANTERIOR ACTIVATES WHEN DISAGREEING ONLY WITH PERCEIVED EXPERT NOT PEER ADVICE Victoria Suen[1], Matthew R.G. Brown[1], Randall K. Morck[1], Peter H. Silverstone[1]; [1]University of Alberta — The brain mechanisms involved in decision-making, particularly obedience to various forms of advice, remain uncertain. We designed a task in which

individuals were presented with a choice to buy or not buy a stock, along with advice on which action to take. This advice was given by either an "external financial expert" or a by a non-financial "peer". In the first 1/3 of trials all advice was good, so participants were trained to follow it. During the rest of the trials the advice became increasingly poor until it was always wrong. We examined what brain changes occurred when individuals decided to disobey the advice. Forty-two adult subjects completed the task during a 60 minute fMRI session. No significant activation was found when participants were agreeing with the advice made by the "expert" (n=23) or with their "peer" (n=19). However, when choosing to "disobey" the "expert" marked activation was found in the dorsal anterior cingulate cortex. In contrast, participants who chose to "disobey" a "peer" showed no such activation. These results suggest that "disobedience" to a perceived expert, but not a peer, causes activation in the dorsal anterior cingulate cortex. This novel finding supports previous findings that this brain region is involved in error detection, but that activation also depends on the perceived authority of the advisor. These results may have relevance for understanding fluctuations in financial decision-making and the stock market, as well as for gambling behavior, particularly when individuals or groups follow "expert" advice.

G127

NEURAL CORRELATES OF EXPECTED RISKS AND RETURNS IN CHILDREN'S, ADOLESCENTS' AND ADULTS' RISKY CHOICE

Anna Van Duijvenvoorde[1,2], Hilde Huizenga[1], Leah Somerville[3], Alisa Powers[4], Wouter Weeda[1], Mauricio Delgado[5], B.J. Casey[4], Elke Weber[6], Figner Bernd[1,6,7]; [1]University of Amsterdam, The Netherlands, [2]Leiden University, The Netherlands, [3]Harvard University, U.S.A., [4]Weill Medical College of Cornell University, U.S.A., [5]Rutgers University, U.S.A., [6]Columbia University, U.S.A., [7]Radboud University, The Netherlands — Risk taking in adolescence has been explained by an imbalance between affective-motivational versus cognitive-control processes, caused by differential subcortical versus prefrontal maturational trajectories. So far, it is unknown which specific processes drive adolescent risk-taking and there is growing interest to examine the psychological and neural mechanisms of adolescent risk-taking. To investigate the processes that underlie age differences in risk taking, we decomposed risky choices into components of the risk-return model. In an fMRI-scanner, 72 participants (23 children, 25 adolescents, 24 adults) played a dynamic risky-choice task: the Columbia Card Task. For each decision a player faced--to either turn over a card or move on to the next round--we calculated the expected value (EV: gain-probability*gain amount + loss-probability*loss amount) and the expected risks (standard deviation of the values of possible choice outcomes). Results showed that greater EV increased the probability to take a card (people liked returns), whereas greater risk decreased this probability (people disliked risks). Age analyses showed a linear increase in EV-sensitivity, whereas risk-sensitivity increased steeply from childhood to adolescence. As expected, whole-brain analyses showed that greater EV led to increased activation in the ventromedial PFC (vmPFC) and the ventral striatum. Moreover, vmPFC activation increased linearly across age groups. Increasing risk led, as expected, to increased activation in thalamus, but also in the dorsal striatum. Thalamus activation increased linearly across age groups, whereas activation in the striatum peaked in adolescents. These results illustrate the different developmental trajectories of risk- and return-sensitivity underlying risky choice across adolescence.

G128

CHOICE AND REWARD PREDICTION IN MEDIAL PREFRONTAL CORTEX

Eliana Vassena[1,2], Ruth Krebs[1,2], Massimo Silvetti[1,2], Wim Fias[1,2], Tom Verguts[1,2]; [1]Ghent University, [2]Ghent Institute for Functional and Metabolic Imaging — Accurately predicting benefits is crucial for survival. Medial prefrontal cortex (mPFC) is a core structure for such predictions (Jessup et al., 2010, Silvetti et al., 2012). It has been suggested that the possibility to make a choice influences this prediction (Peterson et al., 2010) but this relationship has not been systematically investigated. A growing body of evidence outlines different functional profiles for subregions in the mPFC. Anterior cingulate cortex (ACC) is assigned a prominent role in action value estimation and prediction. In contrast, orbifrontal cortex (OFC) is thought to be primarily dedicated to reward representations (Rushworth et al., 2007). In order to disentangle the contrasting roles of these regions, as well as the potential interaction between choice and prediction, a gambling paradigm was implemented (adapted from Jessup et al., 2010). On each trial, participants were given two options, a safe small win and a gamble. The gamble could be risky with an unlikely but high payoff, or less risky but with lower pay-off. The possibility of choosing between the two options was manipulated between trials. Functional MRI data (at 3Tesla) were collected. In the analysis, feedback-related activation was systematically sampled along a dorso-ventral trajectory throughout the mPFC. The ACC region responded strongly and selectively to a positive unexpected outcome, irrespective of choice condition. In contrast, the OFC region was sensitive to positive outcomes only, irrespective of probability. In addition, OFC showed greater involvement in the no-choice condition. This study identifies complementary roles for different parts of mPFC in value computation.

G129

BOUNDARIES OF HUMAN SOCIALITY: THE CASE OF PSYCHOPATHY

Daniel Walsh[1], Eric Set[2], Edelyn Verona[2], Ming Hsu[1]; [1]University of California, Berkeley, [2]University of Illinois at Urbana-Champaign — Individuals with psychopathy generate a disproportionate share of societal damage, comprising 15 to 30% of correctional offenders in North America. Yet, despite these striking abnormalities, studies of social behavior have been relatively rare and have yielded mixed findings. Here we studied social preferences of a cohort of prison parolees evaluated for psychopathy using a battery of economic games. We found that psychopathic individuals exhibited a surprising degree of prosocial behavior. First, they were willing to sacrifice their own payoffs in order to increase the payoffs of another. In addition, they made consistent choices when adjudicating between the payoffs of two anonymous participants. Indeed, using a behavioral model from economics, a quantitative comparison of the psychopath group to matched controls found similar behavior in the pure distribution task, suggesting shared norms of distributional fairness. However, in the dictator game, the psychopathy group showed greater sensitivity to whether they were earning more than the other person. When ahead, the psychopathy group showed relatively greater generosity. Conversely, they were sharply less generous in situations when they were earning less than the other person. These findings are consistent with qualitative descriptions of narcissism in psychopaths. Taken together, we demonstrate that these tasks, along with behavior models of choice, elucidate differences in meaningful ways, which may provide a deeper understanding of psychopathy.

G130

THE DYNAMICS OF PROBABILITY DISTORTION IN DECISION UNDER RISK

Tze Yun Wang[1], Shih Wei Wu[1,2]; [1]Institute of Neuroscience, National Yang-Ming University, [2]Brain Research Center,National Yang-Ming University — In decision under risk, there is accumulating evidence suggesting that people distort information about probability and that the pattern of distortion tends to change depending on how probability information is revealed to the chooser. When probability is explicitly described to the subjects, subjects tend to overweight small probabilities but underweight moderate to large probabilities. In contrast, when information about probability is acquired through experience, the opposite pattern of distortion was observed. Despite recent advances, it remains little known how the pattern of distortion might dynamically change as people gather more information about probability through experience. We investigated the dynamics of probability distortion in a lottery decision task. In each trial, the subjects first sampled from a deck of cards with replacement that contained two possible fractal images. After the sampled outcome was revealed, each fractal image was assigned a monetary amount ($x or $0) and the subjects were asked to choose between the deck and a sure gain. We systematically manipulated the probability distribution over possible outcomes and the monetary gains. By having the subjects make a decision after collecting each sample point, we could estimate how the subjects distort probability when making decisions at different phases during the experiment. Preliminary results (n=8) suggested that the subjects' choice changed as a function of both the probability of reward and experience. In addition, there was an interaction between probability and experience on choice behavior, suggesting that the pattern of distortion dynamically changed as a function of experience.

G131

INDIVIDUAL DIFFERENCES IN P100 PREDICT COGNITIVE COMPONENTS OF GENERAL INTELLIGENCE AND CREATIVITY

Joseph Frantz[1], Michael Weisend[3], Jessica Carrasco[1], Ranee Flores[1], Kim Paulson[3], Sephira Ryman[1], Iris Toribio[1], Andrei Vakhtin[1], Rex Jung[1,2]; [1]University of New Mexico Department of Neurosurgery, [2]University of New Mexico Department of Psychology, [3]The Mind Research Network — Arthur Jensen's lifetime of research led to many theories on intelligence; one being that neural conduction velocity (NCV) could predict General intelligence (g). We hypothesized that, through the improved spatial resolution of MEG, we would detect relationships between the P100 primary visual response and aspects of cognition including intelligence. 30 subjects (16 female) performed 100 trials of an Inductive reasoning task while seated in an Elekta Neuromag Vector View 306 channel MEG. They also completed a broad battery of tests of intelligence (e.g., Wechsler Abbreviated Scale of Intelligence), personality (e.g., NEO-FFI), and creative cognition (e.g., Torrance) outside of the scanner. Temporal Signal space Separation (TSSS) and 100 Hz low pass filters were applied using Neuromag Maxfilter. Data was epoched into 10 second averages using MNE. A mask of each subject's bilateral occipital region was used to create an average activation time-course of peak amplitude and latency (75 – 145ms) estimates for right, left, and total occipital regions. Using a stepwise linear regression, controlling for sex, with amplitude and latency as the independent variables, and factor scores representing "g" and aspects of creative cognition (e.g., Implicit Reasoning, Torrance, processing speed) as dependent variables, we found that the maximum amplitude of the right occipital lobe predicted g (r2 = .20), and latency of the P100 response predicted creative cognition (r2 = .18). This supports Jensen's theory regarding conduction velocity and "g", and to our knowledge is the first time that correlation between the P100 and other cognitive measures has been described.

G132

CROSSING ZERO IN SIMPLE ARITHMETIC WITH POSITIVE AND NEGATIVE NUMBERS

Margaret M. Gullick[1,2], George Wolford[2]; [1]Northwestern University, [2]Dartmouth College — Recent work has begun to investigate the neural mechanisms involved in understanding arithmetic with negative numbers, and their similarity to those used with positives. Simple subtraction with negatives may particularly involve procedural arithmetic knowledge and problem transformations (e.g., "minus a negative is plus a positive"), unlike with positive numbers (Gullick & Wolford, in press). However, this report used only problems where operands and solutions had the same sign (e.g., -5 - -3 = -2), though subtraction with negatives can also involve solutions which cross zero (e.g., -3 - -5 = 2). These crossing problems may be more difficult, as they require a relatively continuous number line representation for expedient solution. We investigated whether these crossing subtraction problems were understood differently from their non-crossing counterparts, and whether there were differences in processing between operand sign conditions, using fMRI. Negative-operand subtraction problems did not demonstrate a significant effect of crossing, either behaviorally (in RT or accuracy) or neurally in any brain region. However, positive crossing problems were significantly slower and less accurate than non-crossing, and demonstrated increased activity in the left superior parietal lobule (including the intraparietal sulcus) and the bilateral inferior frontal gyrus, potentially reflecting increased use of calculation strategies due to difficulty. As such, changing from negative operands to a positive result does not seem to increase or decrease problem difficulty, but moving from the positive to the negative side of the number line (e.g., from generally easier to generally harder problems) may be particularly taxing.

G133

STRATEGIC TRAINING TO ENHANCE FRONTAL LOBE REASONING IN ADULT TRAUMATIC BRAIN INJURY

Stephanie Tuthill[1], Tiffani Jantz[1], Asha Vas[1], Molly Keebler[1], Carlos Marquez de la Plata[1], Nellie Evenson[1], Weikei Yu[1], Guido F. Schauer[1], Sandra B. Chapman[1], Daniel C. Krawczyk[1]; [1]Center for BrainHealth, University of Texas at Dallas — Traditional cognitive remediation following a traumatic brain injury falls short of addressing higher-order cognitive deficits that hinder optimal functioning in daily life. This randomized, controlled study compared the benefits of two intensive short-term training programs. Sixteen participants (10 male, 6 female), 20 to 63 years old (M = 39, SD = 15.95), completed 18 hours of group training over eight weeks. Of the 16 participants, 7 received advanced reasoning training, and 9 participated in an education based program. The advanced reasoning training taught cognitive strategies of strategic attention, integration, and innovation. The education based program informed participants about brain anatomy and effects of lifestyle on brain health. Both were equally engaging training programs that involved group activities, discussions, and home assignments. The advanced reasoning training group showed significant gains in the trained domain of abstract reasoning ($p < .05$). The benefits of the training extended to the untrained frontal domains of switching and verbal fluency ($p < .05$). Positive trends ($p < .10$) were also found on inhibition and working memory performance. Furthermore, participants in the advanced reasoning group reported significantly improved functional outcomes (FSE and GOS-E) and improved sense of well-being (BDI) ($p < .05$). In contrast, gains in the education based program were limited to verbal fluency and BDI ($p < .05$). This current study provides preliminary evidence that improvements in higher-order cognitive abilities of abstract reasoning have wide-ranging benefits, including improved cognitive performance and enhanced functional recovery.

G134

NEURAL UNDERPINNINGS OF REASONING: A CLOSER LOOK AT PARIETAL CORTEX

Elizabeth L. Johnson[1], Carter Wendelken[1], Silvia A. Bunge[1]; [1]University of California, Berkeley — Numerous studies have implicated a lateral frontoparietal network in reasoning, and we have shown that left parietal cortex and left lateral frontal pole are tightly coupled during performance of tasks that require reasoning about either visuospatial or semantic relations between stimuli (Wendelken et al., 2011a). Here, we sought to examine more closely the parietal contribution to relational reasoning. We measured task-related functional magnetic resonance imaging (fMRI) activation in a set of parietal regions of interest (ROIs) that had been defined previously on the basis of their patterns of structural and functional connectivity with other brain regions (Mars et al., 2011). Our fMRI data were drawn from 77 participants between ages 6-18 who had performed a relational matching task that requires 1st-order and 2nd-order relational reasoning (Wendelken et al., 2011b). We measured task-related activation in five inferior parietal lobule (IPL) and five superior parietal lobule/intraparietal sulcus (SPL/IPS) ROIs in each hemisphere, ordered 1-5 from anterior to posterior. A 2 Hemisphere (left, right) × 2 Lobule (IPL, SPL/IPS) × 5 ROI (anterior-to-posterior) × 2 Condition (1st-order, 2nd-order) ANOVA revealed three significant interactions (all $p<.02$): H×L×R, H×L×C, and H×R×C. Post hoc paired t-tests revealed that left mid-IPL was more strongly engaged by 2nd > 1st-order relations than other parietal regions. Notably, Mars et al. (2011) had identified this left mid-IPL region as being most tightly connected to the left lateral frontal pole. These results, along with lesion data (Baldo et al., 2010), indicate that left mid-IPL plays a central role in relational reasoning.

G135

SEMANTIC DISTANCE IN VERBAL ANALOGICAL REASONING MODULATES THE N400 EVENT-RELATED POTENTIAL

Matthew J. Kmiecik[1], Ryan J. Brisson[1], Robert G. Morrison[1]; [1]Loyola University Chicago — Computational accounts have traditionally focused on mapping and inference between structured representations as core components of analogical reasoning. This perspective has received support from neuroimaging studies showing rostrolateral prefrontal cortex, an area associated with the instantiation and integration of abstract relations, is engaged during analogy. However, recent connectionist models (Leech, Mareschal, & Cooper, 2008) have proposed that solving 4-term verbal analogies may be possible without structured representations, possibly via a mechanism involving analogical priming (Spellman, Holyoak, & Morrison, 2001). Green and colleagues (2010) have shown that more anterior regions of prefrontal cortex become more engaged with greater semantic distance between the source and target of verbal analogies suggesting that mapping becomes increasing important when the simple semantic similarity between terms becomes less. We have previously shown that the N400 event-related potential (ERP), a marker of semantic congruity, is differentially modulated by verbal analogy. Herein we present results using a new set of asymmetric verbal analogies characterized for semantic distance using Latent Semantic Analysis (LSA). Participants saw word pairs sequentially presented. After

the second pair of words they made an analogical comparison. Participants were more accurate and slightly faster for semantically near than far word pairs. Likewise, their N400 was more negative for far than near pairs. The magnitude of the N400 ERP correlated with participant performance for near, but not far analogies, providing converging evidence that the mechanism of analogical reasoning may shift from priming to mapping as analogies become more distant.

G136

SPATIOTEMPORAL CORRELATES OF PERCEPTUAL AND INFERENTIAL CAUSAL REASONING: AN EEG STUDY Ada Le[1], Kevin Dunbar[1,2]; [1]University of Toronto Scarborough, [2]University of Maryland — The classical cause-detector view of causal reasoning assumes that causality is distinct across two domains: a) perceptual causality, which is associated with the right parietal and frontal cortex; and b) inferential causality, which is associated with the frontal cortex. Alternatively, the causal-schema view assumes that all causality representations are due to nonmodular inferences, suggesting that perceptual and inferential causality share neural substrates. One way to discern between these models is to examine how the timing of neural activations may or may not differ for the two types of causality. The cause-detector view would predict different neural time courses: Perceptual causality would have early right parietal activity followed by later frontal activity, whereas inferential causality would only exhibit later frontal activity. In contrast, the causal-schema view would predict that perceptual and inferential causality have similar activity time courses. To test this, we recorded EEG while participants performed perceptual and inferential causality tasks. We found positive P300 components at parietal electrodes for both types of causality. Later at around 500 ms, inferential causality had increased left prefrontal positivity, whereas perceptual causality had increased right prefrontal positivity. These results are consistent with the causal-schema view such that both types of causality had similar neural time courses, and reveal new insight into the asymmetric frontal activity for the two types of causality perhaps due to differences in allocations of attentional resources.

G137

AN ERP INVESTIGATION OF TWO MODES OF REASONING Chaille Maddox[1], Karen Froud[2], John Black[3]; [1]Teachers College Columbia University (1,2,3) — We investigate neural correlates of representational systems underlying human reasoning: mental models (MM) and mental rules (MR). Semantic cognitive processes are postulated to be a property of model-based representational systems of reasoning (Gentner & Stevens, 1983; Johnson-Laird, 1983), whereas syntactic processes are posited to operate over symbol-based systems (Braine & O'Brien, 1998; Fodor, 1975; Plylshyn, 1984; Rips, 1994). The N400 and P600, long associated with semantic and syntactic processing in language (Kutas & Hillyard, 1980; Osterhout & Holcomb, 1992), were hypothesized to index cognitive processes underlying MM and MR reasoning, respectively. Participants were trained in MM or MR reasoning strategies (Schwartz & Black, 1996), and then viewed stimuli consisting of rotating gears. Their task was to use the learned reasoning paradigm to predict direction of gear turn. Predictions were either met (the "expected" condition) or violated (the "unexpected" condition). High-density EEG was concurrently recorded and ERPs were derived offline. Grand-averaged responses to expected and unexpected stimuli were compared for MM and MR. In the MM condition, N400 responses were observed, reflecting unexpectedness within image-specific representational networks (Federmeier & Kutas, 2001; McPherson & Holcomb, 1999; Sitnikova, et al., 2006). By comparison, in the MR condition, P600 was observed, reflecting a rule-governed representational system underlying this strategy (Friederici, Hahne, & Saddy, 2002; Hagoort, Brown & Osterhout, 1999; Kaan & Swaab, 2003; van Berkum, Brown, & Hagoort, 1999). ERP topographies differed from language-specific components, hypothesized to reflect execution of complex reasoning processes (Goel, 2009; Kroger, et al., 2002; Prabhakaran, et al., 1997).

G138

AN FMRI STUDY OF NEURO-COGNITIVE COMPONENTS OF HUMAN REASONING Ehsan Shokri Kojori[1], Carrie McAdams[2], Sunbola Ashimi[2], Daniel Krawczyk[1,2]; [1]The University of Texas at Dallas, [2]The University of Texas Southwestern Medical Center — Reasoning involves identifying abstract rules and relationships among elements of information to provide predictable representations of the environment. Reasoning performance is affected by a range of cognitive components, including basic abilities such as change detection (CD), rule verification (RV), and rule generation (RG). Several intelligence tests, such as Raven's Progressive Matrices (RPM), indicate considerable variability in reasoning performance among individuals. In capacity-based theories of reasoning, performance variation is attributed to variability in the number of features or rules that can be processed. However, little attention has been paid to the notion that CD, RV, and RG abilities can independently account for performance differences. We examined this hypothesis using three experimental conditions that additively recruited CD, RV, and RG components. Problems (48 per condition) consisted of three panels, each containing four geometrical shapes. In CD, participants searched for a shape-change across the panels. In RV, participants verified whether a shape-change followed one of four learned rules. In RG, participants inferred whether a shape-change followed a to-be-discovered rule. Hierarchical multiple linear regression analysis of performance measures (n=83) provided evidence that the CD, RV, and RG abilities each uniquely account for a portion of variance in RPM performance. Furthermore, fMRI analyses (n=21) revealed similar bilateral occipitoparietal and prefrontal networks when the RV and RG conditions were contrasted by the CD condition. We found increased involvement of left-inferior-frontal and left-orbital-frontal gyri when rule generation requirements were emphasized. Our study provides insight into how neural networks reconfigure to mediate distinct cognitive components affecting reasoning performance.

G139

CHANGES IN SELECTIVE NEURAL PROCESSING FOLLOWING STRATEGIC LEARNING TRAINING IN PATIENTS WITH TRAUMATIC BRAIN INJURY Fanpei Yang[1], Anthony Chen[2,3,4], Cody Andrews[5], Kamini Krishnan[5], Jerome Fuller[5], Jyh-Shing Jang[6], Sandra Chapman[5], Daniel Krawczyk[5,7]; [1]Department of Foreign Languages and Literature, National Tsing Hua University, Taiwan, [2]UC Berkeley, [3]VA Medical Center, [4]San Francisco and UCSF, [5]Center for Brain Health, University of Texas at Dallas, [6]Department of Computer Science, Tsing Hua University, Taiwan, [7]Department of Psychiatry, University of Texas Southwestern Medical Center at Dallas, Texas, USA — This study aimed to characterize cognitive and neural mechanisms responsive to cognitive rehabilitation in patients with traumatic brain injury (TBI). We hypothesized that prefrontal cortex (PFC) would be modulated by training in the goal-based process of strategic learning. We performed functional magnetic resonance imaging (fMRI) on eighteen patients with chronic TBI (>2 years after injury). Nine patients underwent strategic learning training sessions and nine patients (comparison group) were enrolled in educational sessions that did not involve strategic learning training. Patients in the experimental group showed significant improvements on neuropsychological tests measuring frontally-mediated functions of switching and working memory, as well as on measures of gist-based learning. Patients performed a task requiring them to attend to and hold in mind images depending on their goal relevance. We performed pattern analyses of fMRI multi-voxel data in addition to conventional univariate and region-of-interest analyses. The pattern classification analysis revealed that activation patterns in dorsolateral prefrontal cortex (DLPFC) and anterior cingulate cortex (ACC) were able to distinguish the experimental group's post-rehabilitation scans from the control group's post-session scans. Exploratory whole brain analyses also revealed increased activation in PFC for patients who participated in strategic learning training, but not those in the comparison group. These results showed increased modulatory control over neural processing, providing candidate neural mechanisms that may underlie cognitive improvements with strategic learning training.

Poster Session H

H1

THE EFFECT OF IMAGE FREQUENCY AND SALIENCE ON AVERAGED EVENT-RELATED BRAIN POTENTIALS AND SINGLE-TRIAL CLASSIFICATION

Anthony Ries[1], Amar Marathe[1], Jonathan Touryan[1], Victor Paul[1]; [1]US Army Research Laboratory, Human Research & Engineering Directorate, Aberdeen Proving Ground, MD — Research has shown that classification algorithms accurately discriminate infrequent target-related neural features associated with the P3 event-related potential (ERP) from the neural activity associated with frequent non-target distractors in a rapid serial visual presentation (RSVP) paradigm. Much of this research has used salient target images that have generally been the only infrequent stimulus presented. It is not known if image salience and additional infrequent non-target images affect the neural features and the accuracy of single-trial classification algorithms. To address this issue we used a RSVP paradigm containing three image classes: 1) frequent background distractors, 2) infrequent targets, and 3) infrequent non-targets. Infrequent images were either moving (high salience) or static (Low salience). Analysis focused on the neural activity surrounding the P3 using averaged ERPs as well as single-trial classification. At early P3 latencies infrequent images (targets and non-targets) induced similar neural activity, but were significantly different from the frequent distractors, suggesting attetional engagement to the infrequent images. Subsequent categorization of the image was reflected at later P300 latencies where all three image classes were significantly different from each other. This pattern was found across both image salience conditions. Single-trial classification accuracy was significantly better for high compared to low salience targets; however, many infrequent-non targets were misclassified as targets. The results show that both image frequency and salience significantly affect averaged ERPs as well as single-trial classification and suggest that image classification algorithms may select neural features more associated with target frequency and less with target specificity.

H2

RESTORATIVE EFFECTS OF NATURE IMAGE BREAKS ON MULTITASKING PERFORMANCE

Camarin Rolle[1], Meike Gugel[1], Taha Jabbar[1], Joaquin Anguera[1], Adam Gazzaley[1]; [1]University of California at San Francisco — Studies have shown that cognitive performance on directed attention tasks can be improved after viewing nature images. Here, across 3 different experiments, we investigated the effect of the following 3-min break types on multitasking performance relative to taking no break: images of nature, geometrical patterns, or a technology break (checking either email/texts messages). Experiment 1 compared multitasking performance following an unfilled break and a nature photography break: a benefit of nature was present beyond an unfilled rest period early in the experiment. Experiment 2 compared multitasking performance following a abstract pattern break and a nature image break: similar to Experiment 1, multitasking performance immediately after viewing nature images improved versus the abstract pattern break. In Experiment 3, to evaluate the impact of the break that so many of us actually take in today's society (email or text), we compared multitasking performance following a tech break and a nature photography break. While nature images showed a trend towards being better than tech break early in the experiment, a significant difference was evidenced later in the experiment. These findings indicate that viewing nature-based images can provide a restorative boost in performance, with this benefit emerging at different times dependant upon the break type contrasted against.

H3

TRANSIENT ATTENTION IN MARTIAL ARTS ATHLETES SKILLED VS. NOVICES. EVENT-RELATED POTENTIAL

Javier Sanchez-Lopez[1], Thalia Fernandez[1], Juan Felipe Silva-Pereyra[2], Juan Antonio Martinez-Mesa[3], Steven A. Hillyard[4]; [1]Instituto de Neurobiologia, Universidad Nacional Autonoma de Mexico, [2]Facultad de Estudios Superiores de Iztacala, Universidad Nacional Autonoma de Mexico, [3]Instituto de Medicina del Deporte de Cuba, [4]University of California San Diego — Different studies have found that sport practice produce changes on cognitive processes and brain activity. Event-related potentials (ERPs) studies on attention have found differences in terms of sport expertise. The aim of this study was to identify differences in behavioral performance and ERPs between martial arts athletes skilled and novices while performing a task of transient attention. Eleven skilled and ten novices martial arts athletes were involved in this study. Cue Continuous Performance Task was performed with three conditions: Target (target stimulus preceded by signal), non-Target (any stimulus except target and signal) and False Signal (any stimulus non-Target preceded by signal), and both behavioral and electrophysiological data were analyzed. Behavioral results showed no significant differences between groups, but electrophysiological data showed significant differences in Condition (Target and non-Target) x Group interaction that indicated larger amplitude of P100, P200 and P300 components and of later positivity (600 to 1000 ms) in novices athletes compared to skilled athletes. A similar effect occurred in the Condition (False Signal and non-Target) x Electrode x Group interaction, in which novices athletes showed higher amplitude of P100 component, and Condition x Group interaction in later positivity (600 to 800 ms) than skilled athletes. Amplitude maps of such effects showed a more posterior reduced activation of all components in skilled compared to novices. Results suggest a better cue facilitation and economical that is more efficient information process in skilled than novices, which may reflect a more efficient neural response during attention processes related to the sport expertise.

H4

CONSCIOUS ATTENTION MODULATES SUBCONSCIOUS PROCESSING OF VALENCED STIMULI

Anais Stenson[1], Gwen Frishkoff[2]; [1]Emory University, [2]Georgia State University — Prior work suggests that conscious attention to a task impacts subconscious stimulus processing. However, some argue that valenced stimuli cannot be attended without producing conscious awareness, and therefore deny the existence of unconscious emotions. The present study tests whether subconsciously processed, valenced primes can be selectively attended. Participants (N=37) saw pairs of negative and positive words, while completing word-classification task. The first word, a prime, was presented subconsciously (35 ms). The second word, a target, was consciously perceived. Participants classified these targets as upper or lower case in one block, and as negative or positive valence in the other. Prime-target pairs were either task-congruent or task-incongruent. For instance, the pair "peace-SILK" was task-congruent during the valence task, and task-incongruent during the case task. Participants saw the same 480 pairs (SOA=70ms) in each block. Attention-based priming effects were assessed with evoked-response potential (ERP) and behavioral measures. As predicted, case-congruency speeded response times and modulated the N170, an ERP associated with orthographic processing, only during the case task. Contrary to expectations, valence-congruency did not speed responses or modulate the N400, an ERP associated with semantic evaluation, during the valence task. However, valence-congruency did modulate ERPs at orbitofrontal and centro-parietal sites during the valence task. Both ERP and reaction time differences suggest that priming depended on prime-target task-congruity. These outcomes suggest that valenced primes were selectively attended according to task, thus supporting the claim that attention modulates subconscious processing of valenced stimuli.

H5

TRANSCRANIAL DIRECT CURRENT STIMULATION MODULATES WORKING MEMORY AND SUSTAINED ATTENTION AS A FUNCTION OF ATTENTION DEFICIT HYPERACTIVITY DISORDER SYMPTOMATOLOGY

Jaclyn Stephens[1], Marian Berryhill[1]; [1]University of Nevada, Reno — Neuroimaging data reveal under activity in the pre-supplementary motor area (pre-SMA) in people with attention deficit hyperactivity disorder (ADHD) during sustained attention (Stop-Signal, Go/No-Go) tasks (Mulligan et al., 2011). Additionally, these individuals have reduced short interval cortical inhibition (SICI) correlated with their ADHD symptoms (Gilbert et al., 2006). Furthermore, in healthy adults, recent findings

indicate that stimulating the pre-SMA with anodal (+ current) transcranial direct current stimulation (tDCS) improves sustained attention (Hsu et al., 2011). Here, we investigated whether anodal tDCS to the pre-SMA would provide a greater attentional benefit to those with more ADHD symptoms. First, participants completed the Adult ADHD Self-Report Scale (ASRS-v1.1) (Kessler et al., 2005). Low (<18) or high (>38) scorers received anodal and sham tDCS to the right pre-SMA. After either anodal or sham tDCS participants performed working memory (O-SPAN, visuospatial N-Back) and sustained attention (Go/ No-Go) tasks. There was an interaction between ADHD scores and tDCS condition. Unexpectedly, however, anodal tDCS improved performance on both sustain attention (Go/No-Go) and working memory (O-SPAN, visuospatial N-Back) tasks for the low ADHD group, but impaired performance for the high ADHD group. Methylphenidate, an ADHD medication, can have opposing effects in individuals with ADHD compared to healthy individuals (Moll, Heinrich, and Rothenberger, 2003). Therefore, it is plausible that anodal tDCS could be exerting opposing effects such that anodal tDCS further reduced SICI in the high ADHD group while enhancing SICI in the low ADHD group.

H6

AMYGDALA GUIDES BOTTOM-UP ATTENTION IN TYPICAL DEVELOPMENT BUT NOT IN AUTISM Vanessa Troiani[1,3], Robert Schultz[1,2,3]; [1]Department of Neuroscience, University of Pennsylvania, [2]Departments of Pediatrics & Psychiatry, University of Pennsylvania, [3]Center for Autism Research, Children's Hospital of Philadelphia — The amygdala is thought to guide attention towards motivationally-relevant stimuli, even suppressed from awareness (Whalen et al. 1998,2004; Troiani et al., in press). This type of attention might be impaired in autism, contributing to their poor social functioning and motivation (Chevallier et al., 2012). Using a novel fMRI paradigm combining continuous flash suppression and an orthogonal letter-detection task, we suppress fearful face and house stimuli from conscious awareness. We compared neural activation in 29 typically developing children (TDC) and 32 children with an autism spectrum disorder (ASD) to examine the integrity of bottom-up amygdala activation in ASD. In both TDCs & ASDs, the lateral geniculate nucleus (LGN) is more active for suppressed images compared to a no-stimulus control, indicating the stimuli have reached this portion of the visual processing pathway. In contrast, activation to the suppressed stimuli was decreased compared to the no stimulus control in early visual cortex (EVC), indicating suppression of the fearful faces and houses. TDCs activate the superior colliculus, thalamus, amygdala, and hippocampus in response to suppressed images. Additionally, we find a category-specific (fearful faces > houses) increase in amygdala connectivity with the right pulvinar and left inferior parietal cortex. Thus, TDCs activate the amygdala in response to objects presented outside of their conscious awareness and differentiate between objects based on an amygdala connectivity profile. We find no amygdala activation in response to suppressed stimuli in ASD, which indicates impaired bottom-up amygdala-guided attention and a disturbance of adaptive processing of visual categories even prior to awareness.

H7

TOP DOWN MODULATION OF THE PHASE OF ALPHA ACTIVITY Rosanne van Diepen[1,2], Mike Cohen[2], Damiaan Denys[1], Ali Mazaheri[1]; [1]Psychiatry Department, Academic Medical Center, Amsterdam, The Netherlands, [2]Psychology Department, University of Amsterdam, Amsterdam, The Netherlands — Previous research has shown that the phase of ongoing alpha (8-12Hz) oscillations can influence the perception of visual stimuli. In the current EEG study (256 EGI) we examined if it was possible to actively (i.e top-down) adjust the phase of alpha activity in order to facilitate or suppress stimulus processing. Specifically we looked at how cues signalling whether to attend to the visual or auditory modality of bimodal targets modulated pre-target alpha phase in the associated sensory cortices. We had two conditions 1) a rhythmic presentation of cues and targets which made it possible to predict target onset and 2) a random condition where target onset was not predictable. We found that in the rhythmic condition the phase-locking of alpha activity in auditory channels shortly prior to target onset was significantly stronger for cues signalling visual stimuli than cues signalling auditory. In the random condition where target onset was unpredictable we found no evidence for cue induced phase-adjustment of alpha activity. This suggests that there can be top-down modulation of the phase of alpha activity such that its inhibitory nature can be optimally exploited.

H8

INCREASED IMPACT OF SALIENCY IN ACTION VIDEO GAME PLAYERS: EVIDENCE FROM EYE MOVEMENTS. Wieske van Zoest[1], Benedetta Heimler[1], Francesco Pavani[1]; [1]Center for Mind/Brain Sciences (CIMeC), University of Trento — Enhanced visual performance in action video game players (AVGPs) has often been explained by improved top-down control over the allocation of visual attention compared to the non-gamers (NVGPs). To investigate when in time these differences in control between groups come about, the time-course of visual selection was investigated using an oculomotor additional singleton paradigm. It was predicted that the more efficient top-down strategies in AVGP would reduce the overall influence of early saliency-driven influences and that this control would appear earlier in time in AVGP than in NVGP. In the task, participants were instructed to make a saccadic eye movement to a unique orientation singleton. The target was presented in a display of homogenous nontargets and one additional orientation singleton that could be more, equally or less salient than the target. The results demonstrated that short-latency responses were driven by saliency in both groups; these eye movements were directed to the most salient element regardless of whether it was defined as a target or distractor. Long-latency eye movements were directed in line with the task instructions. AVGPs were overall faster than NVGPs in initiating a saccade. Strikingly, AVGPs revealed a significant greater impact of stimulus- saliency early in time and were less accurate later in time than NVGPs. The present results demonstrate that under certain circumstances AVGPs show enhanced stimulus-driven processing and an inability to implement more efficient top-down strategies.

H9

SEARCHING FOR SINGLE OR MULTIPLE EXEMPLARS AND CATEGORIES: ELECTROPHYSIOLOGICAL MARKERS OF CATEGORY-BASED ATTENTIONAL GUIDANCE Rachel Wu[1], Rebecca Nako[2], Gaia Scerif[3], Martin Eimer[2]; [1]University of Rochester, [2]Birkbeck, University of London, [3]University of Oxford — Visual search is often guided by top-down attentional templates that specify target-defining features. But search can also occur at the level of multiple objects or categories. With adults, we measured the N2pc component, an event-related potential (ERP) marker of attentional target selection in two visual search experiments where targets were defined as either one item (e.g., the letter C), multiple items (e.g., the letters C, F, and X), or categorically (e.g., any letter). Experiment 1 encouraged category-based selection by consistently presenting targets among distractors from a different category (e.g., numbers). Reaction times (RTs) were fastest and the N2pc largest during search for a single item, demonstrating that target selection is most efficient when it is guided by a feature-specific template. There were no RT and N2pc differences between the category-based search task and search for two or three items in Experiment 1, indicating that category-defined templates were used in all three tasks. In Experiment 2, a category-based search strategy was not available because letter targets were now presented among letter distractors. Search efficiency decreased as the number of candidate target letters increased, suggesting that within-category search was based on multiple templates for each target. Results demonstrate that category-based search can operate at early visual stages, and that it is more efficient than within-category search for multiple targets, but less efficient than feature-guided search.

H10

INDIVIDUALS WITH SELF-REPORTED ADHD SYMPTOMS HAVE A MERIT IN OBJECT-BASED ATTENTION: AN ERP STUDY IN A NON-CLINICAL POPULATION Yuji Yamada[1], Tetsuko Kasai[2], Harumitsu Murohashi[2]; [1]Graduate School of Education, Hokkaido University, [2]Faculty of Education, Hokkaido University — It has been shown that individuals with higher ADHD (attention-deficit/ hyperactivity disorder) symptoms have a decline in the ability to suppress task-irrelevant information. The present study examined whether the decline is associated with selective attention in early perceptual processes, by using event-related potential (ERP). We used an ERP paradigm of object-based attention with region commonality, in which the extent of competition across bilateral stimuli was manipulated (Yamada et al., CNS2012). ERPs were recorded from 24 normal (non-ADHD) participants whose ADHD symptoms were measured by Adult ADHD Self-Report Scale (ASRS). Stimuli consisted of two letters,

one in each hemifield, encircled by an oval (same-region condition) or two semiellipses aligned like Greek x-shape (different-region condition). Participants covertly attended to one hemifield while ignoring the other and detected an infrequent target letter at the attended hemifield. Participants with higher ASRS scores produced more false alarms. The N1 attention effect (160-205ms post stimulus, amplitude enhancement at occipito-temporal electrodes contralateral to attended visual fields) was decreased for the same-region condition in participants with higher ASRS score, only in the attend-left condition. Additionally, P1 amplitudes (80-130ms) were smaller over the left than right hemisphere in the higher ASRS participants. These results indicate that individuals with higher ADHD symptoms caused a greater object-based attention effect: attention obligatory spread over task-irrelevant stimuli that were involved in an object or a perceptual group. Such an effect may be associated with differences in hemispheric lateralization or transfer.

H11

TWO DISTINCT ATTENTION OR CONTROL EFFECTS RELATED TO DIVERGENT THINKING VERSUS CREATIVE ACHIEVEMENT. Darya Zabelina[1], Mark Beeman[1]; [1]Northwestern University — Real world creative achievement is thought to encompass creative potential as well as motivation or persistence. We report two different effects of attention or cognitive control that independently relate to two different measures of creativity. Our previous work demonstrated that people with high creative achievements are more likely to perseverate on a particular attentional level, which, in the real world, may encourage more persistent engagement with a creative endeavor. In the present study, 56 undergraduates completed two tests of creativity: one assessing divergent thinking, and the other assessing real world creative achievements. Subsequently, participants identified whether stimuli contained the target letter S or H within hierarchically constructed letters. Critically, 80% of the trials were preceded by a valid cue indicating at which level the target would appear (local or global), and 20% of the trials were preceded by an invalid cue. Participants scoring high on divergent thinking were not slowed by invalid cues compared to low divergent thinkers. This result demonstrates that high divergent thinkers' primary mode of attention may indeed be defocused, which aids them in detecting alternate foci (external stimuli or internal associations), represented here as a quick overcoming of an invalid cue. Together with our previous results, it appears possible to disentangle basic underlying cognitive processes, such as capture of attention, in creative achievers versus people with creative potential (as assessed by divergent thinking tasks). Result from these studies form the basis for future investigations of the neural correlates of attentional and cognitive control in creative individuals.

H12

ELUCIDATING THALAMO-CORTICAL FUNCTION THROUGH THE LENS OF PSYCHOPATHOLOGY: FOCUS ON SCHIZOPHRENIA AND BIPOLAR ILLNESS Alan Anticevic[1,2,3], Michael Cole[6], Grega Repovs[5], John Murray[7,9], Margaret Brumbaugh[4], Anderson Winkler[1,4,10], Aleksandar Savic[1,3,8], John Krystal[1,2,3], Godfrey Pearlson[1,4,7], David Glahn[1,4]; [1]Department of Psychiatry, Yale University School of Medicine, [2]NIAAA Center for the Translational Neuroscience of Alcoholism, [3]Abraham Ribicoff Research Facilities, Connecticut Mental Health Center, [4]Olin Neuropsychiatry Research Center, Institute of Living, Hartford Hospital, [5]Department of Psychology, University of Ljubljana, [6]Department of Psychology, Washington University in St. Louis, [7]Department of Neurobiology, Yale University, [8]University Psychiatric Hospital Vrapce, University of Zagreb, [9]Department of Physics, Yale University, [10]Oxford University, John Radcliffe Hospital — Understanding the function of large-scale distributed neural systems is critical for complete characterization of higher cognitive function. A fundamental aspect of large-scale brain organization across mammalian species are recurrent thalamo-cortico-striatal circuits. Its complex multi-nuclear structure enables the thalamus to serve as a nexus for parallel circuits through which diverse cortical and subcortical functions are integrated. Growing evidence implicates significant thalamo-cortical communication disturbances in schizophrenia on the bases of neuropathology, neuroanatomical and computational studies. Incomplete characterization of thalamic connectivity in schizophrenia limits our understanding of its relationship to symptoms and to diagnoses with shared clinical presentation, such as bipolar illness. Using resting-state fMRI, we characterized thalamic connectivity in 90 schizophrenia patients versus 90 matched controls via: i) subject-specific anatomically-defined thalamic nuclei; ii) anatomical and data-driven clustering to assay within-thalamus dysconnectivity; iii) machine learning to classify diagnostic membership via thalamic connectivity for schizophrenia and for 47 bipolar patients and 47 matched controls. Schizophrenia analyses revealed functionally related disturbances: over-connectivity with all bilateral sensory cortices, which predicted schizophrenia symptoms, but thalamic under-connectivity with prefrontal-cerebellar regions relative to controls, possibly reflective of both sensory gating and top-down control disturbances. Clustering revealed that this dysconnectivity was most prominent for thalamic nuclei densely connected with prefrontal cortex. Classification and cross-diagnostic results suggest thalamic dysconnectivity may be a marker for neural disturbances across schizophrenia and bipolar illness. Collectively, these findings, using large clinical neuroimaging samples, inform our basic understanding of large-scale thalamo-cortical systems and provide vital clues about the nature of its disturbances in severe mental illness.

H13

FEARFUL VS. ANGRY FACIAL EXPRESSIONS DIFFERENTIALLY ALLOCATE ATTENTIONAL RESOURCES TO ENVIRONMENTAL TARGETS James Taylor[1], Paul Whalen[1]; [1]Dartmouth College — We previously demonstrated that fearful facial expressions differentially direct attention towards the environment and away from the expresser, while angry facial expressions direct attention towards the expresser and away from the environment (Davis et al., 2011). This study implemented a rapid serial visual presentation paradigm in which neutral faces were presented sequentially while bordered by four gray hash marks. Participants were presented with faces of one gender and told to watch for a gender change at some point in the sequence (T1). Critically, T1 displayed either a neutral, fearful, or angry expression. Subjects were then told to detect a color change (i.e., gray to green; T2) at one of the four hashtag locations appearing after T1. T2 could appear at one of six temporal positions (128, 256, 384, 512, 640, 768 ms) following T1. Though the fearful and angry stimuli were similar in valence and arousal value, we hypothesized that only the fearful expressions should augment T2 detection. Indeed, we found that, compared to the neutral T1 faces, fearful expressions significantly increased the ability to detect the target at four of the six temporal locations (all p's $< .05$) while anger showed no such effect at any temporal location. The results of this study suggest that, even when task demands are high, fearful expressions have the ability to differentially allocate attentional resources. Further, this work highlights the importance of considering the information value conveyed by facial expressions in addition to their valence and arousal values.

H14

INTENT PERCEPTION GATES THE EFFECT OF EMOTIONAL STIMULI ON PUNISHMENT DECISIONS THROUGH CORTICOLIMBIC CIRCUITS CISIONS THROUGH CORTICOLIMBIC CIRCUITS Michael Treadway[1], Joshua Buckholtz[2], Justin Martin[3], Katharine Jan[4], Christopher Asplund[5], Owen Jones[6], Rene Marois Marois[7]; [1]Harvard Medical School/McLean Hospital, [2]Department of Psychology, Harvard University, [3]Department of Cognitive, Linguistic and Psychological Sciences, Brown University, [4]University of Pennsylvania Law School, [5]Duke-NUS Graduate Medical School Singapore, [6]Vanderbilt University Law School, [7]Department of Psychology, Vanderbilt University — It is increasingly recognized that emotions hold sway over multiple forms of social decision-making, including the determination of just punishment for unfair or criminal acts. However, the influence of emotions over punishment decisions is critically dependent on the mental state of the perpetrator: We frequently abstain from punishing acts committed accidentally compared to those committed purposefully, even when the harm is identical. While much neurobiological work has focused on how emotion affects decision-making, including punishment decisions, it is not yet understood how the emotional modulation of decision-making is regulated by intent. To address this question, we scanned 30 community volunteers using fMRI while they determined appropriate punishment for actions varying in both level of perpetrator responsibility (Intentional or Accidental) and harm severity. Importantly, subjects were randomly assigned to read scenarios that described victim harm using either lurid, graphic language or unadorned, fact-based language. This language manipulation produced an intent-by-language interaction on punishment decision-mak-

ing, such that the presence of graphic language resulted in more severe punishments only when the perpetrator's actions were described as being intentional, and not when they were accidental. Neuroimaging analysis found that amygdala activation mirrored this behavioral interaction effect. Further, effective connectivity analysis revealed an amygdalar-prefrontal network that was selectively engaged during conditions of high criminal intent and affectively salient language. These results establish a novel neural circuit that mediates interactions between emotion and perceptions of intent affect decision making, with broad implications for understanding how we judge and punish the actions of others.

H15

EFFECTS OF WORKING MEMORY AND WORRY ON ALGEBRAIC PROBLEM SOLVING

Kelly Trezise[1], Robert Reeve[1]; [1]University of Melbourne

— Researchers interested in the relationship between math anxiety/worry (MA), working memory (WM) and math ability have treated it as a special cognitive case. Nevertheless, fMRI data suggests that problem solving anxiety is associated with DLPFC activation across various problem solving domains. On the basis of these findings, MA-WM-performance relationships may not be a special case after all. Math researchers have found modest associations between MA/worry, WM and arithmetic ability using generic MA/worry (questionnaires) and WM (backward digit span) measures. It is unclear whether (1) this pattern of findings generalizes to other math domains (e.g., algebra), (2) more domain sensitive measures of MA and WM would yield more robust associations, or (3) differences in MA/worry and WM differentially affect math problem solving. To examine these possibilities, 80 14-year-olds completed (1) an algebraic judgment/worry task, (2) an algebra WM task, and (3) an algebra problem solving task. Latent profile analysis identified four algebraic WM-Worry profiles (Hi/Lo WM x Hi/Lo Worry). Algebraic problem solving performance differed among the four subgroups ($F(3, 72) = 15.63$, $p < .001$, $\eta 2 = .394$). Subgroups with high WM and low Worry showed better algebraic problem solving than other groups. The impact of low WM and high worry was associated with poor algebraic performance. The findings suggest that WM and worry affect algebraic abilities in ways analogous to anxiety-WM relationships in non-math research domains. They also suggest that those interested in anxiety-WM relationships and math ability would do well to examine these relationships in other knowledge/learning domains.

H16

ELECTROPHYSIOLOGICAL CORRELATES OF THE ROLE OF DISTINCTIVENESS IN THE EMOTIONAL ENHANCEMENT OF MEMORY

Sarah Watts[1], Luciano G. Buratto[1], Alexandre Schaefer[1]; [1]University of Durham

— The emotional enhancement of memory (EEM) is a robust phenomenon defined as an improved memory performance for emotional compared to neutral items. Despite its robustness, the cognitive mechanisms underlying this effect are still largely undetermined (Pottage & Schaefer, 2012; Talmi & McGarry, 2012). Behavioural evidence indicates that the distinctiveness of emotional information (the fact that emotional stimuli "stand out" relative to neutral stimuli) is a significant mediator of the EEM, which is potentially in line with attentional explanations of the EEM. The goal of the present study was to further investigate the role of distinctiveness in the EEM using an electrophysiological marker of memory encoding, the "Subsequent Memory Effect" (or the "Dm" effect). Participants were shown emotional and neutral pictures in either mixed lists (emotional and neutral items intermixed) or pure lists (only emotional or only neutral), while scalp event-related potentials (ERP) were recorded. Memory for the pictures was tested in a free recall procedure. Behavioural results revealed a significant memory advantage for emotional pictures compared to neutral pictures in mixed but not pure lists. For emotional items, a larger late (post-800 ms) occipito-parietal Dm effect was found in mixed lists compared to pure lists. For neutral items, the same Dm effect was larger for pure compared to mixed lists. Consistent with recent behavioural findings (Pottage & Schaefer, 2012), these results suggest that the EEM is a consequence of differences in the relative allocation of attentional resources between emotional and neutral items at encoding.

H17

TUNING-IN: INDIVIDUAL DIFFERENCES IN THE EFFECT OF EMOTION ON VISUAL SEARCH

Kristin E. Wilson[1], Rebecca M. Todd[1], Rayan Kosnik[1], Susanne Ferber[1]; [1]University of Toronto

— Currently, there is conflicting evidence about the influence of emotional valence on attention. While some researchers tried to resolve this debate by focusing on stimulus characteristics, we tested whether an individual differences approach can account for the conflicting results. One of the Big Five personality attributes, Openness to experience, which includes emotional awareness/expressiveness as an attribute, may be marked by a more diffuse or open attentional style. The present study examined the influence of viewing facial expressions on visual search performance in the presence and absence of an attentional control set. Participants performed two versions of a visual search task in which search arrays were preceded by happy, angry, or neutral faces. One task required the establishment of an attentional control set (CS) – i.e., look for a house – enabling category-specific features to facilitate search. The other task provided no control set (NoCS) – i.e., look for a unique item – thus requiring more flexible processing in order to track multiple comparisons in search of the unique item. Results showed that, as hypothesized, the influence of facial expression on search performance varied with individuals' Openness scores. This relationship was modulated by control set. In the CS task, individuals low in openness (LO) showed an RT advantage with happy faces, while individuals high in openness (HO) showed an inverse pattern. In the NoCS task, LO showed no effect of emotional faces, whereas HO a facilitation with happy faces. Thus, emotional content may tune attention, however this varies across individuals.

H18

COGNITIVE REAPPRAISAL INFLUENCES PAIN VALUATION, NOT NOCICEPTION

Choong-Wan Woo[1], Mathieu Roy[1], Jason T. Buhle[2], Tor D. Wager[1]; [1]The University of Colorado Boulder, [2]Columbia University

— Behavioral studies of cognitive reappraisal have shown that cognitive reappraisal (reinterpreting the meaning of emotional stimuli) profoundly alters reports of affective experience. Such changes may reflect changes in core affective processes in the brain, decision-making processes, or a combination of the two. Prior neuroimaging studies are inconclusive on this point, because biomarkers for affective vs. decision processes have not been developed. Recently, we have developed an fMRI-based biomarker (a pattern of activity) that is sensitive and specific to physical pain. In the present study, participants (N=33) reinterpreted noxious heat stimuli as either more or less painful. Cognitive reappraisal strongly modulated pain report, but had no impact on the biomarker. Instead, cognitive reappraisal influenced activity in the nucleus accumbens, ventromedial prefrontal cortex, and dorsolateral prefrontal cortex, which are not responsive to noxious input or diagnostic of pain. In addition, connectivity between nucleus accumbens and the ventromedial prefrontal cortex mediated the influence of cognitive reappraisal on pain report. These results provide evidence that cognitive reappraisal does not change early nociceptive processing, but rather influences brain circuits involved in affective meaning and value-based decision-making. In addition, it suggests a critical role for a ventromedial prefrontal-striatal pathway in pain valuation independent of nociceptive information from the periphery.

H19

INDEPENDENT VERSUS INTERDEPENDENT SELF-CONSTRUAL PRIMING ELICITS DIFFERENCES IN THE SPONTANEOUS REGULATION OF POSITIVE EMOTIONS IN CHINESE PARTICIPANTS

Kate Woodcock[1,2], Yi Liu[1], Dian Yu[1], Shihui Han[1]; [1]Peking University, China, [2]University of Birmingham, UK

— When compared to those from independent cultures (like the US), people from more interdependent cultures (like China) tend to report less experience and expression of positive emotions and greater emotion differentiation across social contexts. We used self-construal priming in Chinese participants to investigate the effect of activating more independent versus interdependent thinking on spontaneous emotion regulation in specific contexts. 32 Chinese students (16 males) observed positive photographs in two sessions following independent or interdependent priming. Imagined ingroup versus outgroup social context was manipulated in separate blocks. Participants reported more suppression of positive emotion (questionnaire) and less self-reported arousal (post

picture ratings) following interdependent priming. However, the decrease in arousal was greater in the ingroup context. Gender differences emerged in a performance based measure of cognitively effortful regulation. 20 Chinese male students observed positive photographs during fMRI acquisition. In order to localize brain areas involved in emotion regulation, participants were instructed not to regulate, or to up- or down-regulate their emotions on separate trials. To investigate the effect of self-construal priming on spontaneous emotion regulation, experimental trials were administered in two blocks following independent or interdependent priming. Participants either observed photographs with no specific instructions or regulated their positive emotion as they would in an ingroup context. Using areas of neural activation associated with up- or down-regulation in the localization scans as regions of interest, we compared spontaneous and ingroup-context linked regulation following independent versus interdependent priming. Results revealed effects of self-construal priming on spontaneous regulation of positive emotions.

H20

THE EFFECTS OF STRESS-RELATED NORADRENERGIC CHANGES ON ATTENTIONAL SELECTION AND FLEXIBLE THOUGHT

William O. Wright[1], Evangelia G. Chrysikou[1]; [1]University of Kansas — Research on the neurobehavioral effects of acute stress has shown a shift in brain activity in the presence of stressors, which is thought to reflect a reallocation of resources toward functions that can promote survival. The aim of the present study was to expand on past literature by examining whether the modulation of noradrenergic pathways during stress-related situations in humans affects the reallocation (or narrowing) of attention at the possible expense of flexible thinking. In a between-subjects design, participants were exposed to either a fear-related or an aversive video clip or to one of two neutral video clips matched with the experimental videos for audiovisual characteristics. Stress responses were measured by changes in subjective affect, heart rate, salivary cortisol, and alpha-amylase levels after participants viewed the brief video clips. Following the stress-related manipulation, participants were administered a task associated with creative thought (the Remote Associates Task), which requires flexible access to conceptual networks in memory. Participants were also administered a task of attentional selection (the Neisser task). The order of the tasks was counterbalanced. Measures of individual differences attributed to cognitive, personality, and emotional factors, including susceptibility to anxiety, were also collected. Analyses of performance on the cognitive measures revealed dissociable effects of the different kinds of stressors on attention and breadth of access of semantic memory. These results extend past literature by suggesting possible tradeoffs between attentional focus and flexible thought in the presence of acute stress that can have consequences for performance in real life circumstances.

H21

CURRENT AFFECTIVE STATE AFFECTS EMOTIONAL VISUAL PROCESSING – AN EEG CONNECTIVITY STUDY

Miroslaw Wyczesany[1], Szczepan Grzybowski[1]; [1]Psychophysiology Laboratory, Jagiellonian University, Krakow, PL — Emotional stimuli are preferentially processed and this preference is an additive influence of top-down and bottom-up processes. We aimed to determine how changes in current emotional state affect functional connectivity during perception of affective stimuli. Subjects took part in two counterbalanced sessions (positive and negative). Each session consisted of randomly sequenced emotional pictures intermixed with adjectives from the mood checklist, followed by an inquiry to assess subjects' emotional state on three scales: Energy Arousal (EA), Tension Arousal (TA) and Hedonic Tone (HT). To quantify the information flow between the electrodes, the average Direct Transfer Function (DTF) in the β and θ band was determined for 2 sec epochs following picture onset. Correlations between DTF values and emotional state scales were then calculated separately for both sessions. Significant and consistent effects were observed only in the β band. Most were related to the TA scale, which correlated with: increased flow from the AF3 electrode to the left and right centroparietal region, from F8 to the prefrontal and right centroparietal area, and from T8 to bilateral centroparietal sites, the latter being visible only in the negative session. HT scores (positive valence) correlated with a decrease in connectivity from T7 to the left centroparietal area in the negative session. No effects for EA were observed. The results were interpreted in terms of increased activation of the fronto-parietal attentional network related to the state of tension. Additionally, the role of the right temporal area in mediating a negative subjective state was supported.

H22

EMOTION INTENSITY AFFECTED AUTOMATIC EMOTION REGULATION CHOICE: EVIDENCE FROM AN ERP STUDY

Meng Yang[1], Siyi Chen[1], Mizhi Hua[1], Renlai Zhou[1]; [1]Beijing Normal University, Beijing, China — According to the Process-Specific Timing Framework raised by Sheppes and Gross (2011), the intensity of emotion will affect the choice of emotion regulation strategy, specifically, healthy people will show preference for late selection filter (during semantic analysis) in low-intensity emotional context and early-selection filter (during selective attention filtering mechanism) in high-intensity emotional context. But this prediction needs further verification as the existed studies were trapped in subjective report in method and deliberate regulation in theme. To extend this theoretical framework, we conducted an implicit emotional Go/Nogo task combined with ERPs to explore whether the emotion intensity will change the strategy choice. Twenty participants (10 males) were told to press a bar or withhold the response according to the gender of faces showed with three expressions (fearful, happy and neutral). N1, N170, N2 and LPP components were chosen to reflect different cognitive processing stages during emotion generation, including attention deployment, emotion detection, semantic conflict, and further emotion encoding. The results showed that for fearful emotion, when emotion intensity enhanced, the regulation effect took place on the early selection phase including attention deployment (N1) and emotion detection (N170) rather than late selection phase including semantic conflict(N2) and further analysis (LPP) phase. This result supported the Process-Specific Timing Framework on the angle of automatic emotion regulation.

H23

CHANGES IN VALENCE AND AROUSAL DURING TWO TYPES OF COGNITIVE REAPPRAISAL

Pareezad Zarolia[1], Iris Mauss[2], Danny Lumian[3], Bethany Ciesielski[1], Tchiki Davis[2], Brett Ford[2], Kateri McRae[1]; [1]University of Denver, [2]University of California, Berkeley, [3]University of California, Los Angeles — Typically, cognitive reappraisal research focuses upon the ability of individuals to decrease negative affect in response to a negative stimulus. The current research examined reappraisal strategies with different emotional goals: to decrease negative affect and increase positive affect towards a negative stimulus. During a picture-based reappraisal task, 50 female participants viewed a series of negative images during which they were instructed to view (look), decrease the amount of negative (decrease negative) or increase the amount of positive affect (increase positive) they were feeling. At a threshold of $t = 2.95$, $p < 0.005$, we observed successful down-regulation of amygdala activity for both the decrease negative and the increase positive conditions. Further analyses revealed that self-reported ratings of arousal were most strongly coupled with negative affect during the look condition ($r = .619$, $p < .001$), less coupled during decrease negative (negative rating, $r = .450$, $p < .001$), and least coupled during increase positive (negative rating, $r = .259$, $p < .048$). These results reveal that both decreasing negative and increasing positive affect towards negative images leads to successful emotion regulation, and that there is a qualitative difference between these two strategies as exemplified by the differential uncoupling of valence and arousal ratings.

H24

PROSODY SPECIFIC DISTRACTION DURING DIRECTING OF VISUAL SPATIAL ATTENTION

Ulrike Zimmer[1], Marie-Theres Keppel[1], Christian Poglitsch[1], Anja Ischebeck[1]; [1]University of Graz — TV-advertisements successfully manipulate us by presenting the picture of their "best-to-buy-immediately" product with tempting emotional voices. Such hidden emotional manipulation has been evidenced by recent studies indicating that prosodic fear stimuli enhance directing of visual spatial attention when compared to neutral sounds. However, it remains unclear how the effectiveness of spatial cuing depends on the emotional valence (positive/negative) and the context-relation between cue and target (identical versus different emotional meaning). In an EEG experiment with 21 healthy students, using a modified Posner-paradigm, an emotional voice, inducing either an emotion of disgust or deliciousness, was presented as

spatial cue in equal ratio to the left or right side, followed 1200-1300ms later by two laterally (left/right) presented apple pictures: one with a slug (visual disgust), the other a polished apple (visual delicious). The subjects detected if the slug was on the left or right apple. Control trials included this detection task without sound stimulation. Behaviorally, slug detection was faster when preceded by an invalid versus valid disgusting sound, presumably because subjects tried to avoid the 'disgusting' sound by shifting attention to the opposite side, thus enhancing invalid detection, whereas the 'delicious' sound was cuing as expected. ERP-results for invalid versus valid differences indicated a posterior negativity at 350-400ms over right parietal sites for disgust, however, a late frontal ERP-negativity at ~500-650ms for delicious prosody, thus indicating differential processing due to emotional valence. We conclude that both the prosodic valence and cue/target-context determine the success of directing spatial attention to the expected object.

H25

THE INFLUENCE OF PTSD ON AMYGDALA-MEDIATED EMOTIONAL AROUSAL SYSTEMS

Jennifer Stevens[1], Ebony Glover[1], Negar Fani[1], Timothy Ely[1], Bekh Bradley[1,2], Kerry Ressler[1], Tanja Jovanovic[1]; [1]Emory University School of Medicine, [2]Atlanta Veterans Administration Medical Center — An up-regulation of the systems underlying emotional arousal responses has been hypothesized to form a major component of post-traumatic stress disorder (PTSD), and a large body of neuroimaging evidence has shown exaggerated amygdala responses to negative emotional stimuli in PTSD. The goal of the current research was to further investigate links between increased amygdala activation and exaggerated fear responses in PTSD. 40 women (20 PTSD+, 20 traumatized non-PTSD controls) were recruited from a large urban hospital. Participants viewed fearful and neutral face stimuli during an fMRI scan, and completed a fear conditioning task during a separate visit. In response to fearful face stimuli, PTSD participants showed increased right amygdala responses relative to controls (pcorr<.05), and decreased functional connectivity between the right amygdala and left medial prefrontal cortex (mPFC; pcorr<.05). Initial analyses showed that PTSD participants also showed over-generalized startle EMG responses during fear conditioning. Whereas controls showed decreased startle potentiation to the CS- (safety cue) relative to the CS+ (threat cue), p<.05, PTSD participants did not, p=.49. Scores representing the discrimination of threat and safety were calculated using startle potentiation to threat – safety cues. Increased mPFC responses to fearful faces were associated with greater discrimination scores (r^2=.10). The findings are consistent with the idea that PTSD development after a trauma is accompanied by an exaggerated and over-general response of amygdala-mediated emotional arousal systems, likely linked with disruption of an amygdala-mPFC circuit. This is the first study to demonstrate such links in an understudied civilian population.

H26

NEURAL SUBSTRATES OF AROUSAL IN COMPASSION TRAINING

Helen Weng[1], Julian Motzkin[1], Diane Stodola[1], Gregory Rogers[1], Richard Davidson; [1]University of Wisconsin-Madison — Compassion increases altruistic behavior, in part, by decreasing personal distress when witnessing the suffering of others; however, the neural mechanisms of this are unknown. Here, we investigated the relationship between altruistic behavior, arousal, and neural responses to human suffering after compassion training compared to reappraisal training. Participants were randomized to compassion (N=20) or reappraisal training (N=21), and practiced for 2 weeks (30 min/day) via the Internet. Brain activity was measured with fMRI both pre and post-training while participants implemented their assigned regulation strategies. They viewed negative or neutral social images and reported subjective arousal. Altruistic behavior was measured post-training using the Redistribution Game, where personal funds could be spent to redistribute money after witnessing an unfair transaction. Compassion trainees were more altruistic compared to reappraisal ($t(39) = 2.09$, $p < 0.05$). Furthermore, decreases in arousal predicted greater redistribution after compassion training ($r(18) = -0.45$, $p < .05$) but not reappraisal training ($r(19) = 0.09$, $p = 0.70$). A Group Arousal change interaction test on the analogous neural change scores identified the medial prefrontal cortex (mPFC) and left brainstem (pons; $p = 0.005$, uncorrected). In compassion training, decreases in arousal after training were associated with increases in mPFC and decreases in brainstem activation. In reappraisal training, decreases in arousal were predicted by decreases in mPFC but not brainstem activation. These data suggest that decreased arousal after compassion training contributes to greater altruistic behavior, and this is subserved by neural systems implicated in emotion regulation and autonomic arousal.

H27

DELECTABLE DESSERTS & BEAUTIFUL BLOOMS: THE AFFECTIVE SALIENCE OF NATURAL CATEGORIES

Christy Wilson-Mendenhall[1,2], Lisa Feldman Barrett[1,2], Linda Bartoshuk[3], David Clark[4], Thomas Colquhoun[4]; [1]Dept of Psychology, Northeastern University, [2]Martinos Center for Biomedial Imaging, Massachusetts General Hospital, [3]Center for Taste and Smell, University of Florida, [4]Environmental Horticulture Dept, University of Florida — Visual categorization can rapidly elicit affective changes that are experienced as pleasant and that guide future action. In an fMRI study, we examined the neural patterns underlying two hedonic categories that are frequently encountered in today's world: the homeostatically relevant category of sweet foods and the culturally inspired category of colorful flowers. To assess implicit reactions to the hedonic stimuli, high-resolution images of sweets and flowers were presented rapidly in blocks, amidst blocks of within-category hedonic control images (neutral/slightly pleasant vegetables/fruits and green plants) and low-level visual control images (scrambled versions of the images). Participants performed a simple one-back task in the scanner, with a post-scan manipulation check confirming the pleasantness of the sweets and the flowers. In subcortical regions hypothesized to underlie affective salience and motivated action (including the amygdala, pallidum, and putamen), the sweet foods showed greater right-lateralized activity than all other conditions. In contrast, a cluster in the left amygdala showed heightened activity for the foods and the flowers relative to all other conditions. The flowers also elicited left-lateralized activity in the pallidum/putamen that was significantly greater than all other conditions. Cortical regions involved in integrating internal bodily and external sensory information (e.g., orbitofrontal cortex) generally showed more activity for the food categories than for the plant categories. These findings suggest that the brain swiftly deploys attention and action resources upon viewing natural categories that people later report as pleasant, with lateralized patterns appearing to distinguish delectable desserts from beautiful blooms.

H28

EVENT-RELATED POTENTIALS REVEALED GENDER DIFFERENCES FOR POSITIVE AND BLOODY PICTURES

Nai-Shing Yen[1,2,3], Bethany C. Y. Wu[2,3], Chieh-Ning Lee[1], Wan-Lin Lee[1]; [1]Department of Psychology, National Chengchi University, [2]Research Center for Mind, Brain and Learning, National Chengchi University, [3]Taiwan Mind & Brain Imaging Center, TMBIC — The present study asked 28 participants (half males) to make judgments on valence and arousal levels to 96 emotional (positive, erotic, neutral, bloody and negative) pictures while electroencephalogram (EEG) was recorded. The mean amplitudes across five emotion categories reached significant level between 350 and 750 ms, $F(4, 108) = 4.335$, $p = .003$. Arousal was significantly affected by electrode sites (Fz, Cz and Pz), $F(2, 46) = 21.941$, $p < .001$. The mean amplitude for high arousal pictures was significantly larger than low arousal ones between 400-800 ms at Fz, $t(23) = 2.126$, $p < .05$. Comparisons between male and female participants suggested no gender differences on levels of valence and arousal (assessed by Self-Assessment Manikin) across five categories. Event-related potentials elicited by erotic, neutral and negative pictures were also similar between male and female participants. Gender differences were found for positive and bloody pictures while female participants showed more positive going waveforms than male participants 400 ms after stimuli onset. The present study thus concluded that event-related potentials revealed gender differences for positive and bloody pictures.

H29

RAPID VISUAL CORTICAL SUBTYPING OF THREAT IN HIGH (NOT LOW) SPATIAL FREQUENCY

Yuqi You[1], Wen Li[1]; [1]University of Wisconsin-Madison — Visual cortical categorization of emotion can consummate in as little as 100 ms after stimulus onset. Controversies arise whether this operation is cortically based or dependenet on the amygdala via "quick-and-dirty" subcortical pathways. Combining high-density electroencephalography (EEG) and emotion-ladden images of natural scenes containing either low spatial frequency (LSF, < 3 cycles/degree) or high spatial fre-

quency (HSF, > 7 cycles/degree) information, we isolated neural markers reflective of cortical and subcortical threat processing systems. An early visual potenital (P1) emerging at 110 ms and concomitant extrastriate cortical activity revealed qualitatively divergent response patterns for two threat prototypes, represented by response augmentation in fear and suppression in disgust relative to a neutral condition (t(39)'s > 2.53, p's < .05). Critically, this subcategorization within the threat domain was only present in HSF images, which exclusively stimulate the cortical (vs. subcortical) visual pathway. By contrast, LSF images preferentially transmitted by subcortical routes failed to induce such refined discrimination, only to evoke similarly potentiated visual response to both threat (relative to neutral) emotions in N1 at a delayed latency (135 ms). The initial (P1) response thus contradicts the characteristics of amygdala threat processing, which however align nicely with subsequent (still fairly swift) generalized representation of LSF threat cues (in N1 response). Taken together, our findings support the view that the sensory cortex can sustain rapid threat analysis independently of limbic input, echoing long-standing evidence in animal research (Weinberger, 2007) and accruing human data (Li et al., 2008; Tsuchiya et al., 2009).

H30

THE VOICE OF CONSCIENCE: NEURAL BASES OF INTERPERSONAL GUILT AND COMPENSATION

Hongbo Yu[1], Jie Hu[1], Li Hu[2], Xiaolin Zhou[1]; [1]Peking University, [2]Southwest University — People feel bad for inflicting harms upon others; this emotional state is termed interpersonal guilt. Although interpersonal guilt has fundamental impacts upon people's social life and well-being, the understanding of the neural bases of this emotion is limited by the lack of an appropriate behavioral paradigm to both elicit and measure guilt in an interpersonal context. Here, the participant played multiple rounds of a dot-estimation task with anonymous partners while undergoing fMRI. Regardless of whether it was the partner or the participant who responded incorrectly (or both), the partner would receive the resulting pain stimulation; the subject was then given the option to intervene and bear pain for the partner The level of pain voluntarily taken and the brain activations in anterior middle cingulate cortex (aMCC) and bilateral anterior insula (AI) were higher when the participant was solely responsible for the stimulation (Self_Incorrect) than when both committed an error (Both_Incorrect). Moreover, the gray matter volume in the aMCC predicted the individual's compensation behavior, measured as the difference between the level of pain taken in the Self_Incorrect and Both_Incorrect conditions. Furthermore, a mediation pathway analysis revealed that activation in a midbrain region mediated the relationship between aMCC activation and the individual's tendency to compensate. These results demonstrate that the aMCC and the midbrain nucleus play important roles in not only generating interpersonal guilt, but also in promoting compensation behaviors.

H31

INTER-BRAIN SYNCHRONIZATION DURING BEHAVIORAL SYNCHRONIZATION BETWEEN TWO INDIVIDUALS IN AN ALTERNATE TAPPING TASK

Masahiro Kawasaki[1,2], Keiichi Kitajo[1,2,3], Yoko Yamaguchi[4]; [1]Rhythm-based Brain Information Processing Unit, RIKEN BSI-TOYOTA Collaboration Center, Japan, [2]Laboratory for Advanced Brain Signal Processing, RIKEN Brain Science Institute, Japan, [3]PRESTO, Japan Science and Technology Agency (JST), Japan, [4]Neuroinformatics Japan Center, RIKEN Brain Science Institute, Japan — Behavioral rhythms of different individuals are known to be spontaneously synchronized through social interactions, however, it is not clear whether the inter-brain synchronization emerges or not when behavioral rhythms are synchronized between two individuals. Here, we simultaneously recorded electroencephalograms (EEGs) from a pair of subjects (in total, 34 right-handed subjects) during an alternate tapping task where two subjects faced to each display and tapped a key alternately with their right finger. Subjects were asked to tap the key with an equal time interval of previous tapping of the other subject, presented by visual feedbacks. In a control condition, each subject did the same task with a virtual person (a PC program) who tapped at a constant interval. According to behavioral performance in the control condition, we divided the subjects into good and bad groups. In both two groups, wavelet analyses for EEG data revealed mu (about 10Hz) and beta (about 20Hz) amplitude modulations on the left motor areas. Interestingly, the mu amplitudes were positively correlated between individuals in the good group, whereas the bad group showed the negative correlations. In contrast, the beta amplitudes were negatively correlated between them in both two groups. The mu and beta phases were synchronized between visual and motor areas within individuals just before the tapping timings in both two groups. Furthermore, the visual-motor mu but not beta phase synchronization between individuals was observed only in the good group. The results suggest that mu and beta inter-brain synchronization plays different functional roles in behavioral synchronization.

H32

CREATIVITY TRAINING ENHANCES CREATIVE PERSISTENCE AND INCREASED ABSTRACT CONNECTIONS

Eliza Kienitz[2], Nicholas Bott[2], Eve-Marie Quintin[1], Manish Saggar[1], Grace Hawthorne[1], Adam Royalty[1], Allan Reiss[1]; [1]Stanford University, [2]Palo Alto University — Previous studies have focused on creativity, the ability to synthesize novel connections and create meaningful outcomes, as a static construct measured at one point in time. In this study, we tested the hypothesis that creativity is a fluid construct. We hypothesized that a creativity training intervention would increase creative thinking. A 5-week long creativity-training program (CTP) was conducted in collaboration with the Hasso Plattner Institute of Design at Stanford University, and in parallel a 5-week long language-training program (LTP) was designed as a control intervention. Twenty-eight participants took part in this study, 15 (Age (± 5.64)=29.1 years; 8F) were randomly assigned to CTP and the other 13 (Age (± 6.3)=29.69 years; 7F) were assigned to LTP. Creativity was measured, at pre- and post-training, using standardized Torrance Test of Creative Thinking (TTCT) scores. An ANCOVA, with pre-training TTCT scores as a covariate, revealed a greater increase (at post-training assessment) for CTP than LTP on two (out of five) primary factors of the TTCT – Resistance to closure ($F(1, 28)= 4.891, p=.036$) and Abstractness of Titles ($F(1, 28)= 4.357, p=.047$). We also found a moderate effect size for group differences on the TTCT total score post-training (Cohen's d=.503; p=.079). Altogether, our results indicate that creative potential is a fluid construct, one that can be individually strengthened through targeted training. Specifically, the results suggest that creativity training can enhance the ability to persist in the creation of new ideas as well as the ability to create abstract connections between visual output and verbal labeling.

H33

OUTCOME EVALUATIONS IN THE COLLECTIVE DECISION USING THE MAJORITY RULE: AN ELECTROPHYSIOLOGICAL STUDY

Kenta Kimura[1], Jun'ichi Katayama[1,2]; [1]CAPS, Kwansei Gakuin Univ, Nishinomiya, Hyogo, Japan, [2]Dept Psychol Sci, Kwansei Gakuin Univ, Nishinomiya, Hyogo, Japan — One of the fundamental points that human beings differ from other social animals is to have an explicit rule to decide the collective behavior. The present study examined the evaluative processes for two different types of outcomes accompanied by the collective decision making using the majority rule. First, we examined the evaluative processing of outcomes associated with collective decisions. Second, we investigated whether the conflict of opinions among group members was evaluated as a motivationally significant outcome. During the gambling task with collective decision , feedback-related negativity (FRN), which is a frontal ERP reflecting motivational significance of outcomes, is recorded from three individuals simultaneously. In the task, individual choice was divided into three conditions; the unanimous choice, the majority, and the minority conditions. We found that FRN for monetary loss associated with the collective decision was reduced when the participant's opinion was in the minority compared to when their opinion was in the majority and the unanimous choice. In addition, the FRN was smaller in the unanimous choice than in the majority condition. Furthermore, conflict of opinions among group members elicited FRN, the amplitude of which was greater when the participant's opinion was in the minority. These results indicate that the evaluation of outcome accompanied by collective decision is modulated by the personal feeling of agency for the decision. In addition, the conflict of opinions among group members could be processed by the same mechanism as outcome evaluation and evaluated as important outcomes for performance monitoring.

H34

FAIRNESS CONSIDERATIONS MODULATE FEEDBACK-RELATED BRAIN ACTIVITY WHEN OBSERVING STRATEGIC INTERACTIONS

Claudio Lavín[1], René San Martín[1,2], David Huepe[1], Agustín Ibáñez[1,3], Camilo Melis[1], Pablo Isla[4], Alvaro Rivera[1]; [1]Universidad Diego Portales, Chile, [2]Duke University, [3]Instituto de Neurología Cognitiva, Argentina, [4]Universidad Técnica Federico Santa María, Chile — Previous studies have shown that fairness considerations about behavior are associated with different empathy-related response in the brain. What remains unclear, however, is whether the neural mechanisms supporting the evaluation of one's own gains and losses are affected by such fairness considerations. To shed light on this issue, we recorded event-related potentials (ERPs) from 40 participants (i.e., the observers) while they observed two persons (i.e., the performers) playing an iterative prisoner dilemma game. One of the performers played as a defector, and the other one played as a cooperator. A group of 20 observers were told they would get the amount of money accumulated by the defector (i.e., defector-inclined observers), and the other 20 were told that they would get the money accumulated by the cooperator (i.e., cooperator-inclined observers). Overall, there were 4 types of trials: defector wins, cooperator wins, mutual cooperation and mutual defection. Our ERP data analyses focused on the feedback-related negativity (FRN), an ERP that tends to be larger for negative compared to positive results. As expected, we found that cooperator-inclined observers exhibited a large FRN when the defector won, and a small FRN when the cooperator did. Strikingly, however, defector-inclined observers did not present this pattern of results; instead they showed a large FRN when either player won, and smaller negativity when there was a mutual cooperation. We suggest that the operation of the neural mechanisms in charge of signaling one's own gains may be disrupted when such gains result from an unfair social interaction.

H35

ATTENTIONAL BIAS TO FACES ACROSS MULTIMODAL EMOTION-RECOGNITION: SOCIAL PREFERENCES IN WILLIAMS SYNDROME

Rowena Ng[1], Anna Jarvinen[1], Andrew Arnold[1], Ursula Bellugi[1]; [1]Salk Institute for Biological Studies, Laboratory for Cognitive Neuroscience — Williams syndrome (WS) is a genetic disorder characterized by an unusual social phenotype, which manifests behaviorally (attraction to faces, positive/prosocial disposition), neuroendocrinologically (dysregulation of 'social' hormones, oxytocin and vasopressin; Dai et al., 2012) and neurologically (aberrant emotion-processing neural network; Meyer-Lindenberg et al., 2005). Although previous research reported WS individuals exhibit a social bias in emotion processing (Ng et al., 2010), it is unclear whether faces are uniquely preferred above other social dimensions. We examined emotion-recognition accuracy of WS and typical-developing controls across uni/bimodal sensory paradigms. In Study 1, participants were asked to identify emotions (anger, happiness, fear) portrayed by isolated faces or non-verbal voices. In Study 2, these groups were instructed to identify emotional voices while simultaneously presented with a face matched/mismatched on affect. Results show both groups similarly demonstrate superior emotion-recognition of faces over voices in Study 1. In Study 2, TD controls show comparable emotion-identification performance across congruent/incongruent conditions, implicating a relatively strong ability to flexibly and selectively attend to the auditory domain across affect despite the distractors. Conversely, WS group performed with greater accuracy in the matched condition, indicating a stronger attention to faces in incongruent trials. Specifically, faces were more effective in diverting attention away from negative voices in WS, highlighting their reduced sensitivity to negative-valenced stimuli. Altogether, WS possess relatively strong emotion-processing capacity and attention for faces coupled with diminished sensitivity toward negative affect, which explicates their exaggerated approach behaviors. Implications of the genetic deletion on the foundation of social behaviors will be discussed.

H36

RED LIGHT PROMOTES THE AVERSIVE EVALUATION OF UNPLEASANT STIMULI: AN EEG STUDY

Sejin Oh[1], Hyensou Pak[2], Yeonhong Jung[2], Kwangsub So[1], Myeonghoon Ryu[1], Byoung-Kyong Min[1]; [1]Korea University, [2]LG Electronics Inc. — The degree of emotional processing is possibly susceptible to the surrounding illumination condition. However, illumination-mediated neurophysiological changes during emotional assessment still remain unclear. Therefore, we measured EEG signals from 10 healthy participants during the presentation of affective pictures (pleasant, unpleasant, and neutral) rated by the International Affective Picture System (IAPS) with manipulating RGB values of the background illumination. We measured the peak amplitude in the time window from 200 to 400ms poststimulus (i.e., P300). Since the P300 amplitude was most pronounced around the parieto-occipital region during the presentation of affective pictures, we selected seven electrodes representing these brain areas and averaged the P300 amplitudes across these electrodes. These measures were analyzed with a repeated measures ANOVA, which included two within-subjects factors labeled as 'RGB-combination' and 'stimulus-category'. We found a significant interaction effect between these two factors ($F(6,54)=2.543$, $p<0.05$) in P300 amplitudes. The post-hoc test revealed that only the red light yielded significantly strong differences ($F(2,18)=9.547$, $p<0.005$). Presumably, red light might be related to unpleasant associations such as fire, danger, and blood, so red illumination may promote the aversive evaluation of unpleasant stimuli, reflected in higher P300 amplitude. Indeed, people usually consider red to be more arousing than the other color, and red color is often used as a warning sign to attract attention. Further refinement of the illumination parameters and subsequent exploration of emotional-modulation will be needed to disseminate these findings across a wide range of research and application fields.

H37

UNDERSTANDING LANGUAGE FROM WITHIN: EVIDENCE FOR DIFFERENTIAL INVOLVEMENT OF PERIGENUAL CINGULATE, INSULA, AND INFERIOR FRONTAL GYRUS WHEN PROCESSING SENTENCES DESCRIBING MENTAL STATES.

Suzanne Oosterwijk[1,2], Scott Mackey[3], Piotr Winkielman[3], Martin P. Paulus[3]; [1]Northeastern University, [2]University of Amsterdam, [3]University of California, San Diego — Language is a common way to communicate mental states to others. Theories of embodied cognition hypothesize that bodily and sensory states are simulated in order to understand linguistic references to mental states. In an fMRI experiment we examined whether neural regions that are important for processing of bodily sensations engage when individuals understand sentences that describe mental states with a focus on internal experiences. Subjects were presented with sentences describing emotional (e.g., fear, joy) and non-emotional (e.g., hunger, thinking) mental states from an internal perspective (i.e., focusing on bodily sensations and introspection) or an external perspective (i.e., focusing on expression and action). Participants judged whether sentences described a mental state or not; non-mental states sentences served as control. We hypothesized that external sentences would engage prefrontal regions associated with action representation (e.g., inferior frontal gyrus) and that internal sentences would engage prefrontal regions associated with internal experience and bodily sensations (e.g., anterior insula, anterior cingulate). Both external emotion and external non-emotion sentences significantly engaged the inferior frontal gyrus. Furthermore, internal emotion sentences engaged the anterior cingulate gyrus and the ventral medial prefrontal cortex significantly more than all other sentence categories. Surprisingly, non-emotion sentences, both internal and external, significantly engaged the anterior insula. Together, these results show that perspective matters in the way the brain represents mental states communicated through language. These findings are consistent with theories of embodied cognition that argue for flexible, multimodal simulations that depend on the context in which a mental state is processed.

H38

THE NEURAL UNDERPINNINGS FOR EMPATHY FOR PAIN IN ADOLESCENCE

Sandy Overgaauw[1,2], Berna Güroglu[1,2], Eveline A. Crone[1,2,3]; [1]Leiden University, [2]Leiden Institute for Brain and Cognition (LIBC), [3]University of Amsterdam — Empathy is an important ability for understanding and sharing emotional states of others, which help us to understand and predict others' intentions. This fMRI study investigated the neural underpinnings of individual differences in empathic concern across adolescence. Thirty-seven participants aged 12 to 19 viewed pictures of social situations depicting intentional harm inflicting acts, harmed victims, and neutral scenarios. Subsequently the participants played a Dictator Game, where they were asked to divide money between themselves and the denoted other player, who was a person involved in the social scenarios viewed previ-

ously. The behavioral results showed that participants of all ages acted prosocially towards victims, fair towards neutral individuals and punishing towards offenders. fMRI results revealed a higher neural response in the superior temporal sulcus (STS) during the perception of stimuli depicting victims and offenders relative to neutral individuals. The reversed contrast showed an increase in hemodynamic activity in the temporo-parietal junction and the ventromedial prefrontal cortex. Possibly, this activation is related to participants identifying themselves more with neutral individuals than victims or offenders. In addition, brain activation in the STS while watching harm involving situations was correlated negatively with individual levels of empathic support. This finding suggests that participants reporting more empathic traits filter irrelevant information from social situations, as indicated by lower activation of the STS. Taken together, our findings emphasize the important role of individual differences in empathy during adolescence, both at the level of social behavior and level of neural underpinnings of social cognition.

H39

AN EYETRACKING INVESTIGATION OF INTENTIONAL MOTION PERCEPTION IN SCHIZOPHRENIA

Paul Roux[1,2,3], Christine Passerieux[2,3], Franck Ramus[1]; [1]Laboratoire de Sciences Cognitives et Psycholinguistique, UMR 8554, CNRS-ENS-EHESS, Ecole Normale Supérieure, Paris, France, [2]Centre Hospitalier de Versailles, Le Chesnay, France, [3]Laboratoire ECIPSY Université Versailles Saint Quentin en Yvelines, Versailles, France — Individuals with schizophrenia have been shown to have difficulties attributing intentions to abstract geometrical shapes involved in complex and mentalistic interactions (Koelkebeck et al., 2010). However, these tasks impose large demands on explicit reasoning and on verbal abilities, making it difficult to distinguish deficits in perception from deficits in higher-level inferences. To address this limitation, the perception of intentional motion was assessed in schizophrenia using a quantitative, psychophysical methodology focusing on one specific intentional behavior, chasing, in which one shape pursues another one. 29 patients with schizophrenia and 29 control participants completed a chasing detection paradigm (Gao, Newman, & Scholl, 2009) while their eyes movements were recorded. Participants watched animations in which 5 circles randomly moved. One circle chased another one in half of the trials. At the end of each trial, participants had to say if they had seen a chase or not. Using signal detection theory, we computed measures of chasing detection sensitivity from explicit responses. We also computed a more implicit and online measure of chasing detection based on participants' eye movements. Patients and controls were matched on age, education, sex, intelligence and smooth pursuit abilities. The sensitivity of chasing detection was significantly lower in patients than in control. Eyetracking measures revealed that patients were significantly less able to distinguish circles chasing each other from randomly moving circles. Patients with schizophrenia demonstrate an online disturbance in intentional motion perception at an implicit level, even before they make an explicit judgment about this motion.

H40

ADAPTIVE OBSERVATIONAL INSTRUMENTAL LEARNING

Ida Selbing[1], Björn Lindström[1], Armita Golkar[1], Andreas Olsson[1]; [1]Karolinska Institutet — Social learning through observation can be safe and efficient because it does not incur the potential costs of individual trial and error. However, compared with individual learning, the information gained via observation might be less reliable. When observing the choice behavior of others, information about both their choices and the outcome of these choices are normally available. However, it is unclear how humans use these sources of information to adaptively guide their own learning when the model is more or less reliable. To address this, we used a probabilistic two-choice task where subjects learned to minimize the amount of received electric shocks. Subjects observed the behavior of a learning model under three levels of available observational information; no information, choices only, both choices and choice outcomes. In order to vary the reliability of the observational information, the choices of the learning model were either rational (near optimal) or irrational (random). The results showed that observing only the choices of a rational model resulted in similar performance as observing both choices and their outcomes, whereas observing only the choices of an irrational model led to performance on par with individual learning (no information condition). Reinforcement learning modeling showed that both sources of observational information were discounted when the observed choice was irrational although the observed outcomes of these choices in theory still could inform choice behavior. Taken together, the results show that humans estimate the reliability of social information to adapt their individual learning although not necessarily in an optimal manner.

H41

INCREASED COGNITIVE CONTROL DURING NOREPINEPHRINE RELEASE THROUGH ACUTE VAGUS NERVE STIMULATION

Marlies Van Bochove[1], Leen De Taeye[2], Kristl Vonck[2], Robrecht Raedt[2], Alfred Meurs[2], Paul Boon[2], Ine Dauwe[2], Wim Notebaert[1], Tom Verguts[1]; [1]Ghent University, [2]Ghent University Hospital — When something exciting happens, we become more alert, partly due to a norepinephrine (NE) boost (Sara & Bouret, 2012). It has been proposed that this NE boost not only increases alertness but also cognitive control, the ability to suppress an instantaneous urge in order to execute a more appropriate response (Verguts & Notebaert, 2008, 2009). We currently investigate the role of NE in cognitive control. In the present study epileptic patients who are pharmacoresistant were investigated. To reduce seizure frequency these patients have been implanted with a Vagus Nerve Stimulation device (VNS). Preclinical experiments show that VNS activates the locus coeruleus and increases NE release in the brain which plays a crucial role in the anti-epileptic effect of VNS (Raedt et al, 2011). We asked 17 VNS patients to execute a flanker task, both on and off VNS stimulation (order counterbalanced across subjects). We investigated the effect of stimulation on the congruency effect, the difference in reaction time (RT) between congruent and incongruent stimuli. The congruency effect was significantly smaller in the on stimulation condition, compared to off stimulation. The effect was significantly stronger for 'responders' (patients with more than 50 % reduction of seizure frequency per months in response to VNS, as determined independently from our cognitive control task), compared to 'non responders'. This suggests that VNS, via increased NE signaling, improves cognitive control, possibly due to increased binding between stimuli and responses, which allows better suppression of unwanted action tendencies (Verguts & Notebaert, 2008, 2009).

H42

INDIRECT INFLUENCE OF MEDIAL ORBITOSTRIATAL PROJECTIONS ON RESPONSE SELECTION: CHECK YOURSELF BEFORE YOU RECTUS YOURSELF

Timothy Verstynen[1], Jean Vettel[2]; [1]Psychology & CNBC, Carnegie Mellon University, Pittsburgh, PA, [2]U.S. Army Research Laboratory, Aberdeen Proving Grounds, MD — The lateral and medial orbitofrontal gyri are associated with affect, reward processing and inhibitory control. Yet we know very little about the role of the most medial segment of orbitofrontal cortex, the Gyrus Rectus (GR), in cognition. We looked at functional responses during a color-word version of the Stroop task in a group of healthy adults (N=28, 19 male, ages 19-45 years) using a 3T MRI. Of twenty regions with significantly different responses during incongruent trials (i.e., the word "red" written in blue ink) compared to neutral trials that used non-color words, only a cluster in the left GR exhibited a decrease in its responses. A single-trial GLM analysis detected that fifteen of the twenty regions also had significant correlations between trial-by-trial BOLD responses and response times; however, the GR cluster was not directly correlated with response speed. Using structural equation modeling, we found a significant indirect pathway between GR activity and response times via a network of lateral frontal regions and the anterior-medial caudate nucleus. We confirmed a structural link between the GR and the caudate using streamline tractography from diffusion spectrum imaging. The location of Stroop-related activity in the Caudate was situated directly between where fibers from GR and rostral middle frontal gyrus terminate, an ideal spatial location for integrating information from these two areas. These results suggest that the GR may indirectly modulate the speed of response selection through convergent cortico-striatal pathways with lateral frontal regions.

H43

REWARD RELATED BRAIN ACTIVITY IS INCREASED FOLLOWING EFFORTFUL SELF-REGULATION

Dylan D. Wagner[1], Myra Altman[1], Rebecca G. Boswell[2], William M. Kelley[1], Todd F. Heatherton[1]; [1]Dartmouth College, [2]Yale University — Successful self-regulation requires that individuals match the strength of desires with sufficient control to overcome them.

One popular model of self-control failure posits that self-control relies on a domain general resource which can become temporarily depleted through use, thereby leading to impaired self-control in subsequent tasks. In the present study, we investigated the role of self-regulatory depletion on subsequent neural responses to a natural reward (i.e., high-calorie foods) in thirty-one female chronic dieters, half of which completed a difficult attention control task prior to viewing food images. Compared to dieters whose self-regulatory resources had not been depleted, depleted dieters demonstrated greater food-cue related activity in a region of the orbitofrontal cortex (OFC) associated with coding the rewarding and liking aspects of desirable foods. Moreover, functional connectivity analysis (i.e,, psychophysiological interactions analysis) revealed differential connectivity between control and depleted dieters, such that depleted dieters exhibited reduced connectivity between the OFC and the inferior frontal gyrus. These results suggest that prior self-regulatory exertion provokes subsequent self-control failure by reducing top-down regulation of the OFC which in turn enhances the reward value of temptations.

H44

THE DEVELOPMENT OF INHIBITORY CONTROL: FACT, FICTION, OR ATTENTIONAL CONTROL?

Warren Winter[1], Margaret Sheridan[1,2]; [1]Boston Children's Hospital, [2]Harvard Medical School — The Go/NoGo task (GNG) has been widely used to measure the development of inhibitory control across childhood. However, the prepotency manipulation (frequent Go trials preceding infrequent NoGo trials) confounds inhibition with attentional control by requiring context monitoring, or vigilance for rare signals. Moreover, developmental studies using the GNG inconsistently reveal improvements in NoGo performance over and above improvements on Go trials. Indeed, maturation of attentional control may underlie developmental variation in GNG performance. We test this hypothesis in 137 typically developing children (ages 4-13 years) in two experiments (Exp1 and Exp2). In Exp1, prior to the GNG we rewarded one picture that became a NoGo stimulus and found that this previously rewarded NoGo (R-NoGo) stimulus generated fewer errors of commission relative to a previously unrewarded NoGo (UR-NoGo) stimulus. This finding demonstrates that attention to the NoGo stimulus increases behavioral control. Exp2 added to the paradigm feedback (which did not indicate accuracy) following each button press. Errors of commission increased in Exp2 relative to Exp1, suggesting that increasing the salience of the "Go" goal interfered with maintenance of the "NoGo" goal. Age was associated with errors of omission in both experiments and with errors of commission on UR-NoGo trials in Exp2. After controlling for baseline Go performance, the effect of age on errors of commission on UR-NoGo trials lost significance. Altogether, our results suggest that NoGo performance primarily reflects attentional control that might be more important than motor inhibition for the maturation of everyday self-regulation.

H45

ELECTROPHYSIOLOGICAL DIFFERENCES IN INHIBITORY CONTROL BETWEEN ADHD ADULTS AND THEIR PEERS.

Alan Rokeach[1], Steven Woltering[1], Zhongxu Liu[1], Rosemary Tannock[1,2]; [1]University of Toronto, [2]The Hospital for Sick Children — Inhibitory control allows individuals to suppress prepotent responses and resist irrelevant stimuli, and is thought to be a core deficit in Attention-deficit/hyperactivity disorder (ADHD). While research documenting difficulties in inhibitory control in children with ADHD is extant, less is known about the neural mechanisms underlying this deficit in college students with ADHD – a population that, despite comparatively high educational attainment, still show marked functional impairments in academic, social, and occupational functioning. The present study investigated the neural correlates of inhibitory control in a sample of 60 college students with ADHD and 25 typically developing peers. Specifically the fronto-centrally located N2 and P3 event-related potential (ERP) components were examined due to their known association with response inhibition. Dense array electroencephalography (EEG) data was collected during a Go/Nogo task. Results show significant reductions in the N2 and P3 ERP components during a 200ms -600ms period after subjects correctly inhibited a response. We conclude that when compared to their typically developing peers, ADHD college students show a deviant neural signature, possibly mediated by frontal systems. These results contribute to the growing literature of adult ADHD, increase our understanding of the neural correlates of inhibitory control in ADHD, and may have important implications for clinical and academic practice.

H46

LEFT INFERIOR PARIETAL LOBE AS BOTTLENECK IN DUAL-TASKING: EVIDENCE FROM TRANSCRANIAL DIRECT CURRENT STIMULATION

Britta Worringer[1], Houpand Horoufchin[1], Antonello Pellicano[1], Harshal Patel[1], Jiun-Yiing Hu[2], Iring Koch[3], Ferdinand Binkofski[1]; [1]Division of Clinical and Cognitive Neurosciences, Medical Faculty, RWTH Aachen University, Germany, [2]Department of Neuroscience, Wellesley College, USA, [3]Institute of Psychology, RWTH Aachen University, Germany — Recent literature of dual-task studies indicate that brain activation, especially in the left inferior parietal cortex, is associated with delayed processing of the second task, which presumably reflects the competition for neuronal resources (bottleneck)1. Consequently we hypothesized that transcranial direct current stimulation (tDCS)-induced lowered or enhanced excitability of neurons in the left inferior parietal cortex results in decreased or increased performance particularly of the second task. To test our hypothesis we set up a colour and shape discrimination reaction-time-dual-task with different stimulus onset asynchronies (SOAs of 0ms, 300ms, 900ms). Participants responded to the stimuli with both hands and underwent a baseline measurement without any stimulation before they repeated the task under anodal, cathodal, or sham stimulation condition. Results of 30 right-handed participants show a significant 3-way interaction between SOA, stimulation, and block. Participants who received cathodal-tDCS on their left inferior parietal lobe were slowest in responding to the second stimulus, while participants who received anodal-tDCS on their left inferior parietal lobe were fastest in responding to the second stimulus, specifically at short SOAs. There was no difference in response times to the second stimulus at long SOAs. Our results not only support previous findings that the left inferior parietal lobe is associated with the interference effects in dual-tasks, moreover they explicitly demonstrate a causal relationship between the excitability of neurons in this area and the performance of the second task in dual-tasking. 1Sigman & Dehaene (2008). Brain mechanisms of serial and parallel processing during dual-task performance. Journal of Neuroscience,28(30), 7585—7598.

H47

FALSE MEMORIES CAN BE MODULATED BY TRANSCRANIAL DIRECT CURRENT STIMULATION (TDCS)

Bastian Zwissler[1], Sina Aigeldinger[1], Christoph Sperber[1], Sebastian Schindler[2], Johanna Kissler[2], Christian Plewnia[1]; [1]University Hospital Tübingen, [2]University of Bielefeld — Studying false memories gives insights into basic memory (control) mechanisms and executive functioning. One paradigm that allows for the systematic investigation of false memories - directed forgetting (DF) - has been investigated in a multitude of design variants and populations. In its item-method variant, participants are presented an array of stimuli, each of which is followed by a remember (R) or a forget (F) instruction. On a subsequent surprise memory test, recognition rate for R stimuli is generally higher than for F stimuli. Previous studies of the authors suggest this effect to be borne not only by veridical but also by false memories. The present study aimed at modulating false alarms by transcranial direct current stimulation (TDCS). TDCS is a non-invasive, well-tolerated technique that is used to investigate healthy and impaired neuronal functions. Cortical activity is thought to be enhanced by anodal TDCS and to be reduced by cathodal TDCS. Eighty-three healthy subjects participated in a double-blind sham-controlled crossover study. TDCS (20min, 1mA) to the left dorsolateral prefrontal cortex (dlPFC) or sham stimulation were applied during the encoding phase of a DF task. Whereas hits yielded the classic DF effect in all three groups, false alarm patterns differed massively. Under anodal stimulation, false alarm rates were significantly higher than under sham stimulation. Under cathodal stimulation, in turn, they were significantly lower. No between-group response bias difference was observed. To our knowledge, this is the first study that shows a dose effect of brain stimulation on a complex cognitive task.

H48

EFFECTS OF REDUNDANT FEEDBACK ON THE RESPONSE RELATED ERN Loni Lebanoff[1], Siri-Maria Kamp[1], Yael Arbel[1], Emanuel Donchin[1]; [1]University of South Florida — Incorrect responses in speeded reaction time tasks are associated with the elicitation of two ERP components, the Error Related Negativity (ERN) and the P300. When the accuracy of the performance cannot be evaluated without an external feedback, the ERN is known to be elicited by the informing feedback. The purpose of the presented experiment was to elucidate the extent to which redundant feedback (feedback which is not necessary for task performance) affects the attributes of the error related ERP components. Nine participants completed a Flanker task in two sessions which differed in the extent to which performance feedback followed the participant's responses. In one session, no feedback was provided, while in the other session, each response was followed by performance feedback. Participants were instructed to perform as quickly and as accurately as they can. The results of the study indicated that the amplitude of the response ERN was larger when no feedback was provided, while the P300 amplitude remained constant. These results suggest that the presence of feedback, regardless of its usefulness for task performance affects performance monitoring. Our data suggest that when feedback is provided, participants tend to rely on it to some degree, or in other words, to shift some of the monitoring "responsibility" to the external source.

H49

SAME STIMULI BUT DIFFERENT INSTRUCTIONS INDUCE DIFFERENT ELECTROPHYSIOLOGICAL RESPONSES Kazufumi Omura[1], Asuka Otsu[1], Ai Sakamoto[1], Kenji Kusumoto[1]; [1]Yamagata University — We investigated the influence of instructional differences on electrophysiological responses in an arrowhead-type hybrid flanker-Go/Nogo task. Twenty-nine right-handed healthy participants (mean age: 20.97 years; S.D.: 0.50) performed a hybrid flanker-Go/Nogo task with simultaneous electroencephalographic recording. Four arrowhead strings (congruent: <<<<<, >>>>>; incongruent: <<>><<, >><>>) were prepared as the stimuli. Participants had to focus on the central target arrowhead. In the flanker task, participants were instructed to respond to the central target arrowhead by pressing the left or right button depending on the direction the arrowhead pointed, i.e., left or right, respectively (congruent condition: <<<<<, >>>>>; incongruent condition: <<>><<, >><>>). In the Go/Nogo task, they were asked to press the left or right button upon appearance of the central target arrowhead when all arrowheads pointed in the same direction (Go condition: <<<<<, >>>>); the prepared motor response had to be suppressed upon appearance of the central target arrowhead when all arrowheads pointed in the opposite direction (Nogo condition: <<>><<, >><>>). We compared the congruent condition in the flanker task with the Go condition in the Go/Nogo task. Both conditions required the same responses to the same stimuli but involved different instructions. The amplitude of the P3 in the Go condition was significantly larger than that in the congruent condition. Further, the behavioral reaction time in the Go condition was significantly longer than that in the congruent condition. It is plausible that the task strategy involving same stimuli but different instructions induces different neural processing.

H50

DIFFERENCES IN FUNCTIONAL CONNECTIVITY DURING RESTING STATE FMRI IN INDIVIDUALS WITH ANIRIDIA Jordan Pierce[1], Amanda Rodrigue[1], Cynthia Krafft[1], Anastasia Bobilev[1], James Lauderdale[1], Jennifer McDowell[1]; [1]University of Georgia — Aniridia is a congenital disorder caused by heterozygous null mutations within PAX6, a paired-box transcription factor, or cytogenetic deletions of chromosome 11p13 that encompass PAX6. This condition is relatively rare, affecting one in sixty thousand individuals, and is typically associated with congenital eye defects. Abnormalities in brain structure have also been reported including reduced volume of the interhemispheric commissures and polymicrogyria. Previous studies also have indicated subtle cognitive deficits in executive function and social cognition, though few have investigated this population using functional neuroimaging. "Resting state" functional magnetic resonance imaging (fMRI) can be used to investigate co-activations of widespread brain networks when no task is being performed. One such network, the default mode network (DMN), is often found to be anti-correlated with brain activity during tasks and may reflect ongoing neural processes including self-referential thought. In the present study, resting fMRI scans have thus far been collected from 13 adults with aniridia and 8 age- and gender-matched controls. Group-level independent components analysis with dual regression was performed on the resting state data to obtain individual functional maps corresponding to group networks. Preliminary group comparison results show that the aniridia group has greater functional connectivity with the DMN in a region of the left middle frontal gyrus. This region is involved in higher cognition and the increased connectivity may indicate a greater need for top-down control of DMN functioning. Alterations in neural structure in individuals with aniridia may also contribute to the observed differences in functional connectivity.

H51

NEURAL CORRELATES OF CONFABULATION Mara Serra[1,2], Raffaella Migliaccio[2], Valentina La Corte[2,3], Marta Brazzarola[4], Ilaria Zannoni[4], Gianfranco Dalla Barba[1,2,3,4,5]; [1]Dipartimento di Scienze della Vita, Università degli Studi di Trieste, Trieste, Italy, [2]Centre de Recherche de l'Institut du Cerveau et de la Moelle épinière, UMR-S975, Paris, France, [3]Université Pierre et Marie Curie-Paris, Paris, France, [4]Centro di Foniatria, Unità Operativa per l'Afasia, Villa Valmarana, Padova, Italy, [5]Service de Neurologie, AP-HP, Hôpital Henri Mondor, Créteil, France — Confabulation is the production of statements and actions, unintentionally incongruous to the subject's history, present and future situation (Dalla Barba, 1993a). It is mostly common among patients affected by Korsakoff syndrome and those with rupture of aneurysms of the anterior communicant artery. In this study we used a modified version of the confabulation battery (Dalla Barba & Decaix, 2009) to quantify confabulations in seven confabulating amnesics (CA) compared to six non confabulating amnesics (NCA) and matched healthy controls. For each patient a CT scan or a MRI was obtained in order to describe the brain lesion underlying the cognitive profile. Overall CA produced 203 confabulations whereas NCA only nine. Grey matter lesion analysis showed a greater involvement of the ventral and parasagittal prefrontal cortex, right-lateralized in six CA and left-lateralized just in one CA patient. By using a white matter atlas we estimated that all CA patients' lesions involved the frontal branches of the uncinate fasciculus, connecting anterior e medial temporal lobe portions with ventro-medial prefrontal cortices. NCA presented isolated lesions in the medial temporal lobe (MTL) without lateralization. The NCA lesions indicate that an isolated damage of the MTL causes amnesia but no confabulation. The CA patients' performances were associated with lesions in the ventral and parasagittal prefrontal cortices with greater right lateralization, involving the uncinate white matter bundle. Within this framework, the confabulation might be caused not only by frontal lesions, but also by a functional disconnection between the frontal cortex and the MTL, through the uncinate fasciculus.

H52

NETWORKS INVOLVED IN CONFLICT-RELATED MODULATION OF VISUAL PROCESSING: A COMBINED EEG-DTI STUDY. Marlies E. Vissers[1], Heleen A. Slagter[1], Rudy L. van den Brink[1], Michael X Cohen[1]; [1]University of Amsterdam — Selective attention to a visual feature such as color involves top-down modulation of visual processing. At present, it remains unclear whether similar modulations also occur in a situation that requires fast reactive control, for example in the case of response conflict. Therefore, we examined whether performance on a color-motion response conflict task involves top-down modulation of activity in visual areas using electroencephalography (EEG). In addition, we explored whether these modulations are predicted by anatomical brain connectivity using white matter diffusion tensor imaging (DTI). In the task, subjects responded to one visual feature (e.g., color) while ignoring the other stimulus feature (i.e., motion). Time-frequency analyses of the EEG-data showed a conflict-related increase in low theta power (3 – 6 Hz) over mediofrontal regions, as predicted from previous research. Moreover, conflict enhanced fronto-posterior functional connectivity in the upper theta band (6 – 8.5 Hz; measured through phase synchronization between mediofrontal and parietal electrodes). Using DTI, we investigated the relationship between this conflict-related functional connectivity and the strength of anatomical pathways related to color (V4) and motion (hMT+) processing (regions were defined via fMRI localizers). Cross-subject correlations showed that anatomical pathways connecting V4

and hMT+ to regions in the ventrolateral prefrontal cortex, and to regions within the ventral visual pathway, differentially predicted individual differences in conflict modulation of fronto-posterior connectivity. These findings provide novel insights into the role of the frontal cortex in conflict-related top-down control over visual processing, and reveal a functional role of individual differences in the underlying structural brain networks.

H53

PERSISTENT COGNITIVE IMPAIRMENTS FOLLOWING SEPSIS

Erin Zelinski[1], Janice Sutherland[1,3], Scott Oberg[1], Derrice Knight[2,3], Matt Tata[1], Christopher Doig[2,3], Robert Sutherland[1,3]; [1]Canadian Centre for Behavioural Neuroscience; Dept of Neuroscience; University of Lethbridge, [2]Dept of Community Medicine; Faculty of Medicine; University of Calgary, [3]Alberta Sepsis Network — Sepsis is a pervasive bacterial infection that can overwhelm the immune system, potentially resulting in organ failure, coma, or death in severe cases. Sepsis typically results in admission to a hospital's intensive care unit (ICU) because of its relatively high mortality rate. Sepsis survivors often complain of memory or attention problems following recovery, but few empirical investigations into such cognitive changes have been conducted. Therefore, a subset of tests from the Cambridge Neuropsychological Automated Test Battery (CANTAB) and electroencephalography recording during Iowa Gambling Task (IGT) performance were administered to measure levels of cognitive abilities using standardized testing. Participants included individuals who recovered from Sepsis that required care in the ICU 12 to 18 months prior to participating in the study. Age- and sex-matched controls were used for all between group comparisons. Impairments were observed among the Sepsis group on various CANTAB subtests, particularly in the domains of visual memory and executive functions. Relative to controls, the Sepsis group also exhibited poorer performance on the IGT. Together, these results support the hypothesis that alterations in cognitive performance are observed amongst Sepsis survivors following recovery that can significantly impact daily function. The observed cognitive impairments are associated with long-term neurobiological dysfunction of prefrontal and temporal cortical regions.

H54

ALTERED PATTERNS OF NEURAL CONNECTIVITY ARE ASSOCIATED WITH COGNITIVE PERFORMANCE AND DISEASE SEVERITY IN RELAPSING-REMITTING MULTIPLE SCLEROSIS

Alisha Janssen[1], Aaron Boster[2], Amir Abduljalil[3], Ruchika Shaurya Prakash[1]; [1]Department of Psychology, The Ohio State University, [2]Department of Neurology, The Ohio State University, [3]Wright Center for Innovation, The Ohio State University — Multiple sclerosis is a neurodegenerative, inflammatory disease of the central nervous system, resulting in physical and cognitive disturbances. The goal of the current study was to examine the association between resting-state network integrity and composite measures of cognitive and disease decline through the recruitment of thirty-seven individuals with a clinically definite diagnosis of relapsing-remitting MS and thirty age, gender and education matched healthy controls. ICA and dual-regression techniques revealed nine networks of interest, six of which exhibited group level differences including the Fronto-Executive network, Left and Right Fronto-Parietal networks, Motor network, Lateral and Medial visual networks. An analysis of brain-behavior correlations revealed significant associations between functional integration in the Left-Frontoparietal network and Fronto-Executive network with a composite of processing speed performance. Specifically, increased synchronization in RRMS patients between the Fronto-Executive network and the left post-central gyrus was positively related to processing speed abilities, signifying a possible compensatory activation of motor areas during executive processing. Functional integration between the left fronto-parietal network and the dorsal posterior cingulate gyrus (dPCC) was also positively associated with processing speed performance, exemplifying the importance of the dPCC in task-positive and task-negative network dynamics involved in preserved cognitive functioning. Progression in disease severity, as measured by a composite score of disease advancement, displayed negative associations with network synchrony in the lateral visual network, responsible for visual association processing. These findings illustrate a defined association between the MS brain at rest and behavioral measures of disease progression, supporting the existence of neural based behavioral changes in disease.

H55

EVENT RECONSTRUCTION REVEALS RELATIONAL REPRESENTATIONS THAT DO NOT OVERLAP WITH THE SEMANTIC INFORMATION PRESENT IN THE EXPERIMENT.

Patrick Watson[1,2], Wang Jane[3], Cohen Neal[1]; [1]University of Illinois at Urbana-Champaign, [2]Sandia National Laboratories, [3]Northwestern University — Recent research highlights the importance of default network structures to constructed experience: imagining, configuring, manipulating, and remembering compositions of items and relations. We present a method designed to examine reconstruction of specific compositions. Participants viewed a short movie clip and then immediately reconstructed the configuration of items, locations, and times present in the clip. By examining the overlap between participants' reconstructions and reconstructions from prior trials we were able to disambiguate participants' performance which was due to memory for the current configuration, from that which what was due to shared semantic structure present across study trials. This helps provide a clean signal separating brain activity modulated by information present in a particular trial from activity coding information across trials. Behaviorally, we observed no benefit for reconstructing relations that appeared simultaneously versus those that appeared at different times. In addition, after controlling for the complexity of bindings, there was no difference in performance for within-domain bindings (e.g., inter-item or inter-location bindings), yet there were pronounced performance differences for cross-domain bindings (e.g., item-to-location bindings). Additionally, performance on one type of binding often predicted performance on another type, suggesting that these bindings were not encoded independently, but rather as a single "chunk," and these chunks closely corresponded to bindings which one could infer from the experiment's cross-trial shared semantic structure. This suggests that participants are using complementary systems to represent within and across trial information and it may be possible to examine different brain networks' contribution to the interaction of these systems.

H56

"REAL-TIME EEG-BASED PREDICTION OF MENTAL WORKLOAD IN A MULTITASKING ENVIRONMENT"

Monica Weiland[1], Dan Roberts[1], Matthew Caywood[1], Hal Greenwald[1], Jeffrey Colombe[1]; [1]The MITRE Corporation — In evaluating new Air Traffic Control (ATC) automation, it is critical to objectively measure its impact on controllers' mental workload. To this end, we investigated neurophysiological correlates of traffic load in ATC simulations using electroencephalography (EEG). We had three goals: 1) develop machine learning methods that predict mental workload imposed by varying traffic levels (taskload) , 2) identify EEG features that correlate to taskload, and 3) understand individual differences in EEG features that measure workload. In this study, eight subjects matched for gender and age performed realistic 'human-in-the-loop' ATC simulations with taskload as a within-subject variable. This multitasking environment required controllers to intermix visual, speaking, motor, and listening tasks. Our Gaussian process regressor achieved moderate power in predicting taskload. Comparisons of significant features between linear regression analysis and machine learning indicate that beta and gamma were consistently significant and were among the most informative EEG features for all subjects. These results are consistent with studies using the MATB and military training exercise, suggesting that beta and gamma power increases are related to workload in multitasking environments. Gamma effects were more global, whereas beta effects were occipital-temporal, distinct from the frontal, central and parietal taskload effects reported by others in their ATC task. However, their ATC task did not include speaking and listening, which could explain why our subjects had more temporal effects. These results indicate that EEG-based measures of workload can be developed for multitasking environments such as ATC.

H57

ALPHA OSCILLATIONS VARY WITH TEMPORAL PREDICTIONS COUNTERACTING WORKING MEMORY DEMANDS

Anna Wilsch[1], Molly Henry[1], Björn Herrmann[1], Burkhard Maess[1], Jonas Obleser[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany — Increased alpha power (8--13 Hz) has been associated with increasing working memory demands, e.g. for speech in noise, likely reflecting increased inhibition of task-irrelevant information. In contrast, temporal predictions

are hypothesized to reduce memory demands, but the neural dynamics of this trade-off are not well understood. Using magnetoencephalography, we presented syllable pairs (S1–S2) in an ongoing, individually adjusted noise masker while subjects (N=18) performed a delayed-matching-to-sample task. Temporal predictability was manipulated with "short", "long", or "neutral" (unknown foreperiod) cues indicating the approximate onset time of S1. We performed event-related (ERFs) and time–frequency analyses (also in source space). First, behavioral and ERF results indicated that temporal predictability reduced cognitive demands: Informative foreperiod cues elicited shorter reaction times and higher accuracy than neutral cues. Also, ERFs to S1 were reduced for long-foreperiod trials. Second, non-phase-locked alpha power was increased during memory retention for unknown-foreperiod compared to cued-foreperiod trials, highlighting the tradeoff between cognitive demands and temporal predictability. An interaction with actual foreperiod duration showed that longer foreperiods attenuated alpha power only following neutral cues. Third, alpha power dynamics were also directly correlated with performance modulation: Individual alpha power differences between unknown-foreperiod and cued long-foreperiod trials predicted the respective difference in performance. Alpha power changes during memory retention originated from bilateral Heschl's gyri and posterior cingulate cortex, implicating functional inhibition in the auditory system. The results underline that temporal predictions not only benefit performance, but can directly counteract neural signatures of increased cognitive demand for speech in noise.

H58

MEG EVIDENCES FOR DISSOCIATIONS OF WORKING AND EPISODIC MEMORY

Bethany C. Y. Wu[1,2], David E. J. Linden[3,4], Stephan G. Boehm[5]; [1]Taiwan Mind & Brain Imaging Center, TMBIC, [2]Department of Psychology, National Chengchi University, Taiwan, [3]School of Psychology, Cardiff University, United Kingdom, [4]School of Medicine, Cardiff University, United Kingdom, [5]Wolfson Centre for Clinical and Cognitive Neuroscience, School of Psychology, Bangor University, United Kingdom — Working memory refers to the temporary storage and manipulation of information in the service of ongoing task demands, and episodic memory to the long-term storage of events. Working memory and episodic memory have long been considered to be two distinct but interacting memory systems, where working memory acts as the pathway to and from episodic memory. Studies on the neural underpinnings of working and long-term memory have shown that both engage widely overlapping brain regions, questioning the dissociation of the two systems. However, preliminary studies in our lab have shown that successful performance of faces in working memory does not result in better episodic memory for these faces, questioning the ingoing direction of the pathway from working to episodic memory. Here we investigated the neural underpinning of these memory systems with Megnetoencephalography and the importance of working memory for successful episodic memory with behavioral means. Participants performed a working memory test with faces, followed by an episodic memory for the faces from the working memory task. Evoked magnetic fields for working memory showed old/new effects around 300-500 ms and 500-700 ms at frontal-central sensors and for episodic memory around 500-800 ms at left-parietal sensors. Successful performance for faces in working memory test did not lead to better memory for these faces in the episodic memory test. These results show that the functional dissociation of working and episodic memory is supported by distinct neural underpinnings, but suggest that the creation of episodic memory does not depend on successful working memory performance.

H59

CHOLINERGIC ENHANCEMENT IMPROVES VISUAL SHORT-TERM MEMORY PERFORMANCE

Sahar M. Yousef[1,2], Summer L. Sheremata[1,2], Rachel K. Kaneta[2], Michael A. Silver[1,2]; [1]UC Berkeley Helen Wills Neuroscience Institute, [2]UC Berkeley Vision Science Dept., School of Optometry — Visual short-term memory (VSTM) refers to the retention of visual information from the immediate environment over brief intervals. In patients with mild cognitive impairment, pharmacologically increasing synaptic levels of acetylcholine (ACh) facilitates VSTM by boosting the rate of information processing (Bublak et al., 2011). We therefore hypothesized that cholinergic enhancement would improve VSTM performance in healthy subjects. Synaptic ACh levels were elevated by administration of the cholinesterase inhibitor donepezil in a placebo-controlled, double blind crossover design. Subjects were presented with a set of colored squares for either 100 or 200 ms, and consolidation of the set was disrupted by subsequent presentation of a visual mask. A second set of colored squares was then presented that was either identical to the first set or contained one square of a different color. Subjects were asked to report whether the second set was identical to the first set or not. We assessed the effects of donepezil for set sizes that were based on each subject's VSTM capacity (k), measured prior to the pharmacological manipulation. We found that for 100 ms stimulus presentation, cholinergic enhancement improved VSTM performance, consistent with the hypothesized beneficial role of ACh in information processing in VSTM. However, no effect of donepezil on VSTM performance was observed for longer stimulus durations (200 ms). Our results suggest that cholinergic enhancement can improve VSTM performance but that this may occur only for conditions in which memory performance is limited by the amount of time subjects view the material to be encoded.

H60

TIMING OF CORTICAL EXCITABILITY DURING A VISUAL WORKING MEMORY TASK

Theodore Zanto[1], James Chadick[1], Adam Gazzaley[1]; [1]University of California San Francisco — Alpha band (8-12 Hz) phase dynamics in the visual cortex are thought to reflect cortical excitability. As such, visual stimuli are better detected when presented during specific phases of the alpha cycle. However, it is unclear whether critical temporal windows around stimulus onset exist that are optimal for cortical excitability. To address this, participants performed a delayed-recognition working memory task for visual motion direction during two separate visits. The first visit utilized functional magnetic resonance imaging to identify neural regions involved in the task. These data showed involvement of visual cortical area V5, as well as a region in the PFC, the inferior frontal junction (IFJ). During the second visit, transcranial magnetic stimulation (TMS) was applied to the IFJ and V5 (and vertex as control) while electroencephalography (EEG) was recorded. During each trial, a single TMS pulse was applied to one of six time points (-200, -100, -50, 0, 80, 160 ms) relative to the encoded stimulus onset. Results showed that a TMS pulse applied to V5 that happened to occur during the trough of the posterior alpha phase yielded slowed subsequent response times to the target stimulus 2 seconds later (compared to stimulation during peak alpha phase) and increased early event related potential (ERP) amplitudes of the target. Interestingly, this occurred regardless of when the TMS pulse was applied relative to stimulus onset. These results suggest that ongoing alpha phase, and not specific time-windows relative to stimulus onset, serve to modulate processing states that in turn influences working memory.

H61

HOW THE NEURAL CORRELATES OF RECOGNITION MEMORY CHANGE OVER BRIEF DELAYS

Halle R. Zucker[1,2], Elizabeth A. Kensinger[1,2]; [1]Boston College, [2]Harvard Center for Brain Science — Extensive research has examined how memory retrieval is affected by the remoteness of memories. Most of this research has compared retrieval of information with delay intervals that differ in days or even in years. In the present study, we examined whether recognition memory processes would also differ across much shorter delays, ranging from 1 to 11 seconds. While undergoing fMRI scanning, 17 healthy young adults (mean age=21.8 years; 8 female) studied 4-item lists of semantic associates related to a common non-presented semantic theme (e.g., hope, want, desire, dream all related to WISH). A parametrically varied delay interval (1000, 3400, or 11,000 milliseconds) followed during which participants completed a number shadowing task to prevent rehearsal of the memory set. Following this delay, participants were given a recognition probe (studied, related/unstudied, unrelated/unstudied) to assess memory. Activity in regions implicated in semantic interference resolution (left inferior frontal gyrus; Talairach coordinates [Tal] -44, 27, -5) as well as familiarity processes (parahippocampal gyrus [PHG]; Tal 26, -37, -10) parametrically varied for hits more than for correct rejections of unrelated items. Correctly rejecting related themes as compared to unrelated themes showed a parametrically varying relationship in familiarity regions (PHG; Tal 20, -36, -12). Thus, we replicate the finding that veridical memory relies on semantic interference resolution processes. Additionally, we demonstrate an increased reliance on familiarity traces with increasing retention time both when correctly remembering studied and non-studied themes.

H62

BRAIN DYNAMICS COMPARISON BETWEEN INFANTS AND ADULTS DURING PERCEPTION OF NATIVE VERSUS NON-NATIVE CONSONANT-VOWEL CONTRASTS

Silvia Ortiz-Mantilla[1], Jarmo A. Hämäläinen[2], April A. Benasich[1]; [1]Rutgers, The State University of New Jersey, USA, [2]University of Jyväskylä, Finland — Evoked (phase-locked) and induced (non-phase-locked) stimulus-related modulation of cortical rhythms has been described in theta (3-8Hz) and gamma (30-80Hz) bands during speech perception. To explore the spectral composition of event-related potentials (ERPs) during perception of native versus non-native consonant-vowel contrasts, 6-month-old infants born into monolingual families, and right-handed, monolingual adults were presented with an oddball paradigm using consonant-vowel contrasts with a standard (phonetically relevant in English and Spanish), a native English deviant and a non-native Spanish deviant. Dense array EEG/ERPs were collected using a 62-channel EGI net and mapped into age-appropriate brain templates. Source modeling placed dipoles in auditory and frontal cortices. Temporal-spectral analyses were conducted in source space using a 2-80Hz frequency band range (-300 to 930 ms) with 1Hz wide frequency bins and time resolution of 50 ms. Changes in frequency band amplitude, as a function of time relative to stimulus presentation, were evaluated using measures of temporal spectral evolution. Inter-trial phase locking values measured how consistently the phase at different frequency bands synchronized across trials. Permutation testing in combination with data clustering analyses showed that similar to adults, but at different frequencies, 6-month-olds infants already favored processing of native over non-native contrasts. Theta oscillations underlay infant and adult evoked responses in auditory cortices during syllable perception particularly for native contrasts. Induced activity was also prominent in theta band, 4-6Hz in infants and 3-8Hz in adults with frontal enhancement of low gamma oscillations for the native deviant in infants and left temporal high gamma oscillations in adults.

H63

ANATOMICAL CORRELATES OF LANGUAGE VARIABILITY IN AUTISM

Emmaly Owens[1,2], Brandon Kopald[1], Sephira Ryman[2], Carly Demopoulos[1], Karen Cooper[1], Jeffrey Lewine[1,2]; [1]Mind Research Network, [2]University of New Mexico — Autism spectrum disorders (ASDs) are characterized by deficits in social reciprocity and communication. Research has demonstrated a significant heterogeneity in communication abilities across the phenotypic presentation of autism, but the neurobiological underpinnings of this intra-subject variability in language abilities are poorly understood. This study sought to determine the extent to which variability in language function in the ASDs could be accounted for by variability in cortical gray matter volume. A total of twenty-four children with an ASD were evaluated (ages 5-18 years). Communication ability was assessed using the Clinical Evaluation of Language Fundamentals (CELF-IV). Magnetic resonance images (MRIs) were obtained on a 3-T scanner and were analyzed via voxel-based morphometry (VBM, Ashburner and Friston, 2000), using the CCHMC pediatric template. Total language index scores (i.e., CELF Core) on the CELF were positively correlated with GM volume in the right inferior parietal lobe, and negatively correlated with GM volume of the right superior temporal gyrus. Examination of specific language sub-domains revealed that the relationship was driven selectively by expressive language abilities, there being no significant correlations between receptive language scores and GM volume for any brain region. It is noteworthy that language skills in the ASD group were more closely associated with GM volume profiles in the right versus left hemisphere. This is a somewhat unexpected response since the left hemisphere is typically dominant for language. However, the observation is consistent with an emerging body of literature suggesting that atypical cerebral dominance for language is common for many children with ASDs.

H64

ELECTROPHYSIOLOGICAL RESPONSES OF CHILDREN WITH SPECIFIC LANGUAGE IMPAIRMENT TO VIOLATIONS OF MORPHOSYNTAX

J.D. Purdy[1], Laurence B. Leonard[1], Christine Weber-Fox[1], Natalya Kaganovich[1]; [1]Purdue University — Children with Specific Language Impairment (SLI) exhibit delays in the development of language abilities, and these deficits may persist into adolescence and beyond. In the present study, sentences with two distinct types of morphosyntactic violations were presented auditorily to children with SLI between the ages of 7 and 11 years, and to a group of age-matched control children. Sentences of the first type were simple, containing a subject-verb number violation ("When it snows they builds a snowman"). The second type consisted of complex sentences, with a verb in its grammatical non-finite form replaced with an ungrammatical finite verb in the subordinate clause ("She watches the green frog jumps into the water"). Recognition of the violation in the complex sentences depends on knowledge of long-distance syntactic dependencies, which may be diminished in children with SLI. Electrophysiological (ERP) responses showed that the children with SLI displayed a much smaller P600 response to violations in both simple and complex sentences compared to the children in the age-matched control group. Furthermore, in the simple sentences, the children with SLI exhibited a negative voltage deflection (N400), which may indicate that they were using a semantic, rather than morphosyntactic, strategy for recovering the meaning of the sentence. The results are discussed not only in terms of the group differences, but also in terms of why, in the SLI group only, the two types of ungrammatical sentences yielded distinctly different ERP signatures.

H65

COGNITIVE TRAJECTORY IN MALES AND FEMALES WITH FRAGILE X SYNDROME

Eve-Marie Quintin[1], Scott Hall[1], Booil Jo[1], Jennifer Bruno[1], Lindsay Chromik[1], Mira Raman[1], Amy Linghtbody[1], Allan Reiss[1]; [1]Center for Interdisciplinary Brain Sciences Research, Stanford University — Fragile X syndrome (FXS) is the leading known cause of inherited cognitive deficits and impairments. To date, cross-sectional studies have shown that, as a group, males show more severe cognitive impairments than females. However, few studies have compared of cognitive trajectories of males and females with FXS. With a prospective longitudinal design, we measured cognitive functioning of 117 males and 73 females using the Wechsler Scale of Intelligence for Children, 3rd edition (WISC). Over the course of 14 years, we administered the WISC a second time to 51 males and 45 females and a third time to 30 males and 21 females. Participants' ages therefore ranged from 6 to 25 years. We compared cognitive trajectories of males and females for the ten WISC subtests using growth curve analysis. Given significant flooring on standardized scores, we employed percent raw scores. Our analyses revealed that percent raw scores for females increased at a faster rate than scores for males for all subtests. However, how percent raw scores trajectories changed over time was significantly different for females compared to males for the information, similarities, block design, picture arrangement, coding subtests but not for the other subtests. These results significantly expand our knowledge of the role of sex differences in the developmental trajectories of specific cognitive domains in FXS. Our findings suggest that sex is an important factor to consider for interventions targeting cognitive functioning of individuals with FXS from childhood to early adulthood.

H66

WORD LEARNING SHAPES THE INFANT BRAIN: TRAINING INDUCED EFFECTS ON THE PROCESSING OF PHONOTACTIC REGULARITIES IN 6-MONTH-OLD INFANTS

Maria Richter[1,2], Micol Vignotto[1,2], Hellmuth Obrig[1,2], Sonja Rossi[1,2]; [1]University of Leipzig, Medical Faculty, Day Clinic for Cognitive Neurology, Liebigstr. 18, D – 04103 Leipzig, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Stephanstr. 1A, D – 04103 Leipzig, Germany — In language acquisition infants use phonotactic knowledge to segment the incoming auditory speech stream, with phonotactics describing the combinatorial rules of phonemes in a given language. Already 3-month-old infants are sensitive to phonotactic properties of their native language. The present study investigates how brain activity responses to native (i.e., legal) and non-native (i.e., illegal) phonotactic regularities are modulated through training in 6-month-old infants. We therefore acoustically presented phonotactically legal and illegal pseudowords embedded in a semantic training. Each infant underwent a pretest, training, and posttest on three consecutive days. Pretest and posttest included trained and untrained pseudowords. During training the pseudowords were combined with pictures of real objects to create an associative learning setting. Brain activity responses were monitored by means of event-related brain potentials (ERPs) and functional near-infrared spectroscopy (fNIRS). ERPs and fNIRS results revealed a familiarization effect for phonotactically legal and illegal trained pseudowords leading to modu-

lations of brain activity over time. For the ERP data the familiarization was indexed by an increasing frontally distributed positivity, displayed from day 1 to day 3. The modulation was larger for legal than for illegal trained pseudowords and was not present for untrained words. These findings show that word learning mechanisms emerge very early in life eliciting changes in the brain. The familiarization effect indicates that acoustically oriented perceptual mechanisms guide word learning at this early age even within a semantic learning context rather than pure associative learning. Probably, more lexically oriented brain processes establish later during language acquisition.

H67

OUT OF USE, OUT OF SIGHT? WHAT THE EYES GIVE AWAY ABOUT THE UNUSED LANGUAGE: GRAMMATICAL GENDER PROCESSING

Bregtje Seton[1,2], Christopher Bergmann[1], Sanne Meike Berends[1], Susanne Brouwer[1,3], Simone Sprenger[1], Nienke Meulman[1], Laurie A. Stowe[1], Monika S. Schmid[1]; [1]University of Groningen, [2]Rotman Research Institute, [3]Northwestern University — Eye-tracking is often used to investigate language processing of a first or a second language. However, the first language of a second language speaker is often forgotten. So far, there are no eye-tracking studies that focus on the first language of those who moved to a country where their second language became the more prominent language. These so-called first-language attriters (length of residence > 7 years) are the subject of investigation in the present eye-tracking study. A visual world paradigm was used to investigate whether attriters still rely on morphological cues in their first language to predict upcoming targets on the screen. German and Dutch emigrants living in North America were given the task to click on one of four pictures on the screen, as they heard sentences like the German "Wo ist dermasc grüne Apfel?" (Where is themasc green apple?) and "Wo ist ein grünermasc Apfel" (Where is a greenmasc apple?). The target picture would either have a different grammatical gender than the three other pictures (3 distractors) or share the same gender with one of the three other pictures (1 competitor and 2 distractors). Results show that attriters can still rely on grammatical gender cues, but do so less than the native controls that were tested in Germany and the Netherlands. Moreover, German participants seemed to benefit more from gender cues than Dutch participants, suggesting that the importance of grammatical gender in a language influences the ability to rely on gender cues in speech.

H68

SOLID AS A ROCK THE BOAT: HOW AGING AFFECTS DOWNSTREAM COMPREHENSION FOLLOWING LEXICAL AMBIGUITY RESOLUTION

Mallory Stites[1], Kara D. Federmeier[1]; [1]University of Illinois, Urbana-Champaign — The current study uses eye-tracking to investigate the downstream consequences of difficult ambiguity resolution during natural reading in both young and older adults (60+). Noun/verb (NV) homographs (e.g. duck) and unambiguous words were embedded in semantically neutral but syntactically constraining contexts, followed by a prepositional phrase that was plausible for only one of the word's meanings. Using event-related potential measures with the same materials, Lee and Federmeier (2012) found a sustained frontal negativity in young adults, thought to reflect frontally-mediated meaning selection processes, to homographs in these contexts. Additionally, they found plausibility effects on the head noun of the prepositional phrase following both word types, suggesting that the frontal negativity reflected successful meaning selection. In the current eye-tracking study, young, but not older adults, showed inflated first fixation durations to ambiguous relative to unambiguous words. This finding replicates other work showing increased first fixation durations in young, but not older, adults when readers must disambiguate NV homographs using only syntactic cues. Both age groups exhibited plausibility effects in the form of significantly increased reading times on the head noun of the implausible prepositional phrase, which were smaller following homographs than unambiguous words. Furthermore, for both age groups in the ERPs and eye-tracking, the size of an individual's initial effect (first fixation or negativity) was positively correlated with the size of their plausibility effect, suggesting the magnitude of the initial effect may reflect the degree to which the meaning selection mechanisms have been successfully recruited, leading to larger plausibility effects downstream.

H69

A NOVEL META-ANALYTIC TECHNIQUE IDENTIFIES CONSISTENT ABNORMALITIES OF THE CAUDATE NUCLEUS AND FRONTAL CORTEX IN SPECIFIC LANGUAGE IMPAIRMENT

Michael T. Ullman[1], Mariel Y. Pullman[1], Jarrett T. Lovelett[1], Elizabeth I. Pierpont[1], Peter E. Turkeltaub[1]; [1]Georgetown University — GOAL: This study aims to reveal any localized neuroanatomic abnormalities that are consistently present in Specific Language Impairment (SLI). KNOWLEDGE GAPS: Despite numerous studies, a consensus on the neuroanatomy of SLI has yet to emerge. This is likely due to various factors, including small sample sizes and the difficulty in synthesizing the literature while accounting for study-specific features such as sample size and sensitivity/specificity. SOLUTION: A rigorous quantitative meta-analysis of the neuroanatomy of SLI should provide an accurate assessment of the literature. However, no current neuroanatomic meta-analytic technique is statistically rigorous and flexible enough to handle the literature of SLI and other brain disorders. We developed an innovative new neuroanatomic meta-analytic technique, Co-localization Likelihood Estimation (CLE). CLE incorporates the best features of different current techniques, while adding new capabilities. We applied CLE to all studies of the neuroanatomy of SLI: 25 studies encompassing 270 individuals with SLI and 265 typically-developing controls. RESULTS: Only the basal ganglia and frontal cortex are consistently abnormal across SLI studies. Within the basal ganglia only the caudate nucleus is affected. Within frontal cortex, Broca's region is anomalous in functional imaging studies, whereas structural abnormalities are distributed over frontal subregions (primarily motor regions and Broca's region). No left/right differences were observed. SIGNIFICANCE: The results (1) are consistent with the Procedural Deficit Hypothesis of SLI; (2) have clinical implications (e.g., the abnormalities could serve as biomarkers); (3) suggest that CLE may be useful at revealing the neuroanatomy of other brain disorders.

H70

SUPERIOR PITCH PERCEPTION IN AUTISM? EVIDENCE OF AUDITORY MISMATCH NEGATIVITY FROM CHINESE

Luodi Yu[1], Yuebo Fan[2], Zhizhou Deng[1], Dan Huang[2], Yang Fan[1], Suiping Wang[1]; [1]South China Normal University, Guangzhou, China, [2]Guangzhou Rehabilitation & Research Center for Children with Autism, Guangzhou Cana School, Guangzhou, China — Studies in non-tonal languages using auditory stimuli of various levels of complexity have reported superior pitch perception in autism. To further investigate this phenomenon, an oddball paradigm which elicits the mismatch negativity (MMN) was adopted to examine whether and how autistic children show distinct neural responses to a tonal language. Mandarin-speaking children with autism and TD controls' electroencephalography (EEG) signals were recorded while listening to three oddball sequences. In the pure tone condition, 216Hz and 299Hz tones served as the standard and deviant stimuli. In the non-lexical tone condition, non-word syllables /rai2/ and /rai4/ served as the standard and deviant. In the lexical tone condition, Chinese words "bai2" and "bai4" served as the standard and deviant. The MMN in each condition was derived by subtracting the average response to the standard from that to the deviant. The results showed that autistic children displayed an enhanced MMN for pure tone compared to TD children, suggesting they have greater sensitivity to pitch information in physically simple stimuli. Whereas the MMN elicited by non-lexical and lexical tone change were smaller for autism than for TD, suggesting autistic children's deficits in discriminating linguistic pitch information. Taken together, autistic children have speech-specific impairment in pitch perception. According to the perception alteration model (Kuhl, 2008), social impairment may lead to interruption of phonetic learning in autism. We thus propose that the differences between the current results and previous findings on non-tonal languages may be linked to language abnormalities in autistic population.

H71

AUTOMATICITY OF HIGHER COGNITIVE FUNCTIONS: NEUROPHYSIOLOGICAL EVIDENCE FOR UNCONSCIOUS SYNTACTIC PROCESSING OF MASKED WORDS

Laura Jimenez-Ortega[1,2], Marcos García-Milla[1], Sabela Fondevila[1], Pilar Casado[1,2], David Hernández-Gutiérrez[1], Manuel Martín-Loeches[1,2]; [1]Center for Human Evolution and Behavior (UCM-ISCIII), Madrid, Spain., [2]Complutense University of Madrid, Spain. — Most widely

known models of language comprehension assume that syntactic processing is automatic, at least at early stages. However, the degree of automaticity of syntactic processing is still a controversial topic. Furthermore, evidences of automaticity are either indirect or have been observed for pairs of words, which might provide a poor syntactic context in comparison to sentences. The present study investigates the automaticity of syntactic processing using Event-Related Brain Potentials (ERPs) during sentence processing. To this end, subliminal masked adjectives that could be either correct or incorrect appeared just prior to the presentation of supraliminal adjectives that could also be correct or incorrect relative to the sentence being processed. For the first time it is established that subliminal gender agreement violations embedded in a sentence trigger an early LAN component, whereas supraliminal gender agreement violations elicited a late LAN component. Therefore, first-pass syntactic parsing can be unconsciously – and, consequently, automatically- elicited. In addition, subliminal syntactic processes also modulated the P600 component elicited by unmasked targets, probably reflecting that controlled mechanisms of revising a structural mismatch appear affected by subliminal information. Therefore, according to our findings, both conscious and unconscious processes contribute to syntactic processing. These results are discussed in line with most recent theories of automaticity and syntactic processing models.

H72

STRUCTURE-DRIVEN EXPECTATIONS FOR ANIMACY DRIVE EARLY LEFT EVENT-RELATED POTENTIAL NEGATIVITIES THAT ARE NOT OVERRIDDEN BY CONTEXTUAL EXPECTATIONS

Alexis R. Johns[1,2], Heather K. J. van der Lely[3], James S. Magnuson[1,2]; [1]University of Connecticut, [2]Haskins Laboratories, [3]Harvard University — In English, Wh-words provide strong expectations for animacy of upcoming words in syntactically pertinent positions (e.g., a filled potential Wh-gap). Adults asked to fill blanks in sentences like "Who/What did Barbie push the ___ into?" reliably provide referents that mismatch animacy projected by the Wh-word ("who":"car", but "what":"clown"; Fontenau & van der Lely, 2008 [FvdL henceforth]). FvdL argue this follows from animacy predicted for missing Wh-word referents ("who":animate, "what":inanimate). When presented with spoken sentences, animacy expectation violations (AEVs) generated early left anterior negativities (ELANs) in typically developing individuals but not individuals with "Grammatical-Specific Language Impairment", suggesting grammatical features of the Wh-word and filled gap were evaluated syntactically. However, to focus attention on the task, FvdL added final noun phrases to AEV items ("Who did Barbie push the clown into THE WALL?") but not to expected animacy items ("What did Barney push the clown into?"). Rather than ELANs indicating pre-existing grammatical animacy expectations, participants might implicitly learn to predict sentence-final anomalies from AEVs. We tested this by presenting one group with the original contingency (AEV + ungrammatical final noun phrase) and another with the contingency reversed (no AEV + ungrammatical final noun phrase). Contra the learning hypothesis, we observed ELANs for both groups. Thus, violations of structural expectations for animacy drive ELANs, even for sentences participants judge to be grammatical ("Who did Barbie push the clown into?"), suggesting ELANs index processes sensitive to subtle grammatical feature expectations that incur hierarchical syntactic dependencies, and not just outright grammatical structure or category violations.

H73

NEURAL CORRELATES OF PROCESSING PASSIVE SENTENCES

Aya Meltzer-Asscher[1], Jennifer Mack[1], Julia Schuchard[1], Cynthia Thompson[1]; [1]Northwestern University — Research examining the neural mechanisms of noncanonical sentence processing indicates a left-hemisphere network including anterior and posterior perisylvian regions (Ben-Shachar et al., 2003; Fiebach et al., 2005; Thompson et al., 2010). This work has primarily focused on wh-structures (e.g, object relatives). Although passive sentences likewise involve noncanonical argument mapping, they differ from wh-structures in their syntactic properties (Chomsky, 1981) and processing (Osterhout & Swinney, 1993). In several previous studies, passive sentences have elicited inferior frontal gyrus (IFG) activation (Kinno et al., 2008; Ye & Zhou, 2009; Yokoyama et al., 2006, 2007), but mixed findings have been reported with respect to posterior activations. 12 young adults performed a sentence-picture matching task using fMRI. Reversible active and passive sentences were presented auditorily in separate blocks. Scanning took place on a Siemens TIM Trio 3T scanner. Data analysis was performed in SPM8 with group analyses thresholded at $p < .005$ (uncorrected). Passive sentences, relative to active sentences, elicited greater activation in the left IFG (BA 44, 45) and left superior temporal gyrus (STG)/angular gyrus (AG). The reverse contrast showed no activated areas. English passive sentences activated a network similar to that found for wh-structures. Greater activation in the left IFG likely reflects the increased syntactic processing demands of noncanonical structures. Passive sentences also recruited the left STG and AG, which may support non-canonical argument mapping (Hirotani et al., 2011). This suggests that despite linguistic and processing differences between passives and wh-structures, their neural correlates overlap substantially.

H74

LEFT ANTERIOR NEGATIVITIES (LANS) AND MORPHO-SYNTACTIC PROCESSING IN ERP READING STUDIES

Bradley T. Marcinek[1], Michael T. Ullman[2], John E. Drury[1]; [1]Stony Brook University, [2]Georgetown University — We present new data relevant to our understanding of the etiology and reliability of LANs (left anterior negativities) in language ERP studies. LANs may index detection of a mismatch between morphosyntactic features of incoming items in online processing and those expected on the basis of previously encountered information. For example, biphasic LAN/P600 responses have previously been demonstrated for subject/verb agreement violations. However, though LANs for morphosyntactic violations are by no means a rare finding, questions have been raised about their reliability as a number of studies have failed to detect them (i.e., found only monophasic/P600 responses). Factors relevant to the presence/absence of LANs for agreement violations generally (see Molinaro et al. 2011) include, for example: the types of features involved, test languages, and construction type (e.g., subject-verb, determiner-noun, noun-adjective). Here we document another relevant factor: whether English subject/verb agreement violations are realized by the presence of an illegal affix or absence of a required one. In an ERP reading study (N=30) we found only the -s-marked violations (The boys *walks) elicit the biphasic LAN/P600 pattern. The morphophonologically unmarked case (The boy *walk) elicited only a P600. This asymmetry may help explain inconsistencies across past studies: reliable LANs for sub-conditions in such paradigms may sometimes have been averaged out in analyses probing violation main effects. This asymmetry may also be interestingly related to MEG findings documenting very early sensory effects (in visual cortex) for violations marked by the presence (but not the absence) of illegal functional morphemes (Dikker et al. 2009).

H75

DYNAMIC FREQUENCY CORRELATES OF (MORPHO-)SYNTACTIC PROCESSING: INDUCED THETA AND LOWER BETA BAND ACTIVITY DISTINGUISH DEEP SYNTACTIC AND MORPHOSYNTACTIC PROCESSES

Jessamy Norton-Ford[1], Jon Sprouse[1]; [1]University of California, Irvine — Recent work has begun to uncover the dynamic frequency correlates of grammatical processing. Work by Bastiaansen, Magyari and Hagoort (2009) describes lower beta (13-18Hz) and theta (4-7Hz) band activity as representative of unique aspects of sentence processing, including successful composition of syntactic structure (lower beta) and sequential construction of a working memory representation (theta). Using wavelet analysis and RSVP, this work examines the electrophysiological response to three grammatical violations, in which morphological or syntactic form is degraded: case violations (e.g., *The shoppers can find they at the store), subject-verb agreement violations (e.g., *The shoppers can finds them at the store), and Theta criterion violations, in which a verb's requisite argument is omitted (e.g., *The shoppers can find at the store). Non-parametric cluster-based permutation tests find significant decreases in lower beta activity in posterior regions ~500-800ms post-cw following case and agreement violations, and similar but weaker decreases ~300-700ms following disruption of thematic role processing. These results are broadly consistent with Bastiaansen et al., but crucially expand such findings to cases of morphosyntactic agreement and (to a lesser extent) thematic role assignment. Furthermore, cluster analyses uncover a sustained decrease in posterior theta band activity ~650-1000ms post-cw following only the (coincidentally-named) Theta criterion violation. These latter results differ from Bastiaansen et al., indicating a correlation of theta band activity and deep syntactic process-

ing. Taken together, these results are consistent with a model in which theta band activity facilitates composition of syntactic structure, and lower beta activity isolates a morphosyntactic level of syntactic processing.

H76

HOW EARLY IS GRAMMATICAL GENDER INFORMATION AVAILABLE TO ITALIAN READERS? Sendy Caffarra[1], Francesca Pesciarelli[1], Cristina Cacciari[1]; [1]University of Modena and Reggio Emilia — Syntax-first models (Friederici, 2002) posit that syntactic analysis starts at a very early stage (100-300 ms). Consistently, a number of MEG and ERP studies have shown syntactic effects as early as 150 ms after stimulus onset (Dykker et al., 2009; Pulvermuller et al., 2007). The aim of the present study was to establish how early grammatical gender became available to the reader. Given its important role in syntactic structure building (especially in Romance languages), we hypothesized that grammatical gender information should become available between 100 and 300 ms, as predicted by syntax-first models. To this aim, we conducted an ERP study adopting a paradigm designed to monitor an early ERP component, the N2pc. This attentional component was chosen because of its early sensitivity to linguistic variables (Dell'Acqua et al., 2007). 600 Italian noun-adjective pairs whose gender agreed or disagreed were selected. The noun was presented centrally and was followed by two lateralized stimuli (the adjective and a distractor) presented for 200 ms. Participants judged noun-adjective gender agreement. ERP results showed that agreement violations influenced the amplitude of the N2pc between 170 and 310 ms. Specifically, a greater negativity was observed at P7 for the agreement condition relative to the disagreement condition. These results suggest that grammatical gender information is available at an early stage of language comprehension (100-300 ms).

H77

WHEN SYNTAX BEATS SEMANTICS: ELECTROPHYSIOLOGICAL CORRELATES OF CUE-DEPENDENCE IN SECOND LANGUAGE SENTENCE PROCESSING Darren Tanner[1], Eleonora Rossi[1], Janet G. Van Hell[1]; [1]The Pennsylvania State University — Successful language comprehension requires the integration of lexical-semantic and morphosyntactic information. However, some recent proposals claim that individuals largely ignore morphosyntactic cues when comprehending a second language (L2) (Clahsen & Felser, 2006). This proposal holds that bilinguals rely nearly exclusively on semantic and pragmatic cues to sentence meaning in their L2. We investigated this hypothesis by recording event-related potentials while proficient native Spanish speakers of L2 English read sentences that were correct ("The broken television was repaired…"), syntactically anomalous ("The broken television was repairs…"), semantically anomalous ("The hearty meal was repairing…") or contained a conflict between syntactic and semantic cues ("The broken television was repairing…"). The anomaly in the final sentence is signaled by the active morphology on the verb "repairing": the semantic relationship between the subject noun and verb is fully felicitous, though the morphosyntax renders the sentence pragmatically implausible. Previous research in this domain in English monolinguals shows that these semantic role reversals elicit a robust P600-effect, indicating that the syntactic representation becomes vulnerable to reanalysis in the face of a strong semantic attraction between the subject noun and verb (Kim & Osterhout, 2005). However, in addition to showing standard N400- and P600- effects in the semantic and syntactic conditions, results in the conflict condition showed only an N400-effect in our bilinguals. This suggests not only that bilinguals attend to L2 morphosyntactic information, but also that the strength of the syntactic cue can 'win' over lexical-semantic information, leading to vulnerability and reanalysis of the semantic representation.

H78

NUMBER AGREEMENT WITHOUT SURFACE SYNTAX Ming Xiang[1], Genna Vegh[1]; [1]Linguistics, University of Chicago — Although number-mismatch in overt syntax is ungrammatical in English ("John is teachers"), VP ellipsis appears insensitive to such mismatch. "They are teachers, and John is too" is acceptable, although the predicate of the ellipsis site must be recovered from the antecedent, which presents a number-mismatched candidate. Such examples pose questions about whether syntactic agreement can be computed without surface syntax. An ERP study was conducted to investigate processing sensitivity to such number-feature mismatch. 160 sets of 4-condition items were constructed ("The workers/worker here are writers/is a writer, the worker/workers there is/are too"). Behavioral acceptability norming showed no difference between conditions (ps>.4; ranging 5.7-6 on a 7-point scale). For the ERP, 160 4-condition controls were created that contain an explicit subject-predicate number match/mismatch ("The man/men in command is a general/generals"). Preliminary results (n=14) showed that for control items, the determiner in the mismatched agreement case ("are a…") elicited an early positivity between 100-200ms, and a late positivity peaked at 600ms, compared to matched agreement ("is a…"); the plural noun with mismatched agreement ("is generals") elicited an extended late positivity between 600-800ms compared to matched agreement ("are generals"). For target items, in the ellipsis site, for the singular auxiliary "is", the antecedent-mismatched condition elicited an early positivity between 100-200ms; there was little difference on the plural auxiliary "are" between the matched/mismatched conditions. These results suggest number agreement without surface syntax is calculated in online parsing, but unmarked mismatched antecedents (singular) have a smaller effect than marked mismatched antecedents (plural).

H79

THE EFFECTS OF AGING ON THE NEURAL CORRELATES OF MULTIFEATURAL EPISODIC ENCODING Milton Picklesimer[1], Neil Mulligan[1], Kelly Giovanello[1]; [1]University of North Carolina at Chapel Hill — It has been shown that association cortices assist the medial temporal lobes (MTLs) with the formation of rich, multifeatural memories (Uncapher, Otten, & Rugg, 2006). As we age, deficient binding makes it difficult to form such rich memories. Thus, we sought to understand how aging affects the neural correlates of multifeatural encoding. We used a paradigm that required participants to learn words, their font color, and their spatial location. Modifications were made to accommodate older adults and equate their performance with that of young adults. As a result, memory for items and their features did not significantly differ between the two groups. Event-related fMRI, combined with a subsequent memory analysis, was employed. Analyses of trials in which participants successfully encoded an item, its color, and its location revealed several group differences. MTL activity was observed in both age groups, yet this activity was left lateralized in young adults and right lateralized in older adults. Additionally, both age groups showed mostly left-lateralized activity in the prefrontal cortex (PFC), with dorsomedial PFC activity observed in young adults and ventrolateral PFC activity seen in older adults. Finally, older adults showed more left parietal activity, while young adults exhibited more activity in "old brain" brain regions (i.e., left caudate, putamen, and thalamus). Thus, even though multifeatural encoding was behaviorally equivalent between the two, age-related differences in neural activity were observed.

H80

AGE-RELATED CHANGES IN AUTOBIOGRAPHICAL MEMORY, FUTURE-IMAGINATION AND MEMORY FOR SCENES BASED ON REAL-WORLD LANDMARK CUES Jessica Robin[1,2], Jordana Wynn[2,3], Morris Moscovitch[1,2]; [1]University of Toronto, [2]Rotman Research Institute, Baycrest Hospital, [3]McGill University — Studies have shown that older adults provide fewer relevant (internal) details and more irrelevant (external) details than younger adults when describing autobiographical memories and imagined future events (Levine et al., 2002; Addis et al., 2008). This coincides with a decrease in hippocampal activity in older adults (Addis et al., 2011). It has been suggested that memory and imagination are related via a mutual dependence on the ability to conjure a complex spatial scene, a task also dependant on the hippocampus (Hassabis & Maguire, 2007, Hassabis et al., 2007). It follows, then, that older adults should have parallel impairments in autobiographical memory, future-imagination and remembering real-world scenes, owing to a decline in hippocampal function. This study used landmark cues to prompt descriptions of autobiographical memories, imagined events and remembered scenes. We found that across all three conditions, older adults provided fewer internal details (unique to the event or scene) and more external details, than younger adults. Despite this difference, self-ratings of detail and vividness were no different in younger and older participants. We also found that across young and older adults, a more personally familiar cue led to more detailed remembered events, scenes, and imagined events. These results replicate previous findings that older adults provide fewer internal details and more external details than

younger adults when describing remembered and imagined events. By showing the same age-related pattern in a scene memory task, our findings support the hypothesis that memory for scenes is closely linked to episodic memory and imagination.

H81

PREDICTING RECOLLECTION: ELECTROPHYSIOLOGICAL INDICES OF RECOLLECTION AT ENCODING USING OBJECTIVE AND SUBJECTIVE MEASURES IN CHILDREN AND ADULTS Leslie Rollins[1], Alison Robey[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. Familiarity is an assessment of memory strength, whereas recollection supports retrieval of qualitative information (i.e., contextual details). The current study examines age-related differences in subjective and objective recollection effects at encoding. Event-related potentials (ERPs) are collected while participants make color (i.e., red/green) and semantic judgments (i.e., animacy/size). At retrieval, participants make recognition judgments and three recollection judgments. For the subjective judgment, participants complete the remember/know paradigm. For the objective judgments, participants are asked the original color of the item and which semantic task was performed. Accuracy for the contextual detail is used as an index of recollection. Adults correctly recognized more items than children, $t(37) = -2.78$, $p < .01$. However, children and adults were similar in providing "remember" judgments, $t(37) = 1.11$, $p = .27$, identifying the original color $t(37) = .42$, $p = .68$., and identifying the task performed, $t(37) = .59$, $p = .56$. For the subjective measure adults showed a subsequent recollection effect characterized by more positive mean amplitude ERPs to remembered compared to familiar and missed items at right parietal leads. In contrast, children showed a subsequent recognition effect characterized by amplitude differences between later identified (i.e., remembered or familiar items) and missed items. Consistent with Friedman and Trott (2000), neither children nor adults displayed subsequent recollection effects on the objective tasks. These findings suggest processes supporting subjective recollection at encoding undergo developmental changes between childhood and adulthood.

H82

LIFESPAN AGE DIFFERENCES IN EPISODIC MEMORY FORMATION Yee Lee Shing[1], Ulman Lindenberger[1], Hauke Heekeren[2], Lars Bäckman[3], Yvonne Brehmer[3]; [1]Center for Lifespan Psychology, Max Planck Institute for Human Development, Berlin, [2]Free University, Berlin, [3]Aging Research Center, Karolinska Institute, Stockholm — The two-component framework of episodic memory (EM) across the lifespan posits dissociable neural mechanisms of memory performance patterns observed in children and older adults' of (Shing et al., 2008). According to this model, children's difficulties in EM reflect the protracted development of the prefrontal cortex (PFC), whereas EM deficits in older adults stem from senescent changes in the PFC and medial temporal lobes (MTL). We performed functional magnetic resonance imaging with children (n = 34; aged 10-12), younger adults (n = 34; aged 20-25), and older adults (n = 34; aged 63-68) during word-pair encoding. Subsequent-memory effects were examined using a region-of-interest approach focusing on areas within the PFC and MTL. Compared to younger and older adults, children showed lower activations in the left and right middle frontal gyrus (BA9). In a psychophysiological interactions analysis that measures functional coupling across regions, younger adults, compared to children and older adults, showed stronger connectivity between bilateral BA9 and other prefrontal (BA10) and parietal (BA39) regions, revealing a more integrated EM network. Contrary to predictions based on the two-component model, there were no age differences in parahippocampal gyrus and hippocampal activation. In a whole-brain analysis, children showed higher activation in left and right fusiform cortex relative to adults. Children who reported using inefficient strategies (e.g., repetition) showed higher activation in these regions and lower memory performance. In sum, these results provide support for the two-component framework but also point to existence of EM network maintenance in high-functioning older adults (Nyberg et al., 2012).

H83

RELATIONSHIP OF COGNITIVE RESERVE AND CEREBROSPINAL FLUID BIOMARKERS TO CLINICAL SYMPTOM ONSET IN ALZHEIMER'S DISEASE Anja Soldan[1], Corinne Allen Pettigrew[1], Shanshan Li[2], Mei-Cheng Wang[2], Abhay Moghekar[1], Richard O'Brien[1], Ola Selnes[1], Marilyn Albert[1]; [1]Johns Hopkins University Medical Center, [2]Johns Hopkins School of Public Health — Alzheimer's disease is pathologically characterized by amyloid plaque and tau tangle deposition in the brain. Levels of ß-amyloid and phosphorylated tau (ptau), as measured in cerebrospinal fluid, have been shown to be associated with risk of progressing from normal cognition to onset of clinical symptoms [preceding the diagnosis of mild cognitive impairment (MCI)]. This study examined whether cognitive reserve (CR) modifies this association. CR is the notion that individual differences in lifetime experiences, such as education and cognitive activity, modify the negative effects of brain pathology on clinical expression of symptoms. Cerebrospinal fluid was obtained at baseline from 239 participants (mean age 57.2 years) who have been subsequently followed up to 17 years with annual neuropsychological and clinical assessments. A composite score based on the National Adult Reading Test (NART), WAIS-R vocabulary, and years of education at baseline was used to index CR. Using Cox regression models, we examined the interaction of baseline ß-amyloid, tau, and ptau with CR, using age of onset of clinical symptoms as the outcome. Increased risk of progressing from normal cognition to symptom onset was associated with lower baseline ß-amyloid, higher p-tau, and lower CR. There was no interaction between ß-amyloid and CR, indicating that the protective effects of higher CR are independent of ß-amyloid. In contrast, both tau and p-tau interacted with CR, such that CR was less protective with higher levels of tau and p-tau. This suggests that CR modifies clinical outcome when tau-related pathology in the brain is low but not high.

H84

INCREASING WHITE MATTER COHERENCE BETWEEN HIPPOCAMPUS AND PREFRONTAL CORTEX SUPPORTS IMPROVING MNEMONIC CONTROL IN CHILDREN Carter Wendelken[1], Joshua Lee[2], Jaqueline Pospisil[2], Marcos Sastre III[2], Julia Ross[2], Silvia A. Bunge[1], Simona Ghetti[2]; [1]University of California at Berkeley, [2]University of California at Davis — Mnemonic control, the capacity to initiate and maintain processes that guide encoding and retrieval operations, is associated with increased functional connectivity within a large-scale network including hippocampus, prefrontal, cingulate, and parietal cortices. If the degree of connectivity among these regions is critical for mnemonic control, then integrity of white matter tracts connecting these regions should predict the development of this ability. Thus, we tested for a relationship between mnemonic control and white matter integrity in 8-to 11 year-old children (N = 64). We examined three white matter tracts that connect the hippocampus with other parts of the brain: Uncinate Fasciculus (to prefrontal cortex), Cingulum (to cingulate gyrus), and Fornix (to subcortical structures). Participants attended, ignored, or passively viewed sequences of 4 outdoor scenes, and their memory for the scenes was later tested. Attended items were remembered better than Ignored items, and this attentional modulation significantly increased with age. Fractional anisotropy (FA) within the Uncinate Fasciculus was significantly and positively correlated with attentional modulation, suggesting that developmental improvements in mnemonic control may depend on the development of white matter integrity in a tract that connects the hippocampus and lateral temporal lobes with prefrontal cortex. Neither Fornix nor Cingulum demonstrated this pattern, suggesting a specificity of these findings to the Uncinate Fasciculus.

H85

REPLICATION OF A NOVEL METHOD FOR QUANTIFYING COGNITIVE RESERVE IN AGING BASED ON THE DECOMPOSITION OF EPISODIC MEMORY VARIANCE Laura B Zahodne[1], Jennifer J Manly[1], Adam Brickman[1], Karen Siedlecki[2], Yaakov Stern[1]; [1]Columbia University, [2]Fordham University — The theory of cognitive reserve attempts to explain why some individuals are more resilient to age-related brain pathology than others. Study of this key concept is hindered by measurement difficulties, as common proxy variables (e.g., education) are static, imprecise, and restricted. Using a larger, randomly sampled and community-based cohort, this study replicates a novel method for quantifying cognitive reserve

(Reed et al., Brain 2010). In this method, cognitive reserve is operationalized as residual variance in memory performance after accounting for demographics and brain pathology. Longitudinal data from 704 diverse, non-demented older adults in the Washington Heights Inwood Columbia Aging Project were analyzed using structural equation modeling. Variance in a memory composite derived from the Selective Reminding Test was decomposed into portions explained by demographics (race, ethnicity, education) and brain variables (hippocampal, total brain, white matter hyperintensity volumes). Cognitive reserve was associated with lower likelihood of meeting criteria for mild cognitive impairment (beta=-.573; p<.001), higher literacy (beta=.156; p<.001), 49% reduced risk of dementia conversion over 3 years (p<.001), and less 3-year decline on a language composite (beta=.181; p=.003). In addition, cognitive reserve moderated the relationship between the brain variables and 3-year decline in language (interaction B=-6.169; p=.002). These results provide independent evidence for the utility of this method for quantifying cognitive reserve, which predicted clinical and cognitive outcomes. A potential advantage of this approach over proxy variables is that cognitive reserve can be measured over time, making it a viable outcome measure in intervention studies aimed at imparting cognitive reserve.

H86

FUNCTIONAL HETEROGENEITY ACROSS THE INFERIOR PARIETAL CORTEX IN MEMORY RETRIEVAL AND MAINTENANCE OF RECOLLECTED CONTENT

Kaia Vilberg[1], Michael Rugg[1]; [1]Center for Vital Longevity, University of Texas Dallas — There is growing evidence that the inferior parietal cortex is not only anatomically, but also functionally heterogeneous. Recently, the patterns of functional connectivity between voxels across the inferior parietal cortex and the rest of the brain have been shown to differ along the anterior/posterior axis of this region. In the present study, we addressed the question of whether the patterns of activity in an episodic retrieval task would also vary across the anterior/posterior extent of the inferior parietal cortex. Two experiments were conducted in which recollected information had to be maintained in working memory prior to a behavioral response. In both experiments, word-image pairs were studied in an intentional encoding task. In one experiment, words served as test items, and in the other experiment, images served as test items. Participants were instructed to try to recall the paired associate of the test item and hold it in mind until a question appeared at which time they were to answer the question with respect to the retrieved information, or if not recollected, to respond 'old, associate not recollected' or 'new'. The paradigm enables the identification of brain activity that occurs transiently in response to the test item, as well as that which is sustained over the maintenance interval. In line with prior findings of functional heterogeneity in the inferior parietal cortex, the pattern of activity associated with associative hit, item hit, and correct rejection conditions differed qualitatively along the anterior-posterior axis of this region.

H87

ACTIVE LEARNING STRATEGIES IMPROVE MEMORY FOR CONTEXT-DEPENDENT ASSOCIATION RULES

Joel Voss[1], Jane Wang[1]; [1]Northwestern University Feinberg School of Medicine — Volitional control of exploration is central to adaptive behavior, and previous findings from our laboratory have linked control of learning to a network of brain structures centered on the hippocampus, including prefrontal cortex. In this study, we investigated how benefits conferred by volitional control generalize to abstract information types, such as context-dependent rules that are relevant for real-world environments. We used a contextual association task, in which subjects were required to learn object-face associations presented in one of four contexts (locations) on the screen. Object-face associations varied contextually based on object features, with context governing which object feature (shape or texture) should be used to guide the face selection. In the volitional condition, subjects selected a testing context on each trial and then chose the face associate, whereas this information was presented in a predetermined order in the passive condition. Learning was based on feedback in both conditions. We found that volitional control significantly enhanced learning relative to passive study in subjects with higher overall levels of task performance, and was associated with use of an optimal context-selection strategy. fMRI activity differences were found between individuals employing optimal learning strategies and those employing suboptimal strategies in prefrontal cortex, and we will discuss hippocampal-cortical connectivity differences in the context of volitional versus passive learning. Our findings highlight the vital contributions of strategies that emerge during volitional behavior to learn abstract rule structure and provide a framework for understanding the neural processing that supports adaptive behavior in humans.

H88

CONTENT-SELECTIVE CORTICAL REINSTATEMENT EFFECTS IN OLDER AND YOUNGER ADULTS

Tracy H. Wang[1], Jeffrey D. Johnson[2], Unal Sakoglu[3], Michael D. Rugg[1]; [1]The University of Texas at Dallas, [2]University of Missouri, [3]Texas A&M University - Commerce — Numerous fMRI studies of memory have demonstrated cortical reinstatement effects –the overlap between content-selective encoding- and retrieval-related neural activity. The present study compared content-selective, recollection-related cortical reinstatement effects in young (18-29 yrs) and older adults (63-77 yrs) that were matched for recollection performance. The study phase comprised of the presentation of a series of pictures and words. While undergoing scanning, subjects performed size judgments on the objects denoted in the pictures, and indoor/outdoor judgments on objects denoted by the words. All test items were words – one third of these corresponded to studied pictures, one third to studied words, and one third were new. The test requirement was to perform a 'Remember/Know/New' judgment on each item. fMRI data from the test phase acquired from performance-matched older and young subgroups revealed extensive, age-insensitive cortical reinstatement effects in association with the recollection of previously studied pictures. These regions included bilateral hippocampus, posterior parahippocampal gyrus, parietal and inferior temporal cortex. Additionally greater picture reinstatement effects were evident in occipital cortex in older subjects. Effects for recollected words were markedly more modest, but did not differ according to age. The findings converge with prior results to suggest that there is little age-related attenuation in the neural correlates of episodic retrieval when performance is matched.

H89

HOW LONG DOES IT TAKE TO PREPARE FOR A NEW MEMORY? AN ELECTROPHYSIOLOGICAL INVESTIGATION INTO THE INFLUENCE OF ANTICIPATION TIME ON MEMORY ENCODING

Danying Wang[1], Leun J. Otten[1]; [1]University College London (UCL), UK — The effectiveness with which events are encoded into long-term memory depends on processes engaged beforehand. Here, we asked how such anticipatory processes differ depending on the amount of time that is available before event onset. Scalp-recorded electrical brain activity was obtained from 24 healthy adults while they made size judgments on pictures of objects. Each picture was preceded by a cue 1.5 or 3 s before picture onset. Cues either gave no information about when the picture would occur or indicated that the interval would be short or long. Memory for the objects was probed one day later with a recognition test. Event-related potentials before picture onset predicted later memory of the picture, but only when the cue interval was long. This encoding-related activity was largest over frontal scalp sites when the interval was known in advance and largest over parietal sites when it was not. Time-frequency analyses showed encoding-related differences in the alpha (8-12 Hz) frequency range. The nature of these differences depended on predictability and length of the cue interval. Alpha decreases were particularly evident when information accrued that only a short amount of time would be available until picture onset (i.e. shortly after cue onset in the predictable short condition and after 1.5 s in the unpredictable long condition). Together, the findings indicate that encoding-related activity before an event differs depending on the opportunity to engage such activity. Anticipatory influences on memory may reflect the beneficial effect of strategic preparatory processes engaged ahead of stimulus presentation.

H90

MEDIAL TEMPORAL LOBE STRUCTURE AND ITS RELATIONSHIP TO RECOLLECTION AND FAMILIARITY IN SCHIZOPHRENIA

Weichun Wang[1], Maria E Montchal[1], Andrew P Yonelinas[1], J Daniel Ragland[1]; [1]University of California, Davis — Schizophrenia is characterized by an array of cognitive impairments, including those of episodic memory. However, the extent to which specific retrieval processes are impaired in patients, and whether abnormalities in medial temporal lobe structures are related to

these retrieval deficits is less well known. The current study utilized a dataset of 22 patients and 30 controls from whom structural MPRAGEs and recognition measures of recollection and familiarity estimated with Receiver Operating Characteristics were collected. Preliminary analyses of manual tracings of medial temporal lobe subregions revealed significant group differences within the left parahippocampal gyrus. Specifically, patients relative to controls showed a reduced volume of the left parahippocampal cortex (PHC) and an increased volume of left entorhinal cortex. Consistent with previous research linking the PHC with recollection, we found positive correlations with PHC volume and recollection in the patient sample in that those patients who had larger PHC volumes also had better recollection performance. Additionally, left hippocampal head volume was also positively correlated with recollection performance. These results suggest that previously documented reductions in PHC volume in schizophrenia may be contributing to their prominent recollection deficits during episodic retrieval.

H91

THE LASTING BENEFITS OF THE SPACING EFFECT ON RECALL DESPITE COMPROMISED HIPPOCAMPAL AND EPISODIC MEMORY DEVELOPMENT

Tina Weston[1], Janet L. Green[2], Nicholas J. Cepeda[1], R. Shayna Rosenbaum[1,3]; [1]York University, [2]Dalhousie University, [3]Rotman Research Institute — The spacing effect is a robust memory phenomenon where items reviewed after a spaced interval of time are remembered better than items reviewed immediately. Evidence reported by Cermak and colleagues (1996) suggests that spaced review is a successful memory strategy for patients of adult-onset amnesia. However, it is unclear whether the spacing effect exhibited by these patients was the result of an uncontrolled retention interval (timing between the second presentation of an item and the item at test). Moreover, these patients would have had pre-morbidly intact episodic memory. Experience with episodic memory and prior intact hippocampal function may be a necessary foundation for spacing effect benefits even after the onset of amnesia. To investigate these questions, we examined the spacing effect in a developmental amnesiac patient, an individual with impaired episodic memory in relation to underdeveloped hippocampi from birth. The results of two experiments confirmed the patient's superior memory recall for items reviewed by spacing, both in a single-session paradigm where we properly controlled the retention interval, and in a multi-day paradigm where we assessed the patient's memory after one week. These results suggest that there may be alternate routes to the spacing effect that circumvent the use of episodic memory. Theoretical considerations are discussed.

H92

BRAIN ACTIVATION WHEN RECOGNIZING OR CATEGORIZING OLD AND NEW PICTURES

Mathias Weymar[1], Margaret M. Bradley[1], Peter J. Lang[1]; [1]University of Florida — Recent neuroscience research, using the ERP old/new effect as a measure of prior occurrence, suggests that the amplitude of the difference is often affected by whether the post-encoding task explicitly probes episodic memory. The goal of the present study was to use functional brain imaging (fMRI) to investigate the neural networks in different instructional contexts when the task either explicitly probes episodic memory or not. Participants viewed a series of emotional and neutral pictures (n= 46) followed by a post-encoding procedure, in which 36 old and new pictures were presented in the context of either an explicit recognition (old vs. new) task or a categorization task (one person vs. more). Whole brain analyses revealed shared memory (old > new BOLD activity) regions in the two tasks in cuneus, posterior cingulate cortex, and middle frontal gyrus, with a more extensive network (e.g., precuneus, angular gyrus, cerebellum) activated during explicit recognition. Novelty effects (new > old BOLD activity) were also observed in both tasks across various brain regions (e.g., hippocampus, precentral gyrus, fusiform gyrus), particularly in sensory cortex, where activation was more enhanced during categorization. The presence of shared memory and novelty regions in the two tasks suggests that both prior occurrence and novelty were registered regardless of task. Specific memory regions activated during explicit recognition indicate a broader network mediating episodic retrieval. On the other hand, enhanced activity in sensory cortex suggests stronger perceptual processing of new pictures during categorization.

H93

A FUNCTIONAL MAGNETIC RESONANCE IMAGING INVESTIGATION OF THE EFFECTS OF PRENATAL DRUG EXPOSURE ON EMOTIONAL PROCESSING AND MEMORY PERFORMANCE

Vanessa Williams[1], Betty Jo Salmeron[2], Thomas J. Ross[2], Maureen Black[3], Tracy Riggins[1]; [1]University of Maryland, College Park, [2]National Institute on Drug Abuse, Intramural Research Program, [3]University of Maryland School of Medicine, Baltimore — Rodent models of the postnatal effects of prenatal drug exposure (PDE) provide evidence of dysfunctions in emotional (Salas-Ramirez et al., 2011) and cognitive (Harvey, 2004) functioning. These preclinical studies have elucidated the neurobiological effects that PDE may have on the developing individual by altering the dopaminergic system ultimately leading to atypical development of the cortex and behavior. Given that humans encounter more complex environments and social interactions than rodents and recent empirical evidence suggesting that the effects of PDE on memory may be delayed until the demands of adolescence (Betancourt et al., 2011), exploration of how these neurobiological effects manifest through human development is strongly needed. In the current fMRI study, thirty-nine participants underwent a source memory paradigm to investigate the influence of emotion on memory in prenatally exposed and community comparison adolescents. Behavioral results revealed differences in recognition memory with the community comparisons outperforming the PDE group. Regions of interests (ROI) analysis revealed that the exposed adolescents exhibited increased amygdala activation when viewing emotional as opposed to non-emotional pictures, whereas there was no difference between conditions in the community comparisons. In addition, the exposed adolescents showed altered patterns of activation within the ROI of the hippocampus during memory formation. These results suggest alterations within the neural processes that underlie emotional processing and memory formation. Consistent with previous findings within the animal literature, the present study provides evidence that gestational exposure to drugs can cause long-term impacts on cognitive and emotional functioning.

H94

EXPECTANCY MODULATES NOVELTY ENCODING

Jessica Wilson[1], Vishnu Murty[1,2], Alison Adcock[1]; [1]Duke University, [2]New York University — Experience may or may not produce expectancy. Consequently novelty may be expected or unexpected. Prediction error models of learning suggest that memory formation benefits from novelty that violates expectations; however, anticipatory signals modulate hippocampal activation and may also enhance memory encoding. Memory encoding can thus be augmented by two distinct neural processes, investigated in this study. We sought first to determine whether participants better encode expected or unexpected novel stimuli into long-term memory. We then aimed to elucidate mechanisms of novelty encoding associated with participants' expectancy for novel events. For these purposes, we developed an incidental encoding paradigm in which participants generated expectancy for either familiar objects or trial-unique novel objects, with rare violations of those expectancies. Following encoding, participants completed a surprise recognition memory test. We examined memory performance and functional magnetic resonance imaging (fMRI) activation in the hippocampus and its functionally connected regions for trials in which novelty was expected or was an expectancy violation. Behaviorally, we found individual differences in memory performance across expectancy conditions, such that some participants demonstrated better memory for expected novel objects and others showed better memory for novel objects that were expectancy violations. Using fMRI, we observed positive correlations that were selective for expected versus unexpected novelty encoding, as follows: memory for expected novelty correlated with activation in left inferior frontal gyrus, whereas memory for unexpected novelty correlated with activation in lateral occipital cortex. Together these findings suggest two routes whereby prior expectations modulate hippocampal-dependent encoding of novel events.

H95

SEMANTIC AND EPISODIC MEMORY CORRELATE WITH MEDIAL TEMPORAL LOBE SUBFIELDS IN SEMANTIC DEMENTIA

Khaing Win[1,2], John Pluta[1], Danielle Weinberg[2], Jenna Glasenberg[2], Paul Yushkevich[1], David Wolk[1,2], Murray Grossman[1,2]; [1]University of Pennsylvania, [2]Hospital of the

University of Pennsylvania — Semantic memory (SM) is the representation of concepts about objects, facts, and people. Patients with semantic dementia (SD) have difficulty communicating because of progressive deterioration of expressive and receptive vocabulary, and loss of conceptual knowledge. Most work has related SD deficits to neocortical disease and has suggested the relative preservation of episodic memory (EM), the recollection of specific events, but this remains controversial. Here we examined the atrophy of medial temporal lobe subfields in SD, and performed direct correlations between atrophy and SM/EM performance. Twelve SD patients underwent high resolution (0.4x0.4mm in-plane) T2 MRI with contrast allowing visualization of the dark band separating cornu ammonis (CA) from dentate gyrus. A semi-automated process using in vivo 4T MRI template, informed by hippocampal histology, was applied to these images, with subsequent manual correction. Verbal EM recall was assessed with Philadelphia Verbal Learning Test (PVLT), visual EM recall with Rey Figure Test (RFT), and SM with Boston Naming Test (BNT) and Pyramid and Palm Trees (PPT). In SD, we found: 1) impairments in SM and EM; 2) atrophy in all subfields [hippocampal subfields and entorhinal cortex (ERC)]; 3) right hippocampal head (HH), bilateral CA1 and ERC (bCA1/ERC) atrophy correlated with PVLT recall($p<0.05$); 4) bCA1/ERC atrophy with RFT recall ($p<0.05$); 5) left CA1 and left HH atrophy correlated with BNT ($p<0.05$); and 6) left HH atrophy correlated with PPT pictures ($p<0.05$). These findings suggest that these hippocampal and entorhinal subfields atrophy may contribute to SM and EM deficits in SD.

H96

DISSOCIATION BETWEEN ITEM-ITEM AND ITEM-CONTEXT MEMORY ASSOCIATIONS Jenny Wong[1], Marianne de Chastelaine[1], Derek Beaton[1], Hervé Abdi[1], Michael D. Rugg[1]; [1]The University of Texas at Dallas — Numerous fMRI studies have used the subsequent memory paradigm to investigate the neural correlates of encoding item-item and item-context associations. In the present experiment, the two classes of subsequent memory effect were directly compared. Subjects viewed a series of study trials, each containing the sequential presentation of a picture and a word. The picture was presented to either the left or right of fixation, whereas the word appeared in central vision. Outside of the scanner, each test trial began with a recognition test of a single picture. For pictures that were judged old, either an item-item or an item-context memory judgment was required. Analysis of the fMRI data with a general linear model (GLM) revealed anatomically dissociable subsequent memory effects for successfully retrieved item-item and item-context associations (left inferior frontal gyrus and right posterior fusiform, respectively). Effects common to both tasks were found in bilateral fusiform cortex and anterior hippocampus. Additionally, we sought differences in whole-brain patterns of fMRI signal between four conditions of interest (item-item correct, item-item incorrect, item-context correct, item-context incorrect) by using a PCA-based multivariate approach (barycentric discriminant analysis; BADA). This analysis identified two components that, together, accounted for approximately 80% of the between condition variance. One factor discriminated study trials on the basis of whether item-item associations were successfully encoded, whereas the other discriminated trials according to whether encoding was successful for item-context associations. The findings converge with the GLM results to suggest that encoding these two classes of association depends on partially independent neural mechanisms.

H97

AN ERP INVESTIGATION OF ASSOCIATIVE RECALL Brion Woroch[1,2], Brian Gonsalves[1,2]; [1]University of Illinois, [2]Beckman Institute — Cued recall is often associated with reactivation of cortical regions that were initially involved in perception of the associated information. For example, encoding of word-scene pairs followed by recall of the scene when cued with the word involves reactivation of scene processing regions. However, it is unclear what this cortical reactivation represents- a search for scene information, activation of the general category of scene, or reactivation of the specific scene stimulus? In our study, we had participants study adjectives paired with scenes from one of four different categories: forests, mountains, cities, and highways. Participants were presented with just the word at test and asked to remember the category the associated scene belongs to, followed by a confidence judgment in that decision. They were then given a three-alternative forced choice test, consisting of the associated item and two within-category lures, and asked to identify the associated stimulus. ERPs time-locked to the presentation of the word cue were used to assess whether retrieval-related activity varied with successful category-level recall, specific item-level recall, or both. Initial results indicate that the amplitude of ERPs in the time window of the late parietal complex (LPC; 500-800ms) vary with memory confidence in the category decision, with a larger LPC associated with higher confidence. More broadly distributed ERPs, after the LPC, differ depending on whether or not the correct item was subsequently chosen on the 3-alternative force choice test. This suggests that the neural activity during recall differs for category-level and specific item-level recall.

H98

AGE-RELATED CHANGES IN ANTICIPATORY SOURCE MEMORY MECHANISMS Jiangyi Xia[1], Giulia Galli[1], Leun J. Otten[1]; [1]Institute of Cognitive Neuroscience, University College London (UCL) — A key feature of aging is deficits in episodic memory, a form of long-term memory for events bound with their spatial and temporal context. Effective episodic memory functioning relies on brain activity before and after an event. The present study investigated how encoding-related brain activity associated with the binding of information into episodic memory is affected by aging. Electrical brain activity was recorded during a source memory task in which healthy younger and older participants memorized visually-presented word pairs. Each pair was preceded by a neutral warning stimulus. Within 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. Both event-related potentials and oscillatory activity in the theta (4-8 Hz) and alpha (8-12 Hz) ranges were analyzed. All types of neural activity that followed the object word predicted later successful source memory. This activity differed in size and nature depending on an individual's age. Oscillatory activity before object onset also predicted later recollection. This was observed in both groups, but was restricted to the theta frequency range in the middle of the location-object interval for older individuals. For younger individuals, encoding-related activity already occurred shortly after the onset of the neutral warning stimulus and extended across theta and alpha ranges. These findings indicate that aging affects the neural correlates of episodic binding. Younger and older individuals differ not only with respect to the processes engaged during episodic binding, but also while such binding is being anticipated.

H99

NEURAL BASIS FOR LEARNING A S-R MAPPING SEQUENCE Hsin-Ju Lee[1], Wen-Jui Kuo[1]; [1]Institute of Neuroscience, National Yang-Ming University, Taipei, Taiwan — Sequencing is a fundamental ability for our daily lives, e.g., sequencing sounds for speech and sequencing actions during biking. There is research on sequence learning providing evidence that performance improvement can occur over a relatively short time period. However, the cortical and subcortical neural bases underpinning this dynamic learning process is not really clear yet. The sequence reaction time task is a task often used for research of sequence learning, in which participants will be asked to react by pressing one of the four keys to a flash appearing at one of the four possible locations on a computer screen. Reaction times often show a significant decrease when the locations of the flashes follow a particular sequence, as compared to the random ones. In this study, we used the functional magnetic resonance images to examine the neural correlates of this type of sequencing learning. In our results, in addition to the learning effect revealed by RT reduction, we also found that the learning effect seemed to be consolidated after a short period of rest. The overall neural networks related the learning effect included motor and premotor cortex, intraparietal sulcus, and cerebellum. On the other hand, while the caudate and putamen showed higher activities for random sequences, activities of the right dorsolateral prefrontal cortex and right intraparietal sulcus tracked RT decrease of the fixed sequences.

H100

INDIVIDUAL VARIATION IN LOCAL GREY MATTER DENSITY OF HEALTHY YOUNG VOLUNTEERS CORRELATES WITH PERFORMANCE IN PERCEPTUAL LEARNING Matthew Mundy[1]; [1]School of Psychology and Psychiatry, Monash University — Differential patterns of activation occur in medial temporal lobe during perceptual discrimination of distinct classes of visual stimuli (e.g., places - posterior hippocampus,

Lee et al., 2008; face/objects - perirhinal cortex, Barense et al., 2009). Similarly, extrastriate cortex is thought to contain a number of class-preferential regions (e.g. places - parahippocampal place area (PPA), faces - fusiform face area (FFA), Downing et al., 2006). Perceptual learning (PL) has been shown to produce such brain activity, which is thought to vary with task performance (Mundy et al., 2012). However, it is currently unclear exactly how task performance relates to the differential recruitment of these regions. A cohort of healthy young (18-30 years) volunteers were screened for performance on a PL task. Eight 'good' face perceptual learners were selected, along with eight 'good' scene learners (performance 80% or higher). Eight 'poor' perceptual learners (performance 55-65%) were also recruited. Structural MRI images were acquired for all participants. Comparing grey matter density between groups, via a voxel-based morphometry technique, revealed good learners (irrespective of stimulus-type) had significantly denser grey matter in caudate nucleus and pulvinar regions, along with the hippocampus. Good face learners, specifically, also showed greater grey matter density in posterior fusiform gyrus (within which FFA is found), whilst good scene learners had greater density within posterior parahippocampal gyrus (within which PPA is found). Further volumetric analysis confirmed that good learners had significantly larger hippocampi and caudate nuclei than poor learners. These findings illustrate how task performance may relate to grey matter density.

H101

MIND THE GAP: FLEXIBLE USE OF EXPLICIT KNOWLEDGE DURING SKILLED SEQUENCE PERFORMANCE

Daniel J. Sanchez[1], Paul J. Reber[1]; [1]Northwestern University — Implicit and explicit learning play distinct roles in skill acquisition based on their different operating characteristics. It is hypothesized that implicit learning leads to increasingly fluid action sequence performance while explicit knowledge provides top-down control and flexible knowledge use. Using Serial Interception Sequence Learning (SISL), we have previously found that implicit perceptual-motor sequence learning rate was unaffected by available explicit knowledge when sequential order was perceptually-guided. Here we test the hypothesis that when perceptual information is interrupted during performance, explicit knowledge can be flexibly applied during these 'gaps' to benefit performance. In the SISL task participants make precisely-timed motor responses to cues scrolling down one of four columns. Thirty-one participants were randomly assigned to naïve (incidental learning) or explicit training of a 12-item sequence. Explicit training featured sequence memorization prior to SISL training and included explicit retrieval practice. After training, participants performed a test containing perceptual information 'gaps' of 2 or 6 consecutive items. Gaps were created by masking the response cue with a bar-shaped stimulus covering all four response locations, providing no information about the correct response. Under normal conditions, both groups exhibited similar sequence-specific performance benefits for the trained sequence compared to untrained foils. However, during the perceptual-information gaps, explicitly-trained participants were able to apply their additional explicit knowledge to perform at a significantly higher rate than the naïve (implicit) group. These results suggest that while explicit knowledge does not necessarily improve stimulus-guided performance, it provides the flexibility needed for performance when external cues are not available.

H102

INTERLEAVED PRACTICE OF MOTOR SEQUENCES RESULTS IN GREATER TRANSFER TO NEW SEQUENCES

Renee E. Shimizu[1], Allan D. Wu[1], Barbara J. Knowlton[1]; [1]UCLA — Effective training results in the ability of the learner to transfer knowledge to novel circumstances. A robust finding in the learning and memory literature is the contextual interference effect, in which interleaved practice of different tasks results in diminished performance during training but leads to better retention and transfer of task knowledge as compared to blocked practice (e.g., Shea & Morgan, 1979). The benefits of interleaved practice on retention were recently demonstrated with motor sequence learning, such that after a delay, performance was superior when the sequences had been practiced in an interleaved fashion versus blocked (Lin et al., 2010). In the present study, we examined whether interleaved practice of motor sequences led to better transfer of knowledge to new motor sequences. Participants trained on three sequences in a blocked or interleaved order. In the second phase of the task, they either received the previously practiced sequences or three novel sequences (transfer) presented in an interleaved order. Practice performance was significantly faster for the groups that underwent a blocked practice structure than an interleaved structure ($p < .001$). However, during the test phase, blocked practice resulted in significantly more slowing on novel sequences compared to old sequences in comparison to interleaved practice ($p = .032$). These findings demonstrate that interleaved practice of tasks during acquisition, despite leading to poorer performance during training, enhances transfer of sequential fine motor skills. These results also suggest that interleaved practice of motor sequences results in a more generalized memory representation compared to blocked practice.

H103

CONTINUOUS, MULTIDIMENSIONAL CONTROL OF A MOUSE CURSOR USING A BRAIN-MUSCLE-COMPUTER INTERFACE.

Ida-Maria Skavhaug[1], Rebecca Bobell[1], Cindy Dao[1], Ben Vernon[1], Sanjay Joshi[1]; [1]Department of Mechanical & Aerospace Engineering, UC Davis — Fifty years ago it was demonstrated that humans can learn to single out and control the contractions of individual motor units (Basmasjian, 1963). We take advantage of this ability in the development of a Brain-Muscle-Computer Interface (BMCI), in which subjects control external machines by making fine-tuned activations of a surface muscle (Perez-Maldonadi et al., 2010; Vernon & Joshi, 2011). Multidimensional control is achieved by simultaneously manipulating the power in two separate frequency bands in the surface Electromyogram (sEMG). In essence, subjects learn to use one single sEMG recording site as an electrical signal generator by recruiting necessary motor units. The BMCI device has important applications; it can be used by the paralyzed population to control a cursor on a screen, or navigate a powered wheelchair. As only one recording site is required, the electrodes can be placed on a head muscle (e.g the Auricularis Superior) and cause minimal intrusion. Furthermore, all signal processing is performed on a smartphone or tablet, making the device both portable and affordable. Here we present findings from a new training protocol. Subjects navigated a mouse cursor in two dimensions to hit bullseye targets in different screen locations, by contracting a muscle of the thumb. Subjects received points contingent on how close they got to the center of each target. Performance across sessions improved, and cursor trajectories indicated that subjects moved the cursor with intent rather than at random. Our results demonstrate the effectiveness of a new generation of mobile, minimally-obtrusive control devices for the disabled.

H104

INHIBITORY TMS OVER THE PRIMARY MOTOR CORTEX IMPAIRS IMPLICIT MOTOR SEQUENCE LEARNING AND ITS NEURAL CORRELATES. A COMBINED FMRI TMS STUDY.

Leonora Wilkinson[1], Adam Steel[1], Kris Knutson[1], Eric Wassermann[1]; [1]NINDS, NIH — The basal ganglia and their cortical connections, including the primary motor cortex (M1) play an important role in implicit/unconscious motor sequence learning. Continuous theta burst transcranial magnetic stimulation (cTBS) reduces motor cortex excitability. Using a probabilistic serial reaction time paradigm, we examined the effect of cTBS over M1on implicit sequence learning and on the learning related BOLD response. We conducted an fMRI study of implicit sequence learning in two healthy groups after cTBS to M1 or following sham TMS. cTBS produced an impairment of learning and learning related BOLD response in the primary motor cortex and inferior frontal gyrus relative to sham. This is evidence of an active role for motor cortex involvement in motor sequence learning.

H105

INTRAPARIETAL SULCAL DEPTH REDUCTIONS IN CHILDREN WITH WILLIAMS SYNDROME

Melanie Sottile[1], J. Shane Kippenhan[1], Katherine Roe[1], Carolyn B. Mervis[2], Daniel Eisenberg[1], Joseph Masdeu[1], Jeffrey Bloch[1], Nicholas Turner[1], Philip Kohn[1], Mbemba Jabbi[1], Shau-Ming Wei[1], Karen Faith Berman[1,3]; [1]Section on Integrative Neuroimaging, NIMH/IRP/NIH, [2]Neurodevelopmental Science Laboratory, Dept Psych and Brain Sci., U Lousiville, [3]Clinical Brain Disorders Branch, NIMH/IRP/NIH — Individuals with Williams syndrome (WS), the result of a hemizygous deletion of ~25 genes on 7q11.23, have significant visuospatial construction impairments that are likely related to structural alterations in the dorsal visual processing system. Research in adults with WS has demonstrated reduced gray

matter volume in the intraparietal sulcus (IPS)(Meyer-Lindenberg,2004), a finding that has been associated with reduced sulcal depth in this same brain region (Kippenhan,2005). We have also identified reduced IPS gray matter volume in children with WS who have average-range IQs as compared to typically developing matched controls, and we hypothesize that sulcal depth reductions would also exist in this population. We collected structural MRIs from 25 controls (mean age=13.9, range=7-18, 16 males) and 16 children with WS (mean age=10.8, range=5-17, 7 males). For each participant, we acquired three sagittal, multi-echo MPRAGE (MEMPR) (vanderKouwe,2008) structural images and analyzed sulcal depth based on an average geometric cortical surface representation created using surface-based analysis (Freesurfer, Caret, and SUMA). We found that children with WS show bilateral reductions in the depth of the IPS (right, p=1.5x10-8; left, p=9.3x10-9). We also found a strong correlation, specific to the WS group (R2=.35, p=0.015), between IPS depth and gray matter volume determined with voxel-based morphometry. These results are consistent with previous findings in adults and support the geometric interpretation that gray matter volume is reduced in proportion to a concomitant reduction in surface area. Further research is needed to explore the association of these structural findings to the hallmark visuospatial construction deficits in WS.

H106

HOW ABOUT A BAYESIAN M/EEG IMAGING METHOD CORRECTING FOR INCOMPLETE SPATIO-TEMPORAL PRIORS?

Carsten Stahlhut[1], Hagai T. Attias[2], David Wipf[3], Lars K. Hansen[1], Srikantan S. Nagarajan[5]; [1]Technical University of Denmark, [2]Convex Imaging, [3]Microsoft Research Asia, [4]University of California, San Francisco — In this contribution we present a hierarchical Bayesian model, sAquavit, to tackle the highly ill-posed problem that follows with MEG and EEG source imaging. Our model facilitates spatio-temporal patterns through the use of both spatial and temporal basis functions. While in contrast to most previous spatio-temporal inverse M/EEG models, the proposed model benefits of consisting of two source terms, namely, a spatio-temporal pattern term limiting the source configuration to a spatio-temporal subspace and a source correcting term to pick up source activity not covered by the spatio-temporal prior belief. We have tested the model on both artificial data and real EEG data in order to demonstrate the efficacy of the model. The model was tested at different SNRs (-10.0,-5.2, -3.0, -1.0, 0, 0.8, 3.0 dB) using white noise. At all SNRs the sAquavit performs best in AUC measure, e.g. at SNR=0dB AUC is, 0.985 (sAquavit) and 0.857 (Bolstad et al., 2009). Our results demonstrate that the sAquavit model is capable in balancing spatio-temporal prior guidance and source correction estimation to obtain superior estimates relative to current inverse methods.

H107

MAPPING LANGUAGE AREAS WITH MOVIE-WATCHING FUNCTIONAL MAGNETIC RESONANCE IMAGING

Yanmei Tie[1], Laura Rigolo[1], Srinivasan Mukundan[1], Alexandra Golby[1]; [1]Brigham and Women's Hospital, Harvard Medical School — Task-based language functional magnetic resonance imaging (fMRI) is a non-invasive technique for language mapping and has been used in neurosurgical planning. However, the tasks can be difficult for patients to perform, resulting in decreased detection power. To overcome this problem we propose a task-free movie-watching paradigm. Naturalistic stimuli have been used in studying brain functions with fMRI and have demonstrated highly synchronized responses across subjects while watching the same movie. We hypothesize that during watching a movie containing linguistic content the language area response is similar across subjects, and a temporal model could be derived for general linear model (GLM) approach to map a new subject's language areas. Twenty-two right-handed healthy subjects were shown a 7-min movie clip with dialogues. An inter-subject-correlation (ISC) analysis was applied to identify the areas showing highly synchronized responses. Then, the language components derived from a group independent component analysis (ICA) was used to functionally define regions of interest (ROIs). The voxels within both functionally and structurally defined language ROIs that showed synchronized temporal profile were used to build a model for GLM. Subjects were divided into two groups for cross-validation of the model in individual subjects with exchangeable training and testing groups. Results showed that putative language areas indicated synchronized activities, and GLM map identified moderately overlapped activations with that from task-based language fMRI (dice coefficients: 0.21±0.17, 0.15±017, and 0.27±0.21 for ROIs). This initial investigation suggests that movie-watching fMRI could be used for language mapping, while model optimization and validation in patients are needed.

H108

READING ACCURACY MODULATES TASK-RELATED FUNCTIONAL CONNECTIVITY AT MULTIPLE HIERARCHICAL SCALES

Jane X Wang[1], Luis A N Amaral[2,3], James R Booth[2]; [1]Northwestern University Feinberg School of Medicine, Chicago, IL, [2]Northwestern University, Evanston, IL, [3]Howard Hughes Medical Institute — Reading requires the interaction of a distributed set of cortical areas that gives rise to a wide range of individual skill even in individuals without reading disability. However, the nature of these neural interactions and their impact on reading performance are still poorly understood. Functional connectivity studies, which aim to quantify interactions between brain areas, have in recent years provided much insight into brain dynamics associated with task-free conditions. Here, we investigate how whole-brain functional network patterns acquired during a reading task change with individual variation in performance. We apply data-driven graph theoretical methods to mathematically characterize the constructed network of interactions. We find that connectivity patterns of 39 children (aged 9-15) performing a visual rhyme judgment task can be decomposed hierarchically into multiple sub-networks that partially recover anatomical structure. Importantly, long-range interaction between these sub-networks grows stronger with increasing task accuracy, and we recover a network of hub regions known to be critical to reading which displays increased short-range synchronization as reading accuracy increases. These individual differences in task-related functional connectivity reveal that increased interaction between distant regions, coupled with increased local integration within key cortical areas, promotes enhanced performance of a reading task. Importantly, we demonstrate that task-related neuroimaging data contains far more information than is usually extracted via standard univariate analyses – information that can be meaningfully related to cognition and task.

H109

RESTING STATE FUNCTIONAL NETWORK ORGANIZATION AND TOPOLOGICAL PROPERTIES IN AUTISM SPECTRUM DISORDER

Rachel M. Zamzow[1], Jeffrey D. Johnson[1], David Q. Beversdorf[1], Shawn E. Christ[1]; [1]University of Missouri — Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social communication and restricted, repetitive behaviors. It has previously been suggested that functional connectivity, as measured by functional magnetic resonance imaging (fMRI), is altered in individuals with ASD. In the present study, we used graph theory analysis of resting-state fMRI data to examine how the topological properties of brain functional networks differ based on factors such as diagnosis and age. Resting state fMRI data was collected from 28 individuals with ASD (mean age = 14.9 years) and an age- and gender-matched comparison group of 35 typically developing individuals without ASD (mean age = 15.6 years). Partial correlation matrices for 90 cortical and subcortical regions were generated for each participant and then visualized as undirected mean networks. The ASD and non-ASD group mean networks differed in node membership and organization. Both group mean networks were characterized by numerous long-distance connections; however, the ASD network was characterized by a higher number of local connections. Topological parameters were also calculated for each participant and compared between groups. The two groups did not differ significantly in global network efficiency, $t(63) = 1.43$, $p = 0.16$. Local efficiency, however, was greater for the ASD group as compared to the non-ASD group, $t(63) = 2.06$, $p = 0.04$. The results of the present study indicate potential alterations in functional network organization and topological properties in ASD. Further analysis is needed to fully characterize these differences within the contexts of both age and symptom severity.

H110

NEURORHETORIC: MAPPING THE SEMANTIC STRUCTURE OF COGNITIVE NEUROSCIENCE

Lawrence Appelbaum[1], Elizabeth Beam[1], Jordynn Jack[2], James Moody[1], Scott Huettel[1]; [1]Duke University, [2]University of North Carolina, Chapel Hill — Cognitive neuroscience, as a discipline, links biological systems studied by neuroscience to functions studied by

psychology. To understand the knowledge structure of this emerging discipline, we applied network text analyses to a comprehensive corpus of abstracts collected from five major journals over a 30-month period, including every study that used functional magnetic resonance imaging (fMRI) to study psychological processes. From this corpus, we constructed lists of terms describing neuroanatomical structures and psychological concepts, created sets of semantic networks evaluating how these terms were used in proximity in the individual abstracts, and statistically evaluated whether each term's centrality position in the networks were greater or lesser than predicted by its frequency. Our results demonstrate clear semantic structures in which high-frequency terms anchor onto branches of specialization among domains within each network. In many cases these domains (e.g., decision neuroscience) are disconnected from the main networks, even at high connectivity weights, indicating closed systems whose findings may not be sufficiently integrated with the larger literature. Examination of network statistics revealed terms that have disproportionate centrality relative to their frequency (e.g., insula, pre-SMA, and thalamus) indicating desirable targets for future research that are underreported compared to their importance. Finally, substitutability measures identified clusters of terms that exhibit substantial redundancy, signaling the need for greater conceptual discrimination among them. Collectively, our analyses map the semantic structure of cognitive neuroscience and provide prescriptive recommendations for future directions that will most efficiently build new links between brain structure and function.

H111

CHANGES IN INTRINSIC FUNCTIONAL BRAIN NETWORKS FOLLOWING BLAST-INDUCED MILD TRAUMATIC BRAIN INJURY

Andrei Vakhtin[1], Vince Calhoun[1,2], Rex Jung[1], Jillian Prestopnik[1], Paul Taylor[3], Corey Ford[1]; [1]University of New Mexico, [2]The Mind Research Network, [3]Sandia National Laboratories — The incidence of blast-induced mild traumatic injury (mTBI) has been rising in US veterans due to the widespread use of improvised explosive devices. Blast-injured veterans report cognitive impairments, which are collectively termed post-concussive syndrome, that are similar to those that follow more severe forms of brain injury. These are likely caused by diffuse axonal injury, which disrupts the neuronal cytoskeleton on a microscopic level and is commonly undetected by computed tomography and conventional magnetic resonance imaging. Here, we attempted to detect cortical function abnormalities in a group of blast mTBI subjects by using independent component analysis of resting state functional magnetic resonance imaging (fMRI) data, which may be more sensitive to small individual differences than conventional fMRI analyses. Resting state networks of 13 mTBI veterans with moderate post-concussive syndrome and 50 control subjects were compared across 3 fMRI domains: blood oxygenation level-dependent spatial signal maps, time course spectra, and functional network connectivity. The mTBI group exhibited hyperactivity in the temporal-parietal junctions as well as hypoactivity in the left inferior temporal gyrus. Abnormal frequencies in default-mode (DMN), sensorimotor, attentional, and frontal networks were also detected. Additionally, functional connectivity was disrupted in 6 pairs of networks: DMN-basal ganglia, attention-sensorimotor, frontal-DMN, attention-sensorimotor, attention-frontal, and sensorimotor-sensorimotor. The results suggest white matter disruption across certain attentional networks and that the temporal-parietal junctions may be compensating for damage in other cortical regions, such as the left inferior temporal gyrus. Funded through the U.S. Naval Health Research Center, Office of Naval Research. James Mackiewicz, project funding manager.

H112

PERIPHERALLY AND CENTRALLY DRIVEN SEQUENTIAL EFFECTS IN PAIN

Marieke Jepma[1], Luka Ruzic[1], Matt Jones[1], Tor D. Wager[1]; [1]University of Colorado at Boulder — Repeated exposure to noxious stimuli can change their painfulness. Such sequential effects have implications for pain adaptation in the periphery and affective learning in the central nervous system. In Experiment 1 (N = 100), we found evidence for two distinct types of sequential effects. Repeated thermal stimulation on the same skin site produced temperature-dependent habituation (reduced sensitivity), and repeated stimulation on new skin sites produced sensitization. The same-site habituation effects are incompatible with cognitive anchor-and-adjust effects or other central brain adaptations, and are likely mediated by peripheral adaptation. The across-site sensitization effects more likely reflect central mechanisms. An fMRI study of these phenomena (N = 29) uncovered dissociable brain correlates of each effect. Repeated same-site stimulation produced temperature-dependent widespread decreases in an a priori pain-predictive brain network, consistent with habituation at a very early (e.g., peripheral or spinal) level. However, we also found increases in a region of the subgenual anterior cingulate cortex that has been related to endogenous pain control, suggesting possible central involvement. In contrast, across-site repetition produced an increase in pain that did not modulate the pain-predictive brain network, but instead modulated activation in sensorimotor cortex. Our results reveal complex, but systematic, sequential dynamics of pain, with at least two different underlying mechanisms. These dynamics may provide new measures of normal and pathological adaptation and learning processes, and suggest that they should be carefully controlled and measured in experimental pain protocols. The principles underlying adaptive sequential dynamics of pain may also generalize to other affective events.

H113

REVISITING LIBET'S STUDIES: EFFECTS OF VOLITION ON TIME PERCEPTION AND RESPONSE INTERFERENCE

Lara C. Krisst[1], Maria M. Robinson[1], Ezequiel Morsella[1,2]; [1]San Francisco State University, [2]University of California, San Francisco — In his seminal psychophysiological experiments, Libet (2004) instructed participants to report when they felt the intention to perform a "free-willed" action. Interestingly, neuroimaging measures revealed unconscious neural activity that predicted when participants would have these conscious inclinations. Research has since revealed that voluntary and non-voluntary actions may have distinct neural and subjective correlates (Brass & Haggard, 2007). Building on this work, we investigated how levels of volition (e.g., voluntary versus automatic actions) influence temporal perception and response interference. In Study 1, we measured participants' (n =15) time perception as they emitted an automatic or non-automatic response to an audio cue. The mean discrepancy between actual tone onset and the average perceived tone onset was 112.84 milliseconds (SD = 30.11). To examine the long-term consequences of having responded "freely" to a stimulus, Study 2 (n = 18) employed a variant of Ericksen's flanker task, where participants must respond to a target and disregard the influence of flanking 'distractors.' Psychophysiological research has revealed that distractors can activate motor programs that lead to response interference (DeSoto et al., 2001). We found interference from targets that had been associated with a free-choice response during training, $t(17) = 2.57$, $p < .02$. We also examined participants' subjective urges on a trial-by-trial basis. Combined with neuroimaging technologies, these paradigms can further reveal the unique properties of volitional processes in the brain (Fleming et al., 2009).

H114

NEURAL RESPONSES TO PRESSURE PAIN CLASSIFY FIBROMYALGIA PATIENTS

Marina Lopez-Sola[1,2,3], Jesus Pujol[2], Joan Deus[2,4], Alba Garcia-Fontanals[2,4], Oren Contreras-Rodriguez[2,3], Luke J. Chang[1], Monica Gimenez-Navarro[2], Laura Blanco-Hinojo[2,5], Carles Soriano-Mas[3], Ben J. Harrison[2,6], Hector Ortiz[2], Tor D. Wager[1]; [1]University of Colorado at Boulder, CO, USA, [2]CRC- Hospital del Mar, Barcelona, Spain, [3]Bellvitge University Hospital IDIBELL- CIBERSAM, Barcelona, Spain, [4]Universitat Autònoma de Barcelona, Barcelona, Spain, [5]IMIM- Parc de Salut Mar, Barcelona, Spain, [6]The University of Melbourne, Melbourne, Australia — Fibromyalgia (FM) syndrome is characterized by chronic hypersensitivity to mechanical pain, without evidence of concurrent peripheral tissue damage. Increased pain sensitivity in FM is paralleled by augmented brain responses to experimentally induced painful stimulation. However, the sensitivity and specificity of these findings and their potential as a diagnostic tool for FM is unknown. In this study, we examined fMRI responses to pressure pain (4.5kg/cm2) in 38 FM patients and 35 matched healthy controls. We used a standard support vector machine with 5-fold, stratified cross-validation to develop a brain 'weight map' that is able to classify individual participants as FM patients or controls. The largest weights (i.e., responses to pressure predicted FM) were found in the bilateral insulae-operculae, lateral and medial frontal cortices, brainstem, parahippocampal gyri, and cerebellar areas. This pattern discriminated patients from controls with 74% accuracy (+- 5.1%, SE), $P = 0.00005$. The results suggest that machine-learning algorithms can shed new light on the most distinctive central nervous system features charac-

terizing FM, and thus show promise for use as a complementary diagnostic tool. These results may be of particular importance considering the lack of objective measures of pain perception and the absence of peripheral signs that are diagnostic of FM.

H115

WHEN SCHIZOPHRENIA IMPROVES TIME PERCEPTION

Jose Isidro Martinez-Cascales[1], Juan Manuel de la Fuente[1], Julio Santiago Sr.[2], Julio Santiago Jr.[1]; [1]University of Granada, [2]General Hospital of Lanzarote — Schizophrenic patients are typically reported to exhibit deficits in time perception. Their ability to measure the passing of time has been evaluated in several studies using bisection tasks. These basically consist on providing two anchors that define the extremes of a temporal range and then presenting stimuli that vary in duration. Participants are asked to estimate to which anchor each stimuli is closer. In the present work we used a classical time bisection task together with a more ecological version, both visually presented. Thirteen patients with schizophrenia and thirteen non-psychiatric control participants matched in age, gender, handedness and education completed both tasks. In the classical version we used a blue square as a target stimulus with duration range 1000 to 4000 milliseconds. The other task consisted on watching four videos of aging faces, each of them lasting about 30 seconds. After this we showed photograms belonging to the video and participants had to guess if they were closer to the beginning or the end. Controls and patients presented a similar bisection bias in both tasks. However, schizophrenic patients exhibited a higher level of discriminability as shown by the JND (just noticeable difference) and the slope of the cumulative response curve. Effects of medication, motivational and environmental factors could account for these findings.

H116

CONTEXT-DEPENDENT EXPECTATIONS INFLUENCE NEURAL PROCESSING OF OBSERVED GOAL-DIRECTED ACTION

Sasha Ondobaka[1], Marco Wittmann[1], Floris de Lange[1], Harold Bekkering[1]; [1]Donders Institute for Brain, Cognition and Behaviour — The active inference account of action observation proposes that context generates proprioceptive expectations of concrete movement outcomes and exteroceptive expectations of physical action outcomes in the world. However, the role of context in the neural processing of observed goal-directed action remains elusive. We used fMRI to investigate the neural manifestations of these contextually triggered expectations and to examine their role in subsequent neural processing of other's grasping actions. Participants observed two objects that were followed by an action that was likely or unlikely to occur, for example a full or inverted grip of a bottle. The two objects were intended to create either likely or unlikely action context, such as pouring wine or putting wine away. They then judged whether the action matched the context-dependent expectation. Results indicated that the generation of exteroceptive and proprioceptive expectations was confined to activations of the parahippocampal cortex and the superior parietal lobe, respectively. Unexpected observed actions were processed in the inferior frontal cortex, a region that integrates proprioceptive and exteroceptive outcomes. In contrast, expected grips activated the primary sensorimotor cortex, which codes for proprioceptive outcomes. The results show that action expectation and subsequent processing of action outcomes are manifested in distinct cortical circuits. Collectively, the findings suggest that prior expectations provide a scaffold that shapes perception of observed action and directly support the hierarchical active inference account of action observation.

H117

ACUTE STRESS CONTRIBUTES TO INDIVIDUAL DIFFERENCES IN PAIN-RELATED BRAIN ACTIVITY IN HEALTHY AND CHRONIC PAIN PATIENTS.

Etienne Vachon-Presseau[1], Martel Marc-Olivier[2], Roy Mathieu[3], Caron Etienne[1], Albouy Geneviève[1], Marin Marie-France[1], Plante Isabelle[4], Sullivan Michael[5], Lupien Sonia[1], Rainville Pierre[1]; [1]University of Montreal, [2]Harvard Medical School, [3]Boulder University, [4]Université du Québec à Montreal, [5]McGill University — Individual differences in pain sensitivity and reactivity are well recognized but the underlying mechanisms are likely to be diverse. The phenomenon of stress-induced analgesia is well documented in animal research and individual variability in the stress response in humans may produce corresponding changes in pain. We assessed the magnitude of the acute stress response of 16 chronic back pain (CBP) patients and 18 healthy individuals exposed to noxious thermal stimulations administered in an fMRI experiment and tested its possible contribution to individual differences in pain perception. The temperature of the noxious stimulations was determined individually to control for differences in pain sensitivity. The two groups showed similar significant increases in reactive cortisol across the scanning session when compared to their basal levels collected over 7 consecutive days, suggesting normal hypothalamic–pituitary–adrenal axis reactivity to painful stressors in CBP patients. Critically, after controlling for any effect of group and temperature, individuals with stronger cortisol responses reported less pain unpleasantness and showed a reduction of BOLD activation in nucleus accumbens at the stimulus onset and in the anterior mid-cingulate cortex (aMCC), the primary somatosensory cortex, and the posterior insula during heat pain. Mediation analyses indicated that pain-related activity in the aMCC mediated the relationship between the reactive cortisol response and the pain unpleasantness reported by the participants. These findings indicate that acute stress responses modulate pain in humans and contribute to individual variability in pain affect and pain-related brain activity.

H118

REDUCED ACTIVATION STRENGTH OF OBJECT USE ACTIONS: EVIDENCE FROM LEFT HEMISPHERE STROKE

Christine E. Watson[1], Alexis G. Kington[1], Allison D. Shapiro[1], Laurel J. Buxbaum; [1]Moss Rehabilitation Research Institute — Humans know how to act on familiar objects in two ways: we can grasp objects in order to move them, and we can use objects for their intended purposes. For "low-conflict" objects, the hand is shaped in the same way when we perform either of these actions (e.g., a mug). For "high-conflict" objects, different hand postures are required to move or to use the object (e.g., a calculator). Recent research suggests that both types of actions are activated by the intention to act on an object: participants are slower to plan the hand postures for using high-conflict relative to low-conflict objects. Based on evidence that "use" representations are left hemisphere-mediated, we tested the hypothesis that patients with left hemisphere damage would have difficulty selecting "use" actions for high-conflict objects. Thirty-two chronic left hemisphere stroke patients and 15 age- and education-matched control participants pantomimed the actions associated with using 20 high-conflict and 20 low-conflict objects. Patients, but not control participants, were significantly less accurate at producing hand postures for high-conflict relative to low-conflict objects. We used voxel-based lesion-symptom mapping (VLSM) to identify areas of the brain critical for successful object use. After controlling for accuracy on low-conflict objects, difficulty producing "use" hand postures for high-conflict objects correlated with damage to left supramarginal gyrus (BA 40) and underlying white matter. These data extend previous research from our lab demonstrating that damage to left inferior parietal cortex reduces activation strength of "use" representations, yielding increased selection of erroneous actions.

H119

A BRAIN AREA FOR THE VISUAL RECOGNITION OF NUMERALS

Jennifer Shum[1,2], Dora Hermes[1,2], Brett L. Foster[1,2], Mohammad Dastjerdi[1,2], Vinitha Rangarajan[1,2], Jonathan Winawer[1,3], Kai J. Miller[1,2], Josef Parvizi[1,2]; [1]Stanford Human Intracranial Cognitive Electrophysiology Program (SHICEP), Stanford University, Stanford, California, USA, [2]Laboratory of Behavioral & Cognitive Neurology, Department of Neurology & Neurological Sciences, Stanford University, Stanford, California, USA, [3]Department of Psychology, Stanford University, Stanford, California, USA — Is there an area within the human visual system that has a preferential response to numerals? We addressed this question using intracranial recordings from the human brain in seven participants, observing a remarkably preferential electrophysiological response to visually presented numerals, compared to orthographically similar (letters and false fonts) or semantically similar (number-words) stimuli. Anatomically, this preferential response was consistently located on the inferior temporal gyrus (ITG) across subjects and anterior to the temporo-occipital incisure. This area overlaps with the functional magnetic resonance imaging (fMRI) signal dropout zone, which is produced by the nearby auditory canal and venous sinus artifacts. In more posterior regions, outside of this zone, we observed strong responses to both real numerals

and false fonts. Our findings are relevant to understanding the principles by which visual categorical response selectivity is formed for stimuli, such as numerals, that are learned throughout development and education.

H120

TARGET FINDING WHILE THE SUN IS MOVING Austen Smith[1], Izabela Szelest[1], Lorin Elias[1]; [1]University of Saskatchewan — The perception of three dimensions (3D) when viewing an object is a complex visual process in the brain, made through assumptions about the object and using environmental cues. Lighting of the object (Sun & Perona, 1998) and the spatial location of the object (Nicholls, Bradshaw, & Mattingley, 1999) have been found to influence visual attention and perception of objects. Visual search paradigms have largely focused on reaction time differences for finding a target. Previously, spatial location of the target and illumination of the array including the target have been dichotomously examined, with no attempt to integrate the two. In the current study we employed a target find task using arrays of shaded circles creating a 3D illusion of a single concave sphere among a field of convex spheres, or vice-versa. In the current study we not only compared 57 left to right reading participant reaction times for target location and array illumination, but also visual inspection times of the upper, lower, left, and right visual fields. Greater inequalities were found between the upper and lower, rather than the left and right visual fields. Eye tracking data interacted with reaction times for target location and lighting, with the overall greatest amount of time spent inspecting the upper half. Fastest reaction times occurred for targets in leftward-lit arrays and targets located in the upper half. Implications for ventral stream processing, target finding and lighting direction paradigms are discussed.

H121

FUNCTIONAL SPECIFICITY AND CONNECTIVITY OF THE VISUAL WORD FORM AREA W. Dale Stevens[1], M. Henry Tessler[1], Dwight J. Kravitz[1], Alex Martin[1]; [1]National Institute of Mental Health — Human ventral occipitotemporal cortex (VOTC) shows a category-related organization that is remarkably consistent across individuals. We recently demonstrated that category-related functional dissociations in VOTC regions during task performance are associated with differential intrinsic functional connectivity (FC) with other cortical regions that store and/or process category-relevant properties. The visual word form area (VWFA) located in the left occipitotemporal sulcus is thought to be specialized for visual word recognition. If the VWFA is specialized for processing words, then it should 1) show preferential FC with the language system; 2) differentiate words from other categories of visual stimuli; and 3) differentiate individual words from one another. During 2 separate fMRI sessions, participants (n=34) were scanned during a 1) multi-category functional localizer (10 runs); 2) "resting-state" run (> 8 min); and 3) multi-category conceptual classification task (12 runs). We used the functional localizer to define category-related regions of interest (ROIs), including the VWFA (words > nameable object pictures), in individual participants. We used these individually defined ROIs as seeds in FC analyses of the resting-state data and multi-voxel pattern analysis (MVPA) to assess specificity of processing in the VWFA during the task runs. Across participants, the VWFA showed preferential FC with language regions, including Wernicke's and Broca's areas. MVPA demonstrated that the VWFA differentiates words from other visual stimuli, including pseudowords, and individual words from one another. These results are consistent with the VWFA being specialized for visual word recognition and interactive with a larger distributed language system.

H122

SUPPRESSING STIMULUS VISIBILITY WITH OCCIPITAL AND PARIETAL TMS Evelina Tapia[1], Dustin J. Martin[1], Diane M. Beck[1]; [1]University of Illinois at Urbana-Champaign — When transcranial magnetic stimulation (TMS) is applied over occipital cortex approximately 80-100 ms after the onset of a stimulus its visibility is decreased. The location of the occipital stimulation is typically selected by first determining where on teh scalp TMS results in an experience of a phosphene. Recently it has been shown that phosphene sensations can also be elicited with parietal TMS (Marzi, Mancini, & Savazzi 2009). Our current study investigated whether TMS to parietal regions that elicit sensations of phosphenes also produce visual suppression, akin to that produced by occipital TMS, and if so, how the effects of suppression compare across the two areas. Occipital and parietal stimulation sites within the same hemisphere were selected according to whether they elicited phosphenes. Then, TMS was randomly applied at 0 to 130 ms after the onset of the stimulus (SOA) in steps of 10 ms to these areas. Participants responded to the orientation of the line stimulus and rated its visibility on every trial. Our occipital TMS data replicate previous reports of visual suppression around the classical 80-100 ms window both in the objective line orientation responses and subjective visibility ratings. TMS to the parietal regions resulted in some suppression of visual information in a similar time frame, but the effects were less pronounced and more intermittent than with occipital TMS. Together, these data suggest that both the occipital and the parietal cortex may play an important role in stimulus visibility.

H123

BODY WEIGHT INFLUENCES THE INTERPLAY OF BRAIN DYNAMICS TO THE VIEWING OF HIGH- AND LOW-ENERGY FOODS WITH GASTRIC HORMONE SECRETION: AN INTERDISCIPLINARY INVESTIGATION Marie-Laure Bielser[1], Claudia Valentine Lietti[2], Léonie Egli[3], Vanessa Campos[3], Luc Tappy[3,4], Micah M. Murray[1,2,5], Ulrike Toepel[1,2]; [1]Department of Clinical Neurosciences, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Switzerland, [2]Radiology Department, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Switzerland, [3]Department of Physiology, University of Lausanne, Switzerland, [4]Service of Endocrinology, Diabetes, and Metabolism, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Switzerland, [5]EEG Brain Mapping Core, Center for Biomedical Imaging of Lausanne and Geneva, Switzerland — Endocrine factors convey information about energy needs to brain regions involved in homeostatic control of food intake, but there is mounting evidence for influences on brain areas implicated in hedonic valuation, too. The extent to which endocrine factors interact with sensory and cognitive processes in differing food motivation states and whether individuals' body weight additionally impacts those processes is so far undetermined. Our study investigated the influence of weight on gut hormone secretion as well as associations with the spatio-temporal brain dynamics to food viewing in women ranging in BMI from 19-36 kg/m2 following an overnight fast and subsequent to food intake. BMI differentially influenced the scalp-surface global power of the electric field evoked by high-and low-energy food viewing from ~230ms in pre-prandial nutrition state. On the other hand, the food type viewed and BMI impacted the estimated neural source activity (by applying distributed linear inverse solutions and the LAURA regularization approach) in occipital and frontal regions already from ~100ms after image presentation in post-prandial state, the most prominent interactions being between responses to low-energy food viewing and BMI. Activity in these brain regions modulated by food type viewed and BMI was further correlated with peripheral blood measures of leptin and ghrelin, hormones known to convey food motivation signals along the gut-brain-axis. That is, motivation and body weight substantially influence visual food perception, altering activity in brain regions mediating sensory processing, but also valuation and decision-making. Gut hormone secretion is particularly associated with BMI- and motivation-dependent food valuation signals.

H124

DIFFERENTIAL EFFECTS OF FEATURE OVERLAP IN LATERAL OCCIPITAL CORTEX AND PERIRHINAL CORTEX DURING OBJECT PERCEPTION Katja Umla-Runge[1], Mark Postans[1], Bronson Harry[2], Paul E Downing[2], Kim S Graham[1]; [1]Cardiff University, [2]Bangor University — It has been proposed that object representations within the visual ventral stream become increasingly more complex and conjunctive as one moves from posterior regions, such as the lateral occipital complex (LOC), towards more anterior areas, including perirhinal cortex (PrC). In support of this, Mundy et al. (2012) found evidence for differential effects of high versus low feature overlap in these two regions (LOC: low > high; PrC: high > low). Here, we extended these findings by investigating whether we could find evidence of differential graded activation, by presenting participants with stimuli in which we systematically manipulated feature overlap between objects (low, medium and high), as well as including a condition in which identical objects were presented. Similar to Mundy et al. (2012), we employed a blocked design fMRI study during which participants engaged in a temporal duration detection task. Orthogonal localiser tasks were used to identify functional areas within LOC and PrC that responded

to object stimuli. We then asked how activity in these regions was modulated by feature overlap. Bilateral LOC activity increased as the feature overlap between objects reduced, while left PrC showed greater activation for high compared to low feature overlap blocks. This finding is consistent with representational accounts in which PrC stores more complex and conjunctive objects than LOC.

H125

THRESHOLD FOR VISUAL AWARENESS IS ASSOCIATED WITH STRIATAL DOPAMINE D2 RECEPTOR BINDING

Filip Van Opstal[1], Tom Verguts[1], Nick Van Laecken[1], Filip De Vos[1], Ingeborg Goethals[1], Wim Fias[1]; [1]Ghent University — Previous research suggested that striatal dopamine (DA) activity affects corticostriatal information processing either by disrupting or enhancing the transmission of input signals. This process is referred to as 'sensory gating' and is defined as a pre-attentive ability of the brain to modulate its sensitivity to an incoming stimulus. This indicates a strong relation between striatal DA and subjective visual awareness of a stimulus. In the present study we further investigated this relation. We hypothesized that individual differences in the threshold for subjective visual awareness would relate to the uptake of DA in the striatum. The threshold for awareness was measured in a behavioral masking experiment. In a separate session, the uptake of DA in the striatum was measured with positron emission tomography (PET) and [11C]Raclopride as a radioactive D2 receptor antagonist. Similar to previous work demonstrating a relation between striatal D2 binding potential and cognitive performance (e.g., human working memory, Cools et al., 2008) or personality traits (e.g., sensation seeking, Gjedde et al., 2010), preliminary results (n = 10) revealed a significant quadratic (U-curve) relation between striatal binding and the threshold for subjective awareness. The possibility that this result was caused by a relation between striatal binding and response bias was excluded by a similar analysis on the false alarm rate. In sum, the results of this study show that striatal dopamine activity is related to subjective visual awareness of visual stimuli and could explain the observed increase in the subjective threshold for schizophrenic patients (Del Cul et al., 2006).

H126

IMAGINE THAT! COMPARING BRAIN RESPONSES TO IMAGINING AND PERCEIVING NOVEL STIMULI

Deana Vitrano[1], Alaisa C. Emery[1], Sara S. Patterson[1], Jonathan W. Page[1]; [1]Dickinson College — Recent evidence suggests that the visual system is activated similarly when perceiving a stimulus and later remembering the stimulus. We wondered if the visual system would be activated in the same way when imagining a stimulus that had not been previously seen. Two novel gratings were described to 30 participants. Event-related potential (ERP) responses were recorded at multiple locations with the eyes closed. A tone was used for timing the imaginations and for averaging ERP signals. Participants were then shown the gratings and asked to judge how similar their imagined gratings were to the actual gratings. ERP responses to the perceived gratings were recorded. Responses to imagining and perceiving the gratings were compared and found to be similar at the visual cortex and at many cortical locations. Additionally, response amplitudes were attenuated for those that self-reported lower similarity between their imagined and perceived patterns. The results suggest that the visual system is actively involved in creating visual imaginations and that self-reported vividness may predict response amplitude for mental imagery.

H127

PERCEPTUAL LEARNING OF REAL AND IMAGINARY ORIENTATIONS SHARE COMMON BUT DISSOCIABLE NEURAL SUBSTRATE

Fang Wang[1], Xiang Zhong[1], Meirong Sun[1], Jing Huang[1], Yulong Ding[2], Yan Song[1]; [1]State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing 100875, China, [2]Department of Psychology, Sun Yat-Sen University, Guangzhou 510275, China — When investigating perceptual learning (PL), most researchers use the real figure as stimuli, but little is known about the neural mechanisms of PL in visual imaginary stimuli. Here, we used electroencephalography (EEG) to directly compare neural substrates underlying PL in real lines with those underlying PL in imaginary lines. High-density event-related potentials (ERPs) were recorded from human subjects when they were trained with a real line or an imaginary line discrimination task. After training, the orientation discrimination performance was significantly improved and this learning effect could transfer between real and imaginary lines. The ERP results showed that the early learning effects over the parietal-occipital sites were similar and could transfer between real and imaginary line learning, whereas the late ERP learning effects over the frontal sites were quite different and specific to the type of learning. Compared with real stimuli, the higher-level cortical processing and later processing stages were involved in the learning of imaginary stimuli. These results contribute to understanding the neural basis of perceptual learning and the distinction between real and imaginary stimuli learning. Moreover, our evidences indicate that the parietal-occipital and frontal modulations are differentially related to the common and specific neural substrates of visual PL.

H128

MEASURING COLOR IMAGERY USING A STROOP-TYPE TASK

Andrea L Wantz[1], Fred W Mast[1], Janek S Lobmaier[1]; [1]Department of Psychology and Center for Cognition, Learning and Memory, University of Bern, Bern, Switzerland — Visual mental imagery refers to the ability to visualize objects or scenes in the absence of the corresponding perceptual input. To date, relatively few studies have examined mental imagery of color. Some studies aimed at determining brain areas involved in color imagery and used paradigms that asked participants to compare hues of typical objects. A disadvantage of this paradigm might be that participants may solve this task with semantic or episodic memory rather than mental imagery of colors (e.g., one study using this paradigm found hippocampal activity during this task). The main purpose of the present study was to develop and test a paradigm in which color imagery can be reliably tested while at the same time minimizing the influence of prior knowledge. Colored squares had to be named as fast as possible after imagining colors cued by letters, words or objects in a blank square whereas a control group performed the same task without the instruction to imagine colors. Imagined colors either matched the subsequent colors (congruent trials) or were incongruent. Consistent with the hypothesis, the experimental group showed a larger imagery interference effect (incongruent-congruent trials) than the control group ($p = .006$). The experimental group was faster on congruent compared to incongruent trials ($p < .001$). This effect disappeared when controlling for individual imagery abilities (Vividness of Visual Imagery Questionnaire (VVIQ), $p = .378$). Taken together, these results confirm that this Stroop-type reaction time task is reliable to test color imagery effects.

H129

MASTERY OF ACTION SHAPES OUR VISUAL OBJECT RECOGNITION

Kiyomi Yatabe[1,2], Chihiro Hosoda[1], Katsumi Watanabe[2], Takashi Hanakawa[1]; [1]National Center of Neurology and Psychiatry, [2]The University of Tokyo — Although current views of the perception-action coupling assume that motor area activities are selectively enhanced during observation of experienced action, the precise effect of prior experience on visual object recognition remains unknown. To examine how motor experiences modulate neural responses during recognition of visual stimuli, we conducted a neuroimaging study involving recognition of participants' own and others' handwriting. Contrary to our expectation that recognition of one's own handwriting, i.e., handwriting associated with familiar movements, would elicit stronger motor area activation, recognition of others' handwriting induced stronger activation in dorsal parts of the motor-related regions. In contrast, recognition of one's own handwriting was accompanied by elevated activation in the left-dominant ventral occipitotemporal cortex. This discrepancy between recognition of one's own handwriting and that of others was not confounded with differences in attention or task difficulty between the two conditions. These findings suggest that objects associated with unmastered movements are recognized by object-directed action control in the dorsal region that automatically accompanies visual perception of unfamiliar graphomotor images, whereas objects associated with mastered movements are recognized through retrieval of kinesthetic memory stored in the ventral region closely connected to the middle temporal cortex that is thought to be responsible for long-term memory.

H130

AFFECTIVE REACTIONS AND FRAMING INERTIA IN AMBIGUOUS RISK DECISION MAKING

Paul Whitney[1], Peter Rosen[1], John Hinson[1]; [1]Washington State University — Framing choices in terms of gains or losses has potent effects on risky decisions, but our understanding of framing is based almost entirely on paradigms in which the precise probabilities of options are explicitly provided. In contrast, many naturally occurring risky decision scenarios have risks that are initially ambiguous. The present study introduces a framed gambling task (FGT) that pits sure gains and losses against a gamble option, in the form of a card chosen from one of two decks containing gains and losses. One deck produces gains that on average are superior to the sure gain, and the other produces losses that are on average worse than the sure loss. From the earliest trials, choice data showed the classic framing pattern: gambling when faced with a sure loss. Participants also showed substantial framing inertia over trials, i.e., only a modest ability to overcome framing and choose a sure loss instead of a card from the bad deck. This inertia of frame-biased decision making occurred even though knowledge probes revealed accurate estimation of average outcomes of each deck. Finally, we used SCRs to assess affective reactions during the task and obtained evidence for a specific SCR pattern associated with decisions to gamble on the bad deck once the risks are known. The results indicate that framing-induced biases on risky choice are difficult to overcome with feedback, not because framing effects on information accrual, but instead because of maladaptive weighting of options.

H131

BRAIN ACTIVITY MODULATIONS TRACK RATE OF EVIDENCE DURING PROBABILISTIC REASONING

Sarah Woo[1,2], Scott Marek[1,2,4], Mark Wheeler[1,2,3,4]; [1]University of Pittsburgh, [2]Learning Research and Development Center, [3]Center for the Neural Basis of Cognition, [4]Center for Neuroscience — The present study examined the timecourse of brain activity as subjects integrated a sequence of probabilities informing a forced binary choice. We used functional magnetic resonance imaging (fMRI) to determine how evolving activity reflects the predictive sequences of probabilistic cues and how this pattern relates to choice. Subjects were first trained to associate shapes with a preset probability favoring a colored target selection. Colored targets were counterbalanced between left and right hand responses to eliminate motor effects. Following four training sessions, subjects entered a scanned test phase in which they had to choose the colored target associated with the summed probabilities of a sequence of four trained shapes. Sequences of probabilities were manipulated in three levels of rate of evidence (ROE) -- rapid, gradual, or switch. ROE was defined by stimulus sequences in which summed probabilities favoring one choice would build rapidly, gradually, or switch after first favoring the other choice. Based on previous studies, we predicted that activity in frontal and parietal brain regions would track ROE, with effects occurring earlier for rapid, later for gradual, and latest for switch trials. Inline with our predictions, we found that fMRI timecourses modulated with ROE such that rapid trials showed the earliest onset, followed by gradual, then switch trials, respectively. A hierarchical clustering analysis objectively grouped ROE-modulated brain regions, including bilateral insula, bilateral primary motor cortex, and temporal lobe regions. However, no parietal regions demonstrated ROE-dependent activity. These findings suggest these brain regions monitor evidence accrual during probabilistic decision-making.

H132

SPACE, TIME, AND CAUSALITY IN THE BRAIN: A TDCS STUDY

Adam J. Woods[1], Anjan Chatterjee[1], Alexander Kranjec[2], Preet Minhaus[3], Marom Bikson[3], Roy Hamilton[1]; [1]University of Pennsylvania, [2]Duquesne University, [3]City University of New York — The ability to infer causality is a central feature of human cognition. Causal inferences are built upon elemental spatial and temporal information. We previously reported that the parietal cortex contributes to spatial aspects of causal inference (Straube & Chatterjee, 2010) while others report that the frontal cortices contribute to decision-making aspects of causal inference (Fonlupt, 2003). We tested the hypothesis that the parietal cortex contributes to causal inference because of its role in processing spatial relations, while frontal cortices contribute because of their role in decision-making. Participants (n=16) underwent three transcranial direct current stimulation (tDCS) sessions, receiving 1.5 mA's right anode-left cathode stimulation for 20 minutes to frontal (F3/F4) or parietal cortices (CP3/CP4), or 30-second sham stimulation. Behaviorally, participants inferred causality before and during stimulation in billiard-ball style launching events; a blue ball approaches and contacts a red ball. Spatial and temporal inferences of causality were assessed separately by parametrically varying the spatial trajectories and the temporal delays between objects. Frontal and parietal stimulation significantly decreased the probability of spatial causality judgments (Generalized Linear Model–Session x Location: $X2=6.4$, $p=.04$; Frontal mean difference (MD)=6%, $p=.003$; Parietal MD=4%, $p=.02$). Only frontal stimulation significantly decreased the probability of temporal causality judgments (MD=4%, $p=.04$). Parietal stimulation also significantly improved reaction time for spatial judgments ($X2=15.7$, $p<.001$; MD=72ms, $p<.001$). Our results suggest that the parietal cortex contributes to causal inference because of its specific role in processing spatial relations, while the role of the frontal cortices relates to their role in decision-making.

H133

BRAIN TO BANK: NEURAL PREDICTORS OF FINANCIAL RISK TAKING

Charlene Wu[1], Brian Knutson[1]; [1]Stanford University — Most people will never win the lottery or contract a life-threatening illness, yet profits of casinos and insurance companies indicate that individuals are willing to pay a high premium for the potential to win big or cheat death. To explain human financial risk taking, economics and finance focus on statistical moments of mean and variance but typically ignore higher order moments like skewness (i.e. large and asymmetric but unlikely outcomes). We used neural activity not only to predict individuals' skewed choices in the lab, but also their real world financial outcomes. Subjects (n=16) chose between risky gambles and certain options for real money while being scanned with FMRI. Gambles were constructed such that all shared equal mean and variance, but differed only in terms of skewness (i.e., positive skew, negative skew, symmetric). Localization analyses indicated that increased nucleus accumbens (NAcc) and decreased anterior insula activation preceded risky choices of all types. However, logistic regression indicated that the weight of prediction from these regions varied by the type of risk: increased NAcc activity most robustly predicted choice of positively skewed gambles, whereas decreased anterior insula activity most robustly predicted choice of negatively skewed gambles. Individuals who chose more risky gambles and elicited more anticipatory NAcc activity also allocated less of their total assets to their bank accounts. These predictive anticipatory patterns of neural activation are consistent with an anticipatory affect account (Wu et al., 2012) and may have real world consequences related to the allocation of personal assets.

H134

THE PSYCHOLOGICAL AND NEURAL REPRESENTATION OF SOCIAL NORMS IN MAKING A PURCHASE DECISION

Ryoichi Yokoyama[1,2,4], Takayuki Nozawa[1], Motoaki Sugiura[1], Yukihito Yomogida[3,4], Hikaru Takeuchi[1], Yoritaka Akimoto[1], Ryuta Kawashima[1]; [1]Tohoku University, [2]University of California, Berkeley, [3]Tamagawa University, [4]Japan Society for the Promotion of Science — Social norms (SN) are important factors in decision making. However, little research has been carried out on the mechanisms of SN in purchase decision making. We conducted two experiments to reveal the psychological and neural mechanisms of SN in purchase decision making. In the first psychological study, 210 students rated 15 T-shirt stimuli with respect to 15 questions on purchase and SN using 8-point Likert scale. A factor analysis and regression analysis were applied to elucidate the relationship between "SN" and "buying impulse" in purchase decision making. The results showed SN and buying impulse to be dissociable factors in which SN suppressed the effect of buying impulse in purchase decision making. In the second study, we investigated the neural bases of SN in purchase decision making using functional magnetic resonance imaging (fMRI). 26 subjects were scanned while evaluating the extent to which possession of a particular product violates SN. We used an event-related design and conducted a parametric modulation analysis to find the regions where activation correlates with the subjective rating of SN. 80 T-shirts were used as stimuli. A significant positive correlation between activation of the right temporal parietal junction (rTPJ) and subjective ratings of SN was observed ($p<0.001$, corrected to $p<0.05$ at the cluster level). This result suggests that normative thought activates the rTPJ when subjects consider

buying a product that seems to be socially unacceptable. Combined with our previous study of consumer neuroscience, these results will help in constructing a comprehensive purchase decision making model.

H135

INTUITION- SOLELY A PHENOMENON OF IMPLICIT MEMORY PROCESSING? Thea Zander[1,2], Kirsten Volz[1]; [1]Centre for Integrative Neuroscience, Tübingen, Germany, [2]Graduate School of Neural and Behavioral Sciences, Tübingen, Germany — Starting from a conceptual level, definitions of intuition and implicit memory appear in a very similar kind. For both conceptions a non-conscious process having a positive influence on human behavior is assumed. Thus, an important issue is whether intuitive decision-making is solely a phenomenon of implicit memory processing. More precisely, this can be tested by comparing the neuronal correlates of intuitive decision-making and implicit memory processing. To that end, an fMRI study is conducted that makes use of a semantic coherence task (Bowers et al., 1990) and an additional priming procedure. Participants had to judge the semantic coherence of presented word triads and were asked to find a forth word, which might be a common concept of the three. By addressing our research outline we derived three main hypotheses: a) Given that the orbito-frontal cortex (OFC) is suggested as a candidate region involved in intuitive processing (Volz and von Cramon, 2006), we expect this area to be activated in the case of semantic intuition as well. b) An additional hypothesis is to find brain activation in the medial temporal gyrus for intuitive decisions like a previous study suggests (Ilg et al., 2007). c) Concerning the priming, a third hypothesis predicts an activity reduction in visual areas. In order to allow for detecting activation within the OFC a spin echo sequence is used. All our hypotheses were confirmed suggesting the OFC to play a key role in intuitive processing. Intuition is thereby characterised by different neuronal mechanisms than implicit memory.

H136

DISSOCIABLE NEURAL MECHANISMS UNDERLYING HONESTY AND ALTRUISM Lusha Zhu[1], Eric Set[2], Donatella Scabini[3], Robert T. Knight[3], Pearl H. Chiu[1], Brooks King-Casas[1,4], Ming Hsu[3]; [1]Virginia Tech Carilion Research Institute, [2]University of Illinois at Urbana–Champaign, [3]University of California, Berkeley, [4]Salem VA Medical Center — Both altruistic and honest behaviors require individuals to consider factors beyond their self-interest. How organisms are able to override their self-interest and undertake costly altruistic or honest acts is of central importance to a number of disciplines in the social and biological sciences, including evolutionary biology, moral psychology, and economics. In humans, it is likely that such actions recruit and rely upon the integrity of key neural systems involved in cognitive control. It is therefore likely that core cognitive mechanisms are shared between these types of behaviors. Here, using two sets of economic games, we explored the causal role of key brain regions involved in cognitive control and value-based decision making in these behavior. Specifically, subjects made a series of choices that required tradeoffs between self-interest, altruism, and honesty. We showed that patients with lesions to the DLPFC made decisions that were consistent with altruism but showed little regard for honesty. In contrast, patients with lesions to the OFC were sensitive to concerns for both altruism and honesty, and were similar to healthy controls. These results provide causal evidence of dissociable cognitive mechanisms that underlie altruism and honesty.

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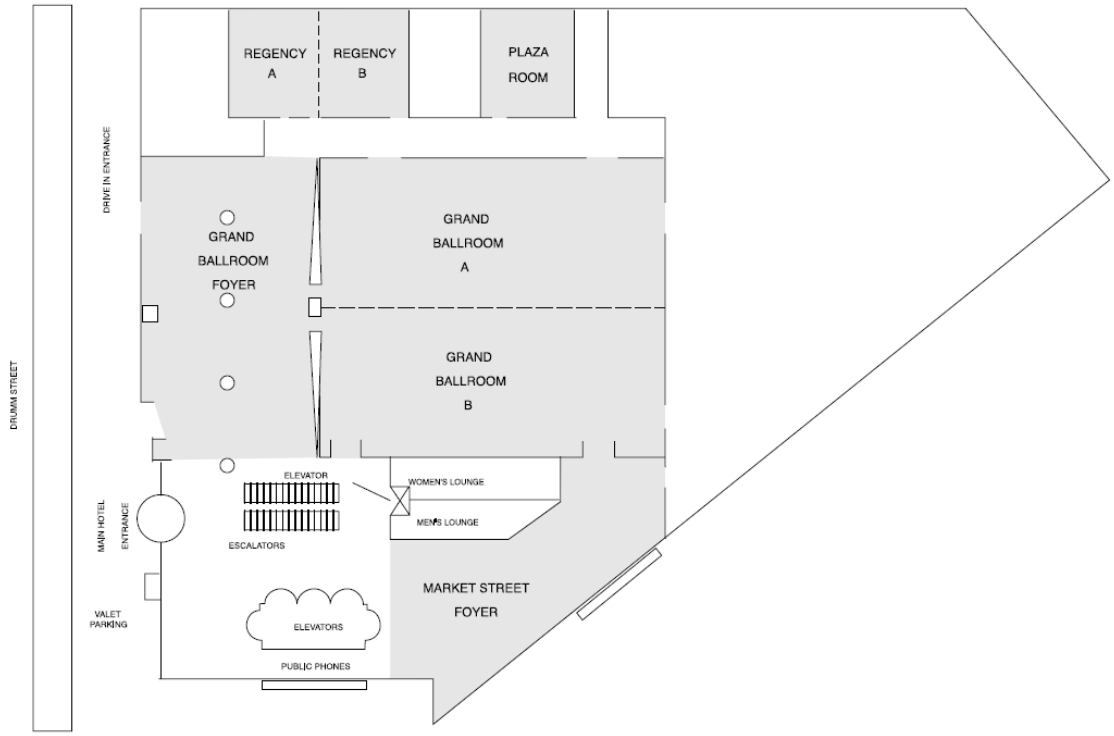
Hyatt Regency Floorplan

Street Level - CNS Registration, Grand Ballroom



Bay Level (2nd Floor) - Seacliff and Bayview Rooms