Social & Affective Neuroscience Society

# SANS 2018



# May 3-5 Brooklyn, NY



# Social & Affective Neuroscience Society Annual Meeting 2018

# May 3-5 | Brooklyn, NY

# کیپ <sup>THE</sup> Williamsburg Hotel

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# Schedule Overview

# Thursday, May 3

Start	End	Session
3:00 PM	7:30 PM	Registration
3:00 PM	3:15 PM	Welcome
3:15 PM	4:30 PM	Symposium Session A: Emotion
		<ul> <li>Andreas Olsson: The social transmission of emotions: From social to neural networks</li> <li>Sylvia Morelli: Medial prefrontal cortex encodes idiographic representations of empathy</li> <li>Benjamin Becker: Training the emotion regulation circuit using functional connectivity-based real-time fMRI neurofeedback: Feasibility and functional relevance</li> <li>Mara Mather: How arousal increases neural gain and and attentional selectivity</li> </ul>
4:45 PM	5:45 PM	Keynote Address
		Joseph LeDoux: Have we misunderstood fear?
5:45 PM	7:00 PM	Poster Session A & Welcome Reception

# Friday, May 4

Start	End	Session
8:00 AM	9:00 AM	Breakfast

9:00 AM	10:15 AM	Symposium B: Learning
		<ul> <li>Philippe Tobler: Social reinforcement learning</li> <li>Julia M. Rodriguez-Buritica: Examining neural</li> <li>correlates of observational reinforcement learning across</li> <li>development</li> <li>Geert-Jan Will: Neurocomputational mechanisms of</li> <li>individual differences in self-esteem</li> <li>Daphna Shohamy: Using memory to guide decisions</li> </ul>
10:15 AM	10:30 AM	Coffee Break
10:30 AM	11:30 AM	Trainee Blitz
		<ul> <li>Björn Lindstrom: Transfer of social fear learning to decision making</li> <li>Federica Meconi: Empathy draws on autobiographical memories</li> <li>Hayley M. Dorfman: Causal inference explains asymmetric learning of positive and negative outcomes</li> <li>Sivan Kinreich: Brain-to-brain neural synchrony during social interaction in couples</li> <li>Daniel Ames: Predicting the effectiveness of health messaging through fMRI and fNIRS</li> <li>Rosemarie E. Perry: Enriched peer relationships prevent social neurobehavioral deficits following early life adversity</li> <li>Yuan Chang Leong: Neurocomputational mechanisms underlying motivational biases in decision-making</li> <li>Marianne Reddan: A neural basis for embodied emotion</li> </ul>
11:30 AM	12:45 PM	<ul> <li>Symposium C: Social Cognition</li> <li>Grit Hein: A neuroscience approach to prosocial motivation</li> <li>Niv Reggev: Stereotype confirmation triggers reward-related neural activity</li> <li>Julia Sliwa: Comparing human and monkey neural circuits for processing social scenes</li> <li>Frank Van Overwalle: The role of the cerebellum in understanding social action sequences</li> </ul>

12:45 PM	2:15 PM	Lunch
		Session on Grant Funding Process (begins at 1:15 PM) Tamera Schneider, National Science Foundation Janine Simmons, National Institute of Mental Health Lisbeth Nielsen, National Institute on Aging Luci Roberts, National Institute on Aging
2:15 PM	3:45 PM	Symposium D: Communication
		<ul> <li>Janice Chen: Shared experience, shared memory: Neural dynamics underlying perception and memory during continuous natural events</li> <li>Benjamin Turner: What makes brains different?</li> <li>Individual differences factors explain shared activity patterns during message processing</li> <li>Beau Sievers: Conversation and neural influence in social networks</li> <li>Asif Ghazanfar: The integrative biology of social behavior and its development</li> </ul>
3:45 PM	5:00 PM	Poster Session B & Coffee Break
5:00 PM	6:15 PM	Presidential Symposium
		<b>Deanna Barch</b> : Motivational function across the spectrum of psychopathology <b>Kevin Pelphrey</b> : Towards a social neuroscience of Autism Spectrum Disorders
6:15 PM	7:30 PM	Poster Session C & Reception

# Saturday, May 5

Start	End	Session
8:00 AM	9:00 AM	Breakfast

9:00 AM	10:15 AM	Symposium E: Decision-Making
		Nathaniel Daw: Approximate action evaluation: Habits and beyond
		Candace Raio: A novel approach to quantifying the subjective cost of self-control
		<b>Pin-Hao Chen</b> : Towards a neurometric-based construct validity of trust
		<b>Cendri Hutcherson</b> : No time to be nice? Motivational computational dynamics underlying altruistic choice
10:15 AM	11:45 AM	Poster Session D & Coffee Break
11:45 AM	12:45 PM	Early Career & Distinguished Scholar Awards
		Leah Somerville: Looking at social and affective neuroscience through a developmental lens Betsy Murray: Specializations for decision making in primate prefrontal cortex
12:45 PM	2:30 PM	Lunch
2:30 PM	3:45 PM	Faculty Blitz
		Harma Meffert: The role of the amygdala in the empathy-based stimulus reinforcement learning for disgusted and happy facial expressions
		multi-disciplinary approaches supporting intergroup conflict resolution
		Brendan Gaesser: A role for the medial temporal lobe
		processes on willingness to help others
		Jennifer A. Silvers: A neurodevelopmental framework
		for the acquisition of self-regulation Peter Mende-Siedlecki: Percentual and neural
		contributions to racial disparities in pain care
		<b>Ebony M. Glover</b> : Sex differences in emotion regulation:
		Comparing naturally cycling women, women using hormonal contraception, and men
		Hermonal contracoption, and mon

Yoko Nomura: Microbiota of meconium in newborns is associated with maternal pregnancy specific anxiety Susanne Quadflieg: Biased attitudes against positive cross-race encounters

3:45 PM 4:00 PM Presidential Closing Remarks Mauricio Delgado, SANS President

# The Williamsburg Hotel, Main Floor Plan



# 2018 Awards

# **Distinguished Scholar Award**

Betsy Murray, National Institute of Mental Health

# **Early Career Award**

Leah Somerville, Harvard University

# SANS Poster Awards<sup>1</sup>

Ingrid Huang Richard Huskey Ai Koizumi Claire R. Leibowicz Prateekshit Pandey Nathan Petro

<sup>&</sup>lt;sup>1</sup> In recognition of the top 6 most highly rated abstracts that will be presented as posters.

# **Conference Program**

# Thursday, May 3, 2018

## **Opening Remarks**

Thursday, May 3, 2018

3:00 – 3:15 PM

## Symposium Emotion

Thursday, May 3, 2018

3:15 - 4:30 PM

Andreas Olsson, Karolinska Institutet

Sylvia Morelli, University of Chicago at Illinois

**Benjamin Becker**, Clinical Hospital of Chengdu Brain Science Institute, Key Laboratory for NeuroInformation, University of Electronic Science and Technology of China

Mara Mather, University of Southern California

## ABSTRACTS

# THE SOCIAL TRANSMISSION OF EMOTIONS: FROM SOCIAL TO NEURAL NETWORKS

## Andreas Olsson – Karolinska Institutet

In rapidly changing environments, humans and other animals often glean information about the value of objects and behaviors through social learning. In humans, for example, observing others' behaviors and their consequences, enables the transmission of a wide range of value-based information, from what stimuli should be avoided or approached to the appropriateness of specific social behaviors. In contrast to learning from direct, personal, experiences, little is known about the mechanisms underlying these forms of social learning. Here, I will discuss studies using behavioral, imaging (fMRI), and pharmacological techniques examining both the sender and receiver during various forms of social emotional learning. The focus will be on threat, avoidance and safety learning. Consistent with research across species, our results show that these forms of social learning draw on processes partially shared with direct conditioning and extinction learning. Importantly, however, the outcome of social learning is distinguished by its dependence on social information and interaction. The study of the mechanisms underlying social learning is fundamental to our understanding of the spread of both adaptive and non-adaptive emotional information between individuals, as well as in networks and societies.

# MEDIAL PREFRONTAL CORTEX ENCODES IDIOGRAPHIC REPRESENTATIONS OF EMPATHY

Sylvia Morelli – University of Chicago at Illinois; Pin-Hao A. Chen – Dartmouth College; Joshua Wondra – University of Illinois at Chicago; Luke J. Chang – Dartmouth College Empathy is a pervasive and common human experience. As such, past work has focused on identifying a common neural signature for empathy across people. However, individuals vary in how they interpret and represent others' emotional experiences. Thus, it's possible that the subjective nature of empathy manifests in unique - not common patterns of neural activation for each individual. To test this hypothesis, we scanned individuals (N=40) as they read 40 different stories about others' negative emotional experiences. For each experience, participants rated how much empathy they felt on a visual analog scale. We trained idiographic whole-brain models using ranked ridge regression and 5-fold cross-validation to separately predict empathy ratings for each participant. We found that these individual models reliably predicted empathy ratings (mean r = .21, std= .23, p < .001, 10,000 permutations). A univariate t-test revealed that voxels in the MPFC consistently contributed to the prediction across participants (q < 10.05 fdr-corrected) highlighting its important role in empathy computations. Interestingly, however, we did not observe any evidence of a consistent spatial similarity of the pattern in MPFC across participants (mean pairwise r = .03, ns), suggesting that each person may have a unique representation of empathy. These findings raise the possibility that empathy is an idiosyncratic appraisal, with each individual evaluating others' negative experiences in a slightly different way. Future work should further explore what factors (e.g., personal experiences, perceiver characteristics, appraisals) lead to more similar patterns of activation within the MPFC during empathy.

### TRAINING THE EMOTION REGULATION CIRCUIT USING FUNCTIONAL CONNECTIVITY-BASED REAL-TIME FMRI NEUROFEEDBACK: FEASIBILITY AND FUNCTIONAL RELEVANCE

Benjamin Becker, Zhiying Zhao, Shuxia Yao, Feng Zhou, Keshuang Li - Clinical Hospital of Chengdu Brain Science Institute, Key Laboratory for NeuroInformation, University of Electronic Science and Technology of China; Michael Luhrs, Rainer Goebel - Maastricht University; Keith Kendrick - Clinical Hospital of Chengdu Brain Science Institute, Key Laboratory for NeuroInformation, University of Electronic Science and Technology of China

Successful emotion regulation relies on an interplay between the amygdala and prefrontal regulatory regions. Deficient emotion regulation and attenuated amygdalaprefrontal functional connectivity represent a core characteristic across neuropsychiatric disorders. Recent technological advances allow the real-time analysis of fMRI data, a technique that has been employed to develop real-time fMRI-informed neurofeedback (rtfMRI-NF) trainings that enable subjects to gain volitional control over regional brain activity. Based on a neurocircuitry model of emotion regulation the present study evaluated an innovative connectivity-based rtfMRI-NF training approach to enable subjects to volitionally enhance functional connectivity in amygdala-prefrontal regulatory pathways to facilitate top-down control of negative affect. A cross-over single-blind shamcontrolled design (n=26, healthy) was employed to evaluate the feasibility of connectivitybased rtfMRI-NF and determine its functional relevance. During four subsequent training runs (4min each) with amygdala-ventrolateral prefrontal functional connectivity feedback subjects learned to volitionally increase connectivity in this pathway. On the behavioral level anxiety levels decreased following the training with the strengths of training-induced connectivity increases being predictive of the anxiety reduction. The regulatory ability was maintained when subjects were re-tested three days after the training. Importantly, a sham-training that used connectivity feedback from motor-circuits was not associated

with comparable effects, arguing against unspecific training effects. Findings provide the first evidence for the feasibility and functional relevance of real-time fMRI connectivityinformed neurofeedback trainings. This approach might allow to evaluate the functional relevance of specific pathways in basic research and could provide a therapeutic strategy to normalize dysfunctional amygdala-prefrontal connectivity and strengthen emotion regulation in neuropsychiatric populations.

#### HOW AROUSAL INCREASES NEURAL GAIN AND ATTENTIONAL SELECTIVITY

#### Mara Mather - University of Southern California

Under arousal, people focus more on whatever is salient and remember it better laterbut at the cost of processing other less salient information, which can lead to lapses of attention and memory. In this talk, I review evidence that the locus coeruleus, a small brainstem region with activity levels closely linked with arousal levels, increases mental selectivity under arousal by interacting differently with cortical regions representing highly salient stimuli than those representing less salient stimuli. This differential modulation based on salience is hypothesized to occur because local glutamate levels influence local norepinephrine release. Thus, local cortical conditions help determine how the locus coeruleus modulates brain activity. Consistent with this, in an fMRI study we found that the salience of place images interacted with arousal such that functional connectivity between the locus coeruleus and the place area was strongest when both the place stimulus being shown on that trial was highly salient and the tone played on that trial was arousing. At a more global level, our fMRI functional connectivity data also suggest that the locus coeruleus increases mental selectivity by stimulating the frontoparietal attention network. Together, these mechanisms explain how mental focus narrows and sharpens when people are in high arousal situations, and how the locus coeruleus flexibly and rapidly identifies what mental processing to enhance under arousal and what to suppress.

# Keynote Keynote Address

Thursday, May 3, 2018

4:45 – 5:45 PM

Introduced by: Elizabeth Phelps

## Joseph LeDoux

Center for Neural Science, NYU; Emotional Brain Institute, NYU; Nathan Kline Institute

## ABSTRACT

## HAVE WE MISUNDERSTOOD FEAR?

# Joseph LeDoux – Center for Neural Science, NYU; Emotional Brain Institute, NYU; Nathan Kline Institute

Fear is a fundamental part of human life, and plays a central role in psychiatric disorders. One of the main ways that fear has been related to brain mechanisms is through studies of defensive behavior in animals. This research has been very successful in revealing the brain's so-called "fear" system. The field has now matured to the point where a sharper conceptualization of what is being studied could be very useful as we go forward. Terms like "fear system" blur the distinction between processes that give rise to conscious feelings of fear and non-conscious processes that control defense responses elicited by threats. While mechanisms that detect and respond to threats contribute indirectly to conscious feelings of fear, they are not the same as those that give rise to conscious fear. This is an important distinction since symptoms based on conscious and non-conscious processes may be vulnerable to different predisposing factors and may also be treatable with different therapeutic approaches in people who suffer from uncontrolled fear or anxiety.

# Posters Poster Session A & Welcome Reception

Thursday, May 3, 2018

5:45 – 7:00 PM

See page 35 for abstracts.

# Friday, May 4, 2018

# Breakfast

Friday, May 4, 2018 8:00 – 9:00 AM

## Symposium Learning

Friday, May 4, 2018

9-10:15am

Philippe Tobler, University of Zurich
Julia M. Rodriguez-Buritica, Freie Universität Berlin
Geert-Jan Will, Leiden University
Daphna Shohamy, Columbia University

## ABSTRACTS

#### SOCIAL REINFORCEMENT LEARNING

Philippe Tobler – Laboratory for Social and Neural Systems Research, Department of Economics, University of Zurich

Humans and animals learn not only about their own outcomes but observe also those of others and may apply individual learning for the benefit of others. Social learning can be modulated by characteristics of the other individual such as group membership and by characteristics of the learning individual, such as prosocial value orientation. For both of these cases, I will present example studies from my group where we introduce computational models into the domain of social learning. I then focus on more recent research for which we use functional neuroimaging in the context of a randomized intervention design, where either an ingroup or an outgroup member provided costly help to the learning individual inside the scanner. We find that individuals who learn that others provide costly help can overcome negative biases, such as reduced neural empathy for the physical pain experienced by outgroup members. Moreover, individuals may learn to react less strongly to their own physical pain after having received costly help from outgroup members. These effects are implemented by the insula, a region that is responsive to both social and individual pain. The findings suggest that computational models originally developed to capture individual learning easily extend into the domain of social learning and that learning could provide a route for overcoming group-related social biases.

# EXAMINING NEURAL CORRELATES OF OBSERVATIONAL REINFORCEMENT LEARNING ACROSS DEVELOPMENT

Julia M. Rodriguez-Buritica – Freie Universität Berlin; Ben Eppinger – Concordia University; Hauke R. Heekeren - Freie Universität Berlin; Eveline Crone, Anna C.K. van Duijvenvoorde – Leiden University

Childhood and adolescence are considered as important periods for social development and learning, but little is known about children's learning in social situations. An important type of social learning is observational learning that can be more beneficial than learning from own outcomes, for instance when potential outcomes are negative. In an functional magnetic resonance imaging (fMRI) experiment we investigated the behavioral and neurobiological changes underlying individual and observational learning in 30 children (8-10-year-olds) and 30 young adults (18-20-year-olds) using a probabilistic rewardbased observational learning paradigm. Results showed that optimal option was chosen more frequently in the observational (i.e., other's actions and outcomes observable) than individual learning condition (i.e., neither actions nor the outcomes of other's observable) and more by adults than adolescents. Reinforcement learning models were used to determine prediction-errors to own and other's feedback. Model-based parametric fMRI analyses revealed that for own outcomes, reward-related regions (e.g., striatum and ventral medial prefrontal cortex) showed increases in activation when outcomes were better than expected, across both age groups. When observing other's outcomes, however, a reversed pattern was observed. That is, reward and cognitive control regions (e.g., striatum and dorsolateral prefrontal cortex (dIPFC)) increased activation when other's outcomes were worse than expected. Interestingly, children showed a diminished activation to other's outcomes in the dIPFC. Moreover, this dIPFC activation mediated the age-related increase in observational learning performance. These results suggest that neural mechanisms for learning from others are prone to developmental change, which is reflected in brain regions foremost related to cognitive control.

## NEUROCOMPUTATIONAL MECHANISMS OF INDIVIDUAL DIFFERENCES IN SELF-ESTEEM

Geert-Jan Will – Leiden University; Michael Moutoussis, Palee M. Womack - Wellcome Trust Centre for Neuroimaging, University College London; Robb B. Rutledge, Raymond J. Dolan - Max Planck University College London Centre for Computation Psychiatry and Ageing Research

People differ in the extent to which their self-esteem is shaped by what other people think of them. We used functional MRI to examine the neural mechanisms underpinning such individual differences in young adults (n =61) who performed a task in which they repeatedly reported on their self-esteem after receiving social feedback. Participants were recruited from a large community sample (n = 1.025) based on prior assessments of self-esteem to ensure that our sample included the full spectrum of trait self-esteem. We used a computational model that quantifies social prediction errors that capture the difference between expected and received social feedback. We find that trait self-esteem predicts the extent to which people use these social prediction errors to: 1) learn what to expect from others and 2) update their self-esteem based on the outcome of these expectations. Low trait self-esteem was associated with low expectations about being liked and a decreased tendency to use social prediction errors to update beliefs about whether others would like them, which correlated with activity in the nucleus accumbens. Low trait self-esteem was associated with increased fluctuations in self-esteem, and this was reflected in increased prediction error responses in the anterior insula. Our results demonstrate that neural signals involved in learning about the social environment and updating self-esteem are represented in different parts of the brain. Our findings reveal

the neurobiological basis of cognitive mechanisms associated with low self-esteem that may act as vulnerability factors to a range of common mental health problems.

## USING MEMORY TO GUIDE DECISIONS

Daphna Shohamy – Columbia University

The ability to learn from experience is essential to adaptive behavior. In this lecture, I will present recent advances in understanding the neurobiological and behavioral mechanisms that allow everyday experiences to change the way we perceive, act, and make decisions. The lecture will focus on how multiple brain regions interact to support learning, what this means for how memories are built, and the consequences for how decisions are made. Results emerging from this work challenge the traditional view of separate learning systems and advance understanding of how memory biases decisions in both adaptive and maladaptive ways.

# **Coffee Break**

Friday, May 4, 2018 10:15 – 10:30 AM

## Blitz Talks Trainee Data Blitz

Friday, May 4, 2018

10:30-11:30am

Björn Lindstrom, University of Zürich
Federica Meconi, University of Birmingham
Hayley M. Dorfman, Harvard University
Sivan Kinreich, Icahn School of Medicine at Mount Sinai
Daniel Ames, UCLA
Rosemarie E. Perry, New York University
Yuan Chang Leong, Stanford University
Marianne Reddan, University of Colorado Boulder

## ABSTRACTS

#### TRANSFER OF SOCIAL FEAR LEARNING TO DECISION MAKING

Björn Lindstrom – Department of Economics, University of Zürich and Department of Clinical Neurosciences, Karolinska Institutet; Arimita Golkar – Stockholm Univeristy and Karolinska Institutet; Simon Jangard – Karolinska Institutet; Pyungwon Kang -Department of Economics, University of Zürich; Philippe N. Tobler – Department of Clinical Neurosciences, Karolinska Institutet; Andreas Olsson - Department of Economics, University of Zürich

Pavlovian conditioning, involving the formation of predictive associations between stimuli, is the standard model of how humans learn fear and avoidance. However, both etiological and experimental studies have shown that social learning is a common cause of human fears and phobias. These studies have so far only examined threat responses that are passively acquired and expressed. Yet, in real-life, associations acquired through observation is likely to influence active behavior, such as instrumental decision-making. The nature of this influence is however unknown. In three behavioral experiments (n=120) and one fMRI experiment (n=44), we established this link between social fear learning and decision-making. We contrasted the influence of fear acquired by social observation (Exp. 1), direct experience (i.e., Pavlovian conditioning) (Exp. 2), and by verbal instruction (Exp.3) on subsequent decision-making (involving the cues from the conditioning session) using behavioral experiments and computational modeling. We found that the influence of observational fear conditioning on decision-making is remarkably strong, surprisingly inflexible, and can lead to distinctly maladaptive behavior. Comparison between experiments indicated that observational and direct, but not instructed, fear conditioning are based in the same Pavlovian computational system. Finally (Exp. 4), we found that that activity in the perigenual anterior cingulate cortex (pqACC), during both observational fear conditioning and decision-making, predicted the maladaptive transfer of social fear. Our results demonstrate the tremendous influence others' expressions of fears can have on one's own behavior, and shed light on the underlying computational and neural mechanisms.

#### **EMPATHY DRAWS ON AUTOBIOGRAPHICAL MEMORIES**

Federica Meconi, Ian Apperly, Simon Hanslmayr – University of Birmingham Empathy relies on the ability to mirror and to explicitly infer others' inner states. Accumulating evidence supports the idea that our memories interact with empathy when building a representation of others' inner states. However, direct evidence of a reactivation of autobiographical memories when it comes to empathizing with others' inner states is yet to be shown. We collected electroencephalographic activity from 28 participants while performing an empathy (i.e., the pain decision task) and a retrieval task. For each trial, participants viewed pictures of faces and were required to imagine that individual in a context described by a written sentence representing either nonautobiographical or autobiographical experiences of painful and neutral events. Participants judged how much empathy they felt for each individual depicted in the specified context. The success of these manipulations was confirmed by participants' higher self-reported empathy for faces depicted in autobiographical compared to nonautobiographical contexts. In the retrieval task participants were cued to imagine the painful and neutral contexts "in their mind's eye", and these data became the training set for a pattern classifier, which was then applied to data from the empathy task to test for evidence that the same memories were activated. The results showed evidence for the reactivation of autobiographical memories in preparation for the empathy judgement independent of the emotional content of the memory. These findings demonstrate that autobiographical memories are involved in drawing our empathy

# CAUSAL INFERENCE EXPLAINS ASYMMETRIC LEARNING OF POSITIVE AND NEGATIVE OUTCOMES

Hayley M. Dorfman, Rahul Bhui – Harvard University; Brent L. Hughes – University of California at Riverside; Samuel J. Gershman – Harvard University People learn disproportionately from good and bad outcomes, but the factors that influence this asymmetry remain unclear. We argue that these valence-dependent learning asymmetries are partly driven by people's beliefs about the causal structure of the environment. If hidden forces in the environment can intervene to generate bad (or good) outcomes, then a Bayesian observer will assign blame (or credit) to them, thereby reducing the effect of the outcome on learning about the underlying reward structure. To test this hypothesis, we conducted two experiments in which we explicitly manipulated participants' beliefs about the behavior of hidden agents. In Experiment 1, we sought to test whether we could create asymmetric learning between positive and negative feedback by manipulating outcome controllability in a novel behavioral task. We also investigated whether participant behavior could be modeled with a Bayesian reinforcement learning model that accounted for inferences about the probability of hidden outcome intervention. We demonstrate both kinds of learning asymmetries in the same paradigm as predicted by our hypothesized model. In Experiment 2, we replicate the results of Experiment 1 in a more realistic scenario, where the probability of hidden interference is not known and must be estimated from observed outcomes. We also provide evidence that participants' beliefs about latent causes are related to individual differences in trait optimism, and can be partially explained by early-life environment.

# BRAIN-TO-BRAIN NEURAL SYNCHRONY DURING SOCIAL INTERACTION IN COUPLES

Sivan Kinreich – Icahn School of Medicine at Mount Sinai; Amir Djalovski – Interdisciplinary Center; Yourom Louzoun – Bar Ilan University; Ruth Feldman – Interdisciplinary Center

Humans are fundamentally social and the capacity to function competently within the social world shapes our physical health and emotional well-being throughout life. However, the mechanisms by which humans coordinate their brain response during social interactions are not fully understood. We used hyperscanning EEG recordings to measure brain-to-brain synchrony during male-female social interaction, comparing romantic couples to strangers. Results revealed that gamma synchrony between brains was found for couples, but not for strangers, localized to temporo-parietal structures. Notably, couples' neural synchrony was anchored in behavioral synchrony; during episodes of shared gaze and positive affect brain coupling was observed but synchrony was minimal during moments of no gaze or neutral affect. Among strangers, longer periods of gaze and positive affect and perceived involvement in the interaction increased brain-to-brain synchrony. Our findings, the first to describe mechanisms of neural synchrony between two individuals during natural interaction in relation to ongoing social behavior, ground neural coordination in micro-level nonverbal social cues. Results also highlight the role of familiarity and shared emotionality in neural coupling, implicate attention and prediction-making in brain coordination, and suggest the involvement of embodied simulation and mentalizing processes in brain-to-brain synchrony.

# PREDICTING THE EFFECTIVENESS OF HEALTH MESSAGING THROUGH FMRI AND FNRIS

Daniel Ames, Grace Gillespie, Shannon Burns, Macrina Cooper-White, Kevin Tan, Matthew Lieberman - UCLA

Many people want to take better care of themselves (e.g., to exercise more or to get more sleep). However it can be difficult to translate these intentions into actions. Persuasive messaging that encourages healthier choices can be helpful or harmful depending on whether it is perceived as encouragement or nagging. The present research investigates the neural mechanisms of persuasion--specifically, how to successfully persuade people to actually enact the heathy behaviors that they themselves endorse. Participants wore biotrackers (FitBits) for two weeks, providing an objective index of sleep behavior. Participants also provided daily diary data on sleep and exercise. After the first week of biotracking (baseline), participants underwent scanning-either fMRI (N=60) or fNRIS (N=60)--while viewing messages that encouraged them to get more sleep. These persuasive messages were ostensibly culled from the online forum reddit.com. Their content was held constant across participants. However the framing of the messages was systematically varied. For half of participants, the persuasive vignettes were framed as prescriptive statements ("You need to sleep more. because here's what will happen to your thinking and creativity..."). The other half of participants saw the same information framed as a set of personal narratives ("I slept more, and here's what happened to my thinking and creativity..."). Neural responses in medial prefrontal cortex predicted whether participants got more sleep following persuasive messaging. Moreover, results suggest that narrative may provide a vehicle for translating intentions into actions.

# ENRICHED PEER RELATIONSHIPS PREVENT SOCIAL NEUROBEHAVIORAL DEFICITS FOLLOWING EARLY LIFE ADVERSITY

Rosemarie E. Perry, Stephen H., Catherine Ubri, Divija Chopra, Eric D. Finegood, Meriah L. DeJoseph, Regina M. Sullivan, Cristina M. Alberini, Cybele Raver, Clancy Blair – New York University

Early-life adversity is associated with disrupted social development interventions for atrisk children target the improvement of caregiver-child relationships to optimize the context in which a child's social learning occurs. Less research is assessing the ability of peer-to-peer relationships to influence social development following adversity, especially in middle childhood when peer groups are more central in youth's lives. Using a rodent model, this study investigated whether peers influence social development following adversity at both behavioral and neurobiological levels. We hypothesized that an earlylife environment of scarcity would negatively impact social behavior and stress physiology in peri-adolescent rats. We further hypothesized that following a 2-week intervention in which scarcity-reared rats were pair-housed with a control rat, scarcity-reared rats would show restored social behavior. Subjects were randomly assigned to control or scarcity conditions (insufficient wood shavings) from postnatal days (PN) 8-12. At weaning, rats were randomly assigned to matched (two animals from same rearing condition) or mismatched peer housing conditions (one scarcity animal, one control animal). At PN37-47 social behavior was assessed and glucocorticoid receptor (GR) levels were quantified in the medial prefrontal cortex (mPFC) and dorsal hippocampus (dHC). Results showed that early-life scarcity reduced social motivation, which correlated with heightened GR levels in the dHC and mPFC. The co-housing of scarcity and control rats repaired social motivation levels of the scarcity cage-mate, without affecting the social development of the control cage-mate. Our results provide a novel manipulation of peer relationships that supports the remediation of altered social behavior following early-life adversity.

# NEUROCOMPUTATIONAL MECHANISMS UNDERLYING MOTIVATIONAL BIASES IN DECISION-MAKING

Yuan Chang Leong – Stanford University; Brent L. Hughes – University of California, Riverside; Yiyu Wang, Jamil Zaki – Stanford University

Our desires and wants can often cloud our judgment, resulting in systematic biases in how we make decisions. Here, we combined computational modeling with fMRI to study motivational biases in decision-making. Participants were presented with morphed images comprising a mixture of a face and a scene, and were rewarded for correctly categorizing whether each image predominantly displayed a face or a scene. On each trial, we manipulated the category participants wanted to see by instructing them that they would win or lose extra money if the upcoming image was of a particular category. Even though the reward maximizing strategy was to perform the categorization accurately, the motivation manipulation biased participants' categorizations and impaired their performance on the task. This motivational bias was associated with greater activity in the salience network and reward-sensitive regions in the brain, as well as an enhanced neural representation of the motivation-consistent category. In particular, activity in the nucleus accumbens was associated with individual and trial-by-trial differences in motivational bias. Participants' choices were well described by a drift diffusion model in which motivation biased both the starting point and rate of evidence accumulation in favor of the motivation-consistent category. Furthermore, the bias in the rate of evidence accumulation was not fixed across trials, but varied as a function of trial-by-trial activity in the nucleus accumbens. Our results highlight the role of the reward circuitry in motivational biases, and provide a computational description of how the drive for reward can lead to suboptimal decisions.

## A NEURAL BASIS FOR EMBODIED EMOTION

Marianne Reddan – University of Colorado Boulder; Luke Chang – Dartmouth College; Tor Wager – University of Colorado Boulder

Emotion is often described as something people 'feel' in their bodies (i.e., sadness can be described as a 'lump in the throat'). Embodied emotion theorists propose that this connection is not purely linguistic; perceiving an emotion may require somatosensory and motor simulations. However, it remains unclear whether self-reports of emotion-related bodily sensations are related primarily to (1) autonomic physiological responses, or (2) brain regions responsible for perception, bodily action, and sensation, or (3) cognitive appraisals. To investigate this, participants were shown arousing emotional images ranging in valence, complexity, and content. fMRI data and physiological responses were recorded. Participants then rated the images on a set of emotion appraisal scales, both in the lab and online, and indicated where on a body map they experienced sensation in response to the image. Representational similarity analysis was used to compare the emotional content in the body maps with physiological responses and appraisals. Rank correlations revealed that physiology was more closely related to self-reported body maps than appraisals. A pairwise distance matrix between the body maps generated for each stimulus was then used in a whole brain voxel-wise searchlight analysis to identify brain regions which reflect the representational geometry of embodied emotion. This analysis revealed a network including bilateral primary somatosensory and motor cortices, precuneus, insula, and medial prefrontal cortex. The results of this exploratory study suggest that the relationship between emotion and the body is not abstract: It is supported by both physiological responses and sensorimotor cortical activations.

# Symposium SOCIAL COGNITION

Friday, May 4, 2018

11:30am-12:45pm

Grit Hein, University of Würzburg Niv Reggev, Harvard University Julia Sliwa, The Rockefeller University Frank Van Overwalle, Vrije Universiteit Brussel

## ABSTRACTS

#### A neuroscience approach to prosocial motivation

*Grit Hein – Translational Social Neuroscience Unit, Department of Psychiatry, Psychosomatic and Psychotherapy, University of Wuerzburg, Germany* All goal directed human behavior is driven by motives. With regard to prosocial behaviors, this fundamental assumption becomes complex. Prosocial behaviors can be incited by different motives such as concern for the other (empathy), concern for a social norm (e.g., reciprocity), or concern for one's own group (collectivism). Identifying the motive(s) behind a prosocial decision is difficult, because motives are not directly observable, and different motives might interact. In my talk I will present recent work that illustrates how neuroimaging methods such as functional magnetic resonance imaging (fMRI) can be used to investigate prosocial motives. The potentials and limitation of this approach will be discussed and important questions for future research will be outlined.

## STEREOTYPE CONFIRMATION TRIGGERS REWARD-RELATED NEURAL ACTIVITY

Niv Reggev, Jason P. Mitchell – Harvard University

Changing pre-existing stereotypes is a notoriously daunting task. However, little is known about the neural mechanisms supporting their persistence. Here we probe a novel hypothesis suggesting that the confirmation of stereotype-based predictions triggers reward-related neural activity, therefore leading to a positive experience whenever stereotypes are confirmed. Undergoing fMRI, participants were presented with 204 verbal statements describing various characteristics which were pre-tested to be either consistent, ambiguous or inconsistent with gender stereotypes. Each statement was followed by a male or a female face, and participants judged how likely the presented person was to be characterized by the description. Subsequently, participants completed the monetary incentive delay (MID) task, which allowed us to localize reward-sensitive neural regions. Results indicated that viewing stereotype-consistent information was associated with more activation in reward-related regions relative to stereotypeinconsistent (and stereotype-neutral) information. Subjective likelihood of statement-face association also predicted reward-related neural activity. Importantly, even stereotypeconsistent associations which were subjectively judged as unlikely triggered more activity in these regions compared to stereotype-inconsistent information. Initial behavioral evidence from additional experiments further supported the rewarding nature of stereotype confirmation. After judging the likelihood of 80 face-statement associations. participants provided their preferences of individuals in a two-alternative forced choice (2AFC). Within each face pair, one individual was previously associated with stereotypeconsistent information and another with stereotype-inconsistent information. Participants' preferences of the former individuals increased compared to their pre-task preferences.

Overall, these findings provide initial support for the role of the reward system in the reinforcement of established stereotypes.

# COMPARING HUMAN AND MONKEY NEURAL CIRCUITS FOR PROCESSING SOCIAL SCENES

Julia Sliwa – The Rockefeller University; Sadie R. Marvel – Bard College; Geena Ianni, Winrich A. Freiwald – The Rockefeller University

Recognizing agents, their actions, and their interactions is essential for understanding the world around us. In the monkey brain, these cognitive steps engage serially three distinct neural circuits: The face and body patches, the Mirror Neuron System (MNS) and finally the Exclusively Social Interaction Network (ESIN), a putative precursor of the Theory of Mind (ToM) network in monkeys (Sliwa J and Freiwald WA, Science 2017). It remains unknown however whether homologous brain regions are involved in humans, or whether humans and monkeys employ different neural strategies to process social scenes. To answer these questions we scanned twenty-six human subjects for fMRI acquisition, while they were presented with the same videos as the ones presented to monkeys, and additionally with videos of social scenes involving human actors. Whole-brain activity for watching individuals, their actions and their interactions was compared to the activity for watching control videos of objects' still, moving and interacting, using RFX GLM. We show that similarly to monkeys, humans 1) engage face and body areas (mapped independently) in all social video conditions, and 2) engage the MNS (mapped independently) in a generic manner for watching agent-object, agent-agent and objectobject interactions. Yet contrary to monkeys, humans spontaneously engage the ToM network (mapped independently) even when watching non-acting agents or agents performing goal-directed actions. These preliminary results identify which neural strategies are shared and which ones adapted to the specific needs of the species, and specifically emphasize the uniquely human interest in understanding peers' goal-directed actions.

# THE ROLE OF THE CEREBELLUM IN UNDERSTANDING SOCIAL ACTION SEQUENCES

#### Frank Van Overwalle, Sarah De Coninck, Mario Manto, Peter Mariën - Vrije Universiteit Brussel

Recent neuroimaging research has revealed that the posterior cerebellum plays a critical role in social reasoning, and in particular in understanding false beliefs and making trait attributions. A recent meta-analysis (Van Overwalle, Baetens, Mariën, & Vandekerckhove, 2014), including over 350 functional magnetic resonance imaging (fMRI) studies, identified robust clusters in the cerebellum that showed activity in about one third of the fMRI studies on social cognition, and in about all studies that involved complex social inferences (cf. Trope & Liberman, 2010). Although initially a domaingeneral modulatory explanation was offered (Van Overwalle et al., 2014), novel evidence substantially favored the view of a domain-specific process (Van Overwalle et al., 2015). This domain-specific social function was confirmed by a meta-analytic connectivity analysis involving 34 studies (578 participants; Van Overwalle, D'aes, & Mariën, 2015), and a multi-study analysis exploring functional connectivity within individual participants pooled across five published studies (92 participants; Van Overwalle & Mariën, 2015), showing unique cerebro-cerebellar links between the mentalizing networks of the cerebellum and the cerebrum. But what exactly is the cerebellum doing during social mentalizing? One hypothesis is that the cerebellum is responsible for the understanding of sequences of motions and actions, and the automatization of these action sequences. Automatization of actions in their correct order are a prerequisite for understanding false

beliefs and traits. In order to explore this hypothesis, we tested for the first time patients with generalized cerebellar degenerative lesions on a number of tests of social and affective understanding, and compared their performance with matched control volunteers. The tests involved matching of different faces showing the same affective expression, understanding mentalizing during reading false belief stories (Dewey, 1991), making causal and trait attributions on the basis of short behavioral sentences (Kestemont et al., 2016), and generating the correct order of social actions depicted in cartoons (Langdon & Coltheart, 1999). Only the latter tests showed clear deficits in cerebellar patients. In particular, patients performed at or close to normal in generating the correct order in mechanical stories and social scripts, but performed much worse when dealing with cartoons depicting false beliefs. In addition, cerebellar patients performed marginally worse on trait attributions inferred from verbal behavioral descriptions. We discuss extensions of the present tests in order to develop additional control conditions and tasks, including matched true beliefs stories that are equally nonscripted as the false stories, and verbal versions of the false and true belief cartoon test, in order to get a better understanding of the social impairments of the cerebellar patients and the critical role of the cerebellum in social understanding.

# Lunch

Friday, May 4, 2017

12:45 – 2:15 PM

Session on Grant Funding Process (begins at 1:15 PM):

**Tamera Schneider,** Deputy Division Director, Behavioral and Cognitive Sciences, National Science Foundation

Janine Simmons, Chief, Social and Affective Neuroscience Program, National Institute of Mental Health

**Lisbeth Nielsen,** Chief, Individual Behavioral Processes Branch, National Institute on Aging

Luci Roberts, Program Officer, Division of Neuroscience, National Institute on Aging

# Symposium COMMUNICATION

Friday, May 4, 2018

2:15-3:45pm

Janice Chen, Johns Hopkins University Benjamin Turner, Nanyang Technological University Beau Sievers, Dartmouth College Asif A. Ghazanfar, Princeton University

## ABSTRACTS

# SHARED EXPERIENCE, SHARED MEMORY; NEURAL DYNAMICS UNDERLYING PERCEPTION AND MEMORY DURING CONTINUOUS NATURAL EVENTS

Janice Chen – Johns Hopkins University

How do we construct and recall memories of complex real-world episodes? I present a series of studies examining memory encoding and retrieval using naturalistic continuous stimuli: audiovisual movies and auditory narratives. Inter-subject temporal and spatial correlation techniques allow us analyze neural responses as subjects view audiovisual movies and then freely recount aloud their memories of the events. Activity patterns in the default network reveal a common neural code: event-specific brain states that are robustly similar across individuals during spoken recall, despite the fact that each person chooses their own words to describe each memory. Furthermore, listening to a person's spoken recollection elicits signatures of the described movie events in the brains of the listeners, illustrating how speech is used to communicate memories between people. These studies probe the nature of brain activity underlying our ability to comprehend and recall real-world events that unfold continuously across time.

# WHAT MAKES BRAINS DIFFERENT? INDIVIDUAL DIFFERENCES FACTORS EXPLAIN SHARED ACTIVITY PATTERNS DURING MESSAGE PROCESSING

Benjamin Turner - Nanyang Technological University, Wee Kim Wee School of Communication and Information; Richard Huskey - The Ohio State University, Cognitive Communication Science Lab, School of Communication; Rene Weber - UC Santa Barbara, Media Neuroscience Lab, Department of Communication Much communication research treats individuals as interchangeable. However, individuals vary widely, behaviorally as well as neurally. Using a task in which 28 participants watched anti-drug public service announcements (PSAs), we have previously shown that by considering individual differences (IDs) along a single binary dimension (drug-use risk), we can gain important insights into message processing (Huskey et al., 2017; Weber et al., 2014). However, the variety of individuals is far richer than one binary dimension can capture. Therefore, in the present work, we take a multi-dimensional ID approach (see, e.g., Miller et al., 2012) to explore which ID factors-including sensation seeking, brain structure, and message perception measures - drive patterns of brain activity to be more or less similar across individuals encountering the same anti-drug PSAs. Our results demonstrate that several ensembles of regions show activity patterns driven by unique factors; for instance, activity patterns in regions including the middle temporal, inferior frontal, and precentral gyrus were all related to perceived message sensation value (Morgan et al., 2003), while those in regions including perirhinal cortex, inferior insula, and precuneus were related to sensation seeking and brain structure. Standard group fMRI analyses failed to detect activity in several of these regions, as it was washed out through averaging. This work demonstrates the importance of considering the correct level of specificity when studying message processing-in terms of brain region, message features, and IDs-and points the way toward possible advances in message tailoring based on neural as well as message features.

## CONVERSATION AND NEURAL INFLUENCE IN SOCIAL NETWORKS

Beau Sievers – Dartmouth College; Adam M. Kleinbaum – Tuck School of Business, Dartmouth College; Thalia Wheatley – Dartmouth College

Short conversations can create lasting changes in belief. On the level of the community or society, these changes have profound effects. For example: we choose who to vote for in part based on conversations with others, and jury deliberations decide the fates of tens

of thousands every year. We present a neuroimaging and social network study of how conversation changes belief, testing three hypotheses: (1) consensus-building conversation synchronizes neural activity, (2) social influence is neural influence influential people can alter others' neural activity to become more like their own, and (3) people who exert strong neural influence hold privileged, central positions in their social networks. Students at Dartmouth's Tuck School of Business (N~=275) completed an online social network survey, mapping the social network of the entire population. Study participants (N=33) viewed 5 silent movie clips with ambiguous narrative content during functional magnetic resonance imaging (fMRI). Participants split into groups of 3-6 and discussed the movie clips with the goal of reaching a consensus interpretation of their content. Participants then underwent a final fMRI session, viewing the movie clips a second time alongside new clips from later in each movie. We show increased neural inter-subject correlation and pattern similarity across a network of brain areas within discussion groups, versus both other groups and controls. This approach introduces a novel measure of neural influence and elucidates the relationship between neural and behavioral measures of influence and social network centrality.

THE INTEGRATIVE BIOLOGY OF SOCIAL BEHAVIOR AND ITS DEVELOPMENT

Asif A. Ghazanfar – Princeton Neuroscience Institute, Princeton University Behavioral development is the adaptive coordination of biomechanics, muscles and the nervous system with social experience. My lab explores one type of social behaviorvocal communication-to illuminate how this process works. It is typically conceived that adaptive coordination occurs through a sequence of two processes—an early maturation phase where vocal sounds change as a function of body growth followed by a period during which social experience can influence vocal production. I will review my lab's work on developing marmoset monkeys - a species that exhibits strikingly similar vocal developmental processes to those of prelinguistic human infants — that demonstrates how bodily growth and experience are actually parallel, interactive processes. Our experiments reveal how some behavioral changes that are typically attributed to changes in the developing nervous system are actually off-loaded to the body (i.e., they are "morphologically computed"), while at the same time social reinforcement from caregivers leads to an acceleration of other behavioral changes through learning. Together, these data underscore the importance of considering the whole organism, not just the nervous system, when trying to understand how social behavior works or may go awry.

Posters Poster Session B & Coffee Break

Friday, May 4, 2017

3:45 – 5:00 PM

See page 64 for abstracts.

## Symposium Presidential Symposium

Friday, May 4, 2018

5:00 – 6:15 PM

Deanna Barch, Washington University in St. Louis

Kevin Pelphrey George Washington University

## ABSTRACTS

## MOTIVATIONAL FUNCTION ACROSS THE SPECTRUM OF PSYCHOPATHOLOGY

Deanna Barch - Washington University in St. Louis

The Research Domain Criteria (RDoC) initiative has recognized the importance of studying motivation and hedonic processing in psychopathology and includes a "positive valence" system domain that captures many relevant constructs. This talk will review behavioral and neuroimaging studies examining impairments in these constructs in individuals with psychosis versus depressive pathology, as there appear to be important differences patterns and neural alterations associated with reward and hedonic function in psychosis versus depression. In depressive pathology, impairments in the experience of pleasure may propagate forward and lead to impairments in other aspects of the positive valence system that are reliant on hedonic responses, such as anticipation, learning, effort, and action selection. Such pleasure impairments in the context of depression could reflect disruption in dopamine and/or opioid signaling in the striatum related to depression more generally, or more specifically to anhedonia symptoms. In contrast, the existing data indicate relatively intact in-the-moment pleasure experience in psychosis, but disruptions in other components involved in the positive valence system. Specifically, individuals with schizophrenia exhibit altered reward prediction and associated striatal and prefrontal activation, impaired reward learning, impaired rewardmodulated action selection, and impaired effort-cost decision making, which may combine to disrupt goal-directed behavior and function in everyday life. Thus, this talk will illustrate the potential for diverse mechanistic pathways leading to common proximal outomes.

## Towards a Social Neuroscience of Autism Spectrum Disorders

#### Kevin Pelphrey – George Washington University

As humans, we are constantly engaging in social perception and social cognition, using cues from facial expressions, gaze shifts, and body movements to infer the intentions of others and plan our own actions accordingly. In this talk, I will describe my laboratory's research using functional neuroimaging techniques including functional magnetic resonance imaging (fMRI), electroencephalography (EEG) and functional near infrared spectroscopy (fNIRS) to chart the development of brain mechanisms for social cognition in typically developing infants, children, and adolescents. Our work has served to characterize the functional properties and development, from infancy to adulthood of a set network of interacting, distributed neuroanatomical structures dedicated to processing social meaning. With this understanding of the typical development of the neural basis of social cognition as a backdrop, I will describe our efforts to chart the atypical development of these brain mechanisms in infants at increased risk for developing autism and children with autism, as well as their unaffected siblings. I will then describe a developmental experimental therapeutics approach to using social neuroscience findings in the development and evaluation of more precise, individually-targeted behavioral and pharmacological treatments for autism spectrum disorders.

# Posters Poster Session C & Coffee Break

Friday, May 4, 2018 6:15 – 7:30 PM See page 94 for abstracts.

# Saturday, May 5, 2018

# Breakfast

Saturday, May 5, 2018 8:00 – 9:00 AM

# Symposium DECISION-MAKING

Saturday, May 5, 2018

9:00-10:15am

Nathaniel Daw, Princeton University

Candace Raio, New York University

Pin-Hao Chen, Dartmouth College

Cendri Hutcherson, University of Toronto

# ABSTRACTS

## APPROXIMATE ACTION EVALUATION: HABITS AND BEYOND

Nathaniel Daw – Princeton University

In many tasks, such as mazes or social interactions, effective decision making typically requires enumerating the expected outcomes of candidate actions over a series of subsequent events. Because of the computational complexity of such evaluation, it is believed that human and animal brains use a range of shortcuts to simplify or approximate it. I review behavioral and neural evidence that humans rationally trade off exact and approximate evaluation in such sequential decision making. This research offers a new perspective on healthy behaviors, like habits, and pathological ones, like compulsion, which are both viewed as approximate evaluations that fail to incorporate experiences relevant to a decision and instead rely on inappropriate or out-of-date evaluations. I also present new theoretical and experimental work that aims to address the the positive counterpart to such neglect: which particular events are considered, in which circumstances, to support choice. This brings the reach of the framework to many new phenomena, including pre-computation for future choices, nonlocal activity in the

hippocampal place system, consolidation during sleep, and a new range of disordered symptoms such as craving, hallucinations, and rumination.

# A NOVEL APPROACH TO QUANTIFYING THE SUBJECTIVE COST OF SELF-CONTROL

#### Candace Raio, Paul Glimcher – New York University

Emerging theoretical accounts suggest that rather than a 'failure' of self-control, deviations from goal-directed behavior may arise from a rational decision-making process that weighs the costs and benefits of exercising control. These 'control costs' are thought to stem from the limited cognitive resources available to support the cognitive demands of exercising control. This proposal dovetails nicely with behavioral economic theory, which posits that choosers aim to maximize expected utility, extending these cost-benefit principles to the mobilization of self-control. Yet, we still lack an empirical qualification of how individuals construct self-control costs. Here, we employed a novel economic decision-making task to quantify self-control costs in healthy dieters and further tested how these costs are modulated by stress, a prominent risk factor for self-control failure. Before and after exposure to tempting food rewards, dieters reported how much they were willing-to-pay to adopt strategies to eliminate temptation from their environment, effectively revealing their subjective cost of exercising self-control. Across two studies, we found novel evidence that individuals were willing to incur monetary costs to avoid using self-control, offering a quantifiable index of individuals' aversion to deploying control processes. Further, we found these costs were higher in stressed individuals, revealing a novel mechanism through which self-control is compromised under stress. Consistent with emerging value-based framework viewing self-control as a cost-benefit decision, our results suggest that the subject cost of self-control can be quantified in humans and that these costs are strongly modulated by changes in affective and motivational states.

#### TOWARDS A NEUROMETRIC-BASED CONSTRUCT VALIDITY OF TRUST

Pin-Hao Chen – Dartmouth College; Dominic S. Fareri – Adelphi University; Berna Güroğlu, Eveline Crone – Leiden University; Mauricio Delgado – Rutgers University; Luke J. Chang – Dartmouth College

Trust is a nebulous construct central to successful cooperative exchanges and interpersonal relationships. In this study, we introduce a new approach to establishing construct validity of trust using "neurometrics". In study 1, we combine data from two studies (n=40) to develop a whole-brain multivariate pattern that can classify whether new participants will trust a relationship partner using a linear support vector machine combined with leave-one-subject-out cross-validation. Our trust signature was able to successfully discriminate decisions to invest compared to keep money with 74% accuracy (p < 0.001). In study 2, we find that the pattern can accurately discriminate trust decisions with an accuracy of 68% (p < 0.001) in participants collected in a separate country (n=17) demonstrating generalizability of the pattern. In study 3, we establish construct validity by testing the pattern on ten separate datasets measuring distinct psychological processes. We find that our trust signature can successfully discriminate safe compared to risky decisions (accuracy = 93%, p < 0.001) and viewing neutral images from those depicting negative arousing scenes (accuracy = 65%, p < 0.001). This is consistent with the notion that trust involves an expectation of reciprocation by a relationship partner to avoid negative betrayal experiences. Moreover, we find that the signature does not generalize to reward, social closeness, facial familiarity, cognitive control, self-referential processing, and language processing indicating that the pattern is highly specific. These results provide strong support for the use of "neurometrics" in

identifying the psychological processes associated with a brain-based multivariate representation.

# NO TIME TO BE NICE? MOTIVATIONAL AND COMPUTATIONAL DYNAMICS UNDERLYING ALTRUISTIC CHOICES

#### Cendri Hutcherson – University of Toronto

Altruistic behavior is a ubiquitous feature of human behavior, yet is still incompletely understood. One fundamental and still contentious question concerns its underlying drivers: does altruism require the controlled suppression of rapid and automatic selfish instincts, or do people intuitively default to prosociality? Dual process models of choice have used a variety of approaches to answer this question, with conflicting results. To shed new light on these questions, we have begun to develop a neurocomputational model of altruistic choice capable of simulating and predicting the temporal dynamics of neural and behavioral responses. Here, I will show how a combination of data from fMRI, eye tracking, mouse-tracking, and time pressure studies can be used to inform and constrain the parameters of the computational model, generating unique insights into the processes driving prosocial behavior. Our results suggest that altruism is neither wholly automatic nor wholly controlled. Instead, selfish and altruistic motives evolve and shift dynamically over the course of just a few seconds depending on a host of inter- and intrapersonal factors that change the motivational and attentional priorities of the decision maker. Our results have important implications for predicting when, why and for whom altruism might feel like a battle between inner demons and better angels, or like an intuitively obvious choice.

## Posters Poster Session D & Coffee Break

Saturday, May 5, 2018

10:15 – 11:45 AM

See page 123 for abstracts.

# Award Award Ceremony

Saturday, May 5, 2018

11:45 AM - 12:45 PM

Introduced by: Mauricio Delgado

Leah Somerville, Harvard University SANS Early Career Award

Betsy Murray, National Institute of Mental Health SANS Distinguished Scholar Address

## ABSTRACTS

# LOOKING AT SOCIAL AND AFFECTIVE NEUROSCIENCE THROUGH A DEVELOPMENTAL LENS

#### Leah Somerville - Harvard University

The field of social and affective neuroscience has made great strides toward revealing how the brain instantiates our social and emotional lives. My lab's developmental approach highlights the dynamic nature of these processes. We have begun to uncover how the transition from childhood to adulthood remodels social and emotional behaviors, and how those processes are yoked to active brain development. My talk will highlight the value of a developmental approach, and some of the new directions of our work.

## SPECIALIZATIONS FOR DECISION MAKING IN PRIMATE PREFRONTAL CORTEX

Betsy Murray - National Institute of Mental Health

Some of the most sophisticated behaviors of primates, including humans, depend on the granular prefrontal cortex (PFC), yet there are few well defined and experimentally verified functional specializations within the primate PFC, especially at a causal level. Recent work from our laboratory has demonstrated contrasting specializations of the ventrolateral PFC (VLPFC) and the orbital PFC (also known as orbitofrontal cortex, OFC). We found that the OFC and the VLPFC play complementary roles in updating representations of value (i.e., valuations) that underlie decision making. Valuations represented in or accessed by the OFC depend on the dynamic internal state of an individual, what an object or action is worth at any given time based on current biological needs; valuations represented in or accessed by the VLPFC depend on dynamic external contingencies. In other words, the OFC updates valuations based on reward desirability whereas the VLPFC updates valuations based on reward availability. Additional studies have identified distinct functional subdivisions within the OFC. Its posterior part (area 13) is necessary for updating the valuations of objects and actions, while its anterior part (area 11) translates these valuations into choices and actions. According to comparative neuroanatomy, the granular parts of OFC and all of the VLPFC emerged during the evolution of primates, and it seems likely that their valuation-updating specializations elaborated on related functions performed by the agranular orbitofrontal areas that all mammals share.'

## Lunch

Saturday, May 5, 2018

2:30 - 3:45 PM

## Blitz Talks Faculty Data Blitz

Saturday, May 5, 2018

2:30-3:45pm

Harma Meffert, Boys Town National Research Hospital Yoni (Jonathan) Levy, IDC Herzliya Brendan Gaesser, SUNY Albany Jennifer A. Silvers, University of California, Los Angeles Peter Mende-Siedlecki, University of Delaware Ebony M. Glover, Kennesaw State University Yoko Nomura, Queens College, CUNY Susanne Quadflieg, University of Bristol

## ABSTRACTS

#### THE ROLE OF THE AMYGDALA IN THE EMPATHY-BASED STIMULUS-REINFORCEMENT LEARNING FOR DISGUSTED AND HAPPY FACIAL EXPRESSIONS

Harma Meffert – Center for Neurobehavioral Research, Boys Town National Research Hospital; Joseph Leshin – Carolina Affective Science Lab, University of North Carolina; James Blair - Center for Neurobehavioral Research, Boys Town National Research Hospital

Consistent with previous animal work, we recently showed that the human amygdala is computationally involved in empathy-based stimulus-reinforcement learning for fearful and happy expressions. Historically, the amygdala has been most consistently linked to the processing of fear, although more recent data suggests that it also processes sad and happy expressions. Given its more general involvement in aversive and appetitive stimulus-reinforcement learning, we wanted to examine whether the amygdala is involved in learning from facial expressions that do not consistently activate it. We utilized a social referencing paradigm to examine whether the amygdala is engaged in establishing object value from happy and discusted facial expressions directed towards these objects. Thirty healthy adult volunteers observed objects in the middle of the screen. Neutral faces appeared next to the object, directed their gaze towards the object and then remained neutral or changed their emotion to happy or disgust depending on the object (probabilistically). We show that the amygdala codes learning cues for happy as well as disgusted facial expressions. Interestingly, we also show that, apart from the amygdala, a larger network of regions, including the anterior insula, ventral striatum and inferior frontal gyrus processes learning cues as a function of participants overall learning accuracy. In summary, our data suggests that the amygdala is involved in learning from expressions that do not consistently activate it. This appears to be embedded within a larger network involving anterior insula, ventral striatum and inferior frontal gyrus.

# THE EMERGENCE OF MULTIDISCIPLINARY APPROACHES SUPPORTING INTERGROUP CONFLICT RESOLUTION

Yoni (Jonathan) Levy – IDC Herzliya; Abraham Goldstein – Bar-Ilan University; Moran Influs - Bar-Ilan University; Shafiq Masalha – College of Academic Studies; Ruth Feldman – IDC Herzliya

One of civilization's most important challenges is finding ways to minimize intergroup conflicts. Despite their prevalence, few interventions have been rigorously researched to evaluate their actual impact on intergroup relations. In the present study, which is framed within the Israeli-Palestinian conflict, we applied an innovative approach to evaluate the impact of a traditional intergroup intervention. Guided by advances in the neuroscience of intergroup relations and building on our recent pioneering multidisciplinary study between Jewish-Israeli and Arab-Palestinian youth, we implemented a multi-level assessment (brain, implicit associations and social behavior) evaluating the impact of a contact-based

intervention. To this end, 55 Jewish-Israeli and Arab-Palestinian adolescents were randomly assigned to participate either in a contact-based intervention or not (i.e., the control group). Participants' brain response to implicit associations was assessed right before and several months after the intervention using magnetoencephalography (MEG), and social behavior towards the outgroup was evaluated through one-on-one ecologically-valid interactions. Results show that the intervention did not significantly reduce negative implicit associations toward the outgroup at the reaction time level, yet, rhythmic neural activity associated with the implicit associations was strongly inhibited following the intervention. Importantly, the neural effect was coupled by a reduction in hostile social behavior toward the outgroup. These findings highlight the potential impact of the contact-based intervention, and at the same time reveal the utility of conducting multidisciplinary assessments. Finally, we currently evaluate the potential impact of other forms of intergroup contact (e.g., immersive virtual contact) and of interventional strategies in supporting intergroup conflict resolution.

### A ROLE FOR THE MEDIAL TEMPORAL LOBE SUBSYSTEM IN GUIDING PROSOCIALITY: THE EFFECT OF EPISODIC PROCESSES ON WILLINGNESS TO HELP OTHERS

# Brendan Gaesser – SUNY Albany; Mary Horn, Emily A. Wasserman, Liane Young – Boston College

Why are we willing to help others? Social neuroscience research has focused on neural systems supporting person perception and emotional reactions to the person in need; however, this person-centric view of prosociality overlooks the importance of how the helping event itself is represented. Recent behavioral work on episodic processes (i.e., the ability to represent an event that is specific in time and place) suggests that imagining and remembering scenes of helping a person in need increases intentions to help. Here, we provide insight into the cognitive and neural mechanisms that enhance prosocial intentions via episodic simulation and memory. In Experiment 1, we scanned participants using functional neuroimaging as they imagined and remembered helping episodes, and completed non-episodic conditions that controlled for exposure to the story of need and conceptual priming of helping. Imagining and remembering helping episodes increased activity in brain regions within the default network and medial temporal lobe subsystem, and heightened participants' willingness to help others compared to control conditions. ROI analyses revealed that activity in the parahippocampus, hippocampus, as well as the RTPJ predicted the effect of conditions on the strength of prosocial intentions. In Experiment 2, we used transcranial magnetic stimulation to disrupt activity in the RTPJ, and better isolate the contribution of medial temporal lobe subsystem to prosocial intentions. These findings point to novel neurocognitive mechanisms for facilitating prosocial decisions, suggesting that our willingness to help others in need is guided, in part, by how easily we can construct imagined and remembered helping episodes.

### A NEURODEVELOPMENTAL FRAMEWORK FOR THE ACQUISITION OF SELF-REGULATION

#### Jennifer A. Silvers – University of California, Los Angeles

Childhood and adolescence present novel socioemotional challenges. As such, a hallmark of health development is the acquisition of effective self-regulation skills. In the present two studies, we investigated age-related differences in self-regulation and their neural mechanisms across childhood and adolescence. Study 1 employed fMRI scanning in a sample of 112 healthy individuals ranging in age from 6-23 years. To assess self-regulation ('Regulation' trials), participants were instructed to emotionally distance themselves from aversive images on a subset of trials. These trials were compared to an

emotional "baseline" condition wherein participants viewed images without regulating ('Reactivity' trials) to assess self-regulation. Age predicted significant linear reductions in negative affect and amygdala reactivity on Regulation trials. Study 2 followed up on Study 1 by examining whether increased cortical specialization in lateral prefrontal regions were associated with better self-regulation during childhood and adolescence. To this end, we used the same experimental paradigm in 38 youth aged 8-17 years as they underwent fMRI scanning. Cortical specialization was operationalized with a novel approach that entailed calculating Gini coefficients for lateral prefrontal regions of interest (Leech et al., 2014). Results revealed that youth who were more successful at self-regulating showed greater specialization in the lateral prefrontal cortex for Regulation, but not Reactivity trials. Together, these studies reveal that age-related changes in self-regulation hinge upon enhanced engagement of lateral prefrontal cortex and specifically, enhanced cortical specialization within lateral PFC. These data are significant both for both basic and translational neurodevelopmental work of self-regulation.

# PERCEPTUAL AND NEURAL CONTRIBUTIONS TO RACIAL DISPARITIES IN PAIN CARE

Peter Mende-Siedlecki, Jennie Qu-Lee, Robert Backer – University of Delaware; Jay J. Van Bavel – New York University

The pain of Black Americans is systematically under-diagnosed and under-treated, compared to the pain of Whites. While other work has examined social-cognitive factors driving such biases (e.g., gaps in empathy, judgments of status, stereotypes about biological differences between Blacks and Whites), we tested whether racial bias in pain care stems from a perceptual source, as well. Across a series of behavioral and neuroimaging experiments (total N = 1297) using a novel stimulus set, we observed racebased disparities in both perceptual and neural indices of pain recognition. White participants consistently showed more stringent thresholds for recognizing pain on Black faces, versus White faces. This bias was indeed perceptual in nature — arising from disruptions in configural processing associated with other-race faces, and was supported by divergent patterns of activity in brain regions associated with social perception — and could not be explained by differences in low-level stimulus features (e.g., luminance, contrast), or subjective evaluations related to pain (e.g., masculinity, dominance). We even observed these biases when facial structure and expression intensity were objectively equated across digitally rendered Black and White targets. Critically, we repeatedly observed that bias in pain perception predicted subsequent bias in treatment recommendations (specifically, grams of a non-narcotic pain reliever), over and above participants' explicit racial prejudice and stereotypes regarding status, strength, and pain tolerance. These data illuminate the perceptual underpinnings of disparities in pain care and can inform new interventions to bridge those gaps.

#### SEX DIFFERENCES IN EMOTION REGULATION: COMPARING NATURALLY CYCLING WOMEN, WOMEN USING HORMONAL CONTRACEPTION, AND MEN Ebony M. Glover – Kennesaw State University

Women are disproportionately diagnosed with anxiety disorders at more than twice the rates than men. There is a growing need for research examining biological underpinning of these sex disparities. Previous research has characterized estrogen as playing an important modulatory role in emotion regulation. However, there are mixed findings and limited understanding of the activational effects of natural cycling estrogen versus exogenous estradiol exposure (via hormonal contraceptives) on emotion regulation in women contrasted with men. The current study uses the fear-potentiated startle (FPS) paradigm to quantify psychophysiological correlates of emotion regulation (i.e., ability to

inhibit acoustic startle responses in a safe context relative to a threatening context) in naturally cycling women, women on oral contraceptives, and men. Female participants were grouped as naturally cycling or combined oral contraceptive (COCs) users. Naturally cycling women were further divided into menstrual cycle phases (luteal vs. follicular) according to what day they fell on the menstrual cycle at the time of testing. In addition, saliva samples were collected for analysis of circulating levels of salivary 17 $\beta$ -estradiol immediately prior to testing. Women in the follicular (low estrogen) phase of their menstrual cycle and women using COCs showed deficits in emotion regulation compared to women in the luteal phase (high estrogen) and men. These data support previous findings that low estrogen may be a risk factor for anxiety. They also underscore the need for assessing contraceptive use as a critical variable when attempting to understand sex differences in emotion regulation and its clinical implications.

# MICROBIOTA OF MECONIUM IN NEWBORNS IS ASSOCIATED WITH MATERNAL PREGNANCY SPECIFIC ANXIETY

Yoko Nomura, Wei Zhang – Queens College, CUNY; Melissa Huang, Scott Koenig – Graduate Center, CUNY; Jiazong Hu – Icahn School of Medicine at Mount Sinai Emerging evidence shows that newborn infants' meconium is not sterile and the bacterial transmission between a mother and her infant takes place in utero via an unknown transmission mode. So far, little is known about whether mother's psychological wellbeing, measured by antenatal mood and anxiety, influences transmission of bacteria in utero from mothers and infants. The first intestinal discharge (i.e., meconium) from the 148 newborns was collected at birth. The meconium microbiome was profiled using multibarcode16S rRNA sequencing followed by taxonomic assignment and diversity analysis. The study aims to assess the diversity of the meconium microbiome and determine if the bacterial community is affected by mother's anxiety and depression during pregnancy. The results found that the meconium samples were not sterile and contained diversified microbiota. The most robust predictor for the overall meconium microbiota composition was pregnancy-specific anxiety (p-value=0.001). At specific taxa level, the greater pregnancy specific anxiety during pregnancy was related to the lower level of Enterococcaceae family (i.e., Enterococcaceae, comamonadaceae, enterococaceae, moraxellaceae, and enterococcacea) (p-value=0.00025, r=-0.42). In conclusion, our study supports evidence that meconium contains diversified microbiota and suggests that the initial colonization of the gut flora may start prior to birth. Furthermore, the meconium microbiome of babies born to mothers with greater pregnancy-specific anxiety is less enriched for specific bacterial OTUs. These findings can enhance our understanding of a non-genetic risk of transmission, and can potentially help design novel preventive measures among children of anxious women.

#### **BIASED ATTITUDES AGAINST POSITIVE CROSS-RACE ENCOUNTERS**

# Susanne Quadflieg – University of Bristol; Yin Wang – Temple University; Thomas Schubert – University of Oslo

Initial data indicate that positive encounters between people of different racial backgrounds can elicit negative impressions in uninvolved bystanders. To examine this phenomenon in further detail, this study combined unobtrusive methods from social psychology and social neuroscience to probe Black as well as White Americans' attitudes towards other people's cross-racial encounters. In Experiment 1, an affective priming paradigm was used to demonstrate that both Black (n = 44) as well as White Americans (n = 44) evaluate the same positive encounters (e.g., a friendly chat) less favorably when it occurs between a Black and a White individual than when it occurs between two Black or two White individuals. In Experiment 2, functional magnetic resonance imaging (fMRI)

revealed that both Black (n = 46) as well as White Americans (n = 42) respond with brain activity indicative of reduced reward processing (i.e., lower activity in the ventral striatum) and enhanced mentalizing (e.g., higher activity in the dorsomedial prefrontal cortex and the bilateral temporoparietal junction) towards other people's cross-race relative to same-race encounters. Together, the data begin to elucidate people's attitudinal bias against instances of racial egalitarianism in everyday life.

# **Presidential Closing Remarks**

Saturday, May 5, 2018

3:45 - 4:00 PM

Mauricio Delgado, Rutgers University SANS President

# **Poster Session A**

Thursday, May 3, 5:45 – 7:00 PM

## A-1

## THE DYNAMIC PROCESS OF AMBIGUOUS EMOTION PERCEPTION

Michael Berkebile, Jonathan Freeman - New York University; Maital Neta - University of Nebraska– Lincoln

Everyday social interactions hinge on our ability to resolve uncertainty in nonverbal cues. For example, although some facial expressions (e.g., happy, angry) convey a clear affective meaning, others (e.g., surprise) are ambiguous, in that their meaning is determined by the context. Here, we used mouse tracking to examine the underlying process of resolving uncertainty. Previous work has shown suggested that negative ratings would be faster than positive ratings of surprise. We examined responses to filtered images in order to emphasize the faster, more automatic response (low spatial frequencies; LSF) as compared to slower, more elaborate processing (high spatial frequencies; HSF). We found a significant rating (positive, negative) x filter (LSF, HSF) x time (3 levels) interaction on mouse trajectory X-coordinates. This suggests there was a higher attraction to the negative response option even when participants responded "positive", and that this effect is significantly stronger for HSF than LSF trials, specifically in the middle of the response process. Further, mean trajectories were unimodally distributed, suggesting a parallel activation of both positive and negative responses on surprise trials, as opposed to sequential activation of one response option followed by the other. Since LSF images are processed more quickly than HSFs, decisions on these trials are attracted more directly to the negative response, and experience less response competition than HSFs. These results are consistent with previous work examining responses to filtered images of surprised faces, and demonstrating that a more regulated (prefrontal cortex) response is associated with positivity.

#### A-2 \*SANS Poster Award winner\*

# USING TRANSCRANIAL DIRECT CURRENT STIMULATION TO EXAMINE THE DORSOLATERAL PREFRONTAL CORTEX'S ROLE IN INTERGROUP EMPATHY

Claire R. Leibowicz - the D. E. Shaw group, New York, United States of America; Mina Cikara, Joshua, W. Buckholtz - Harvard University, Cambridge, United States of America

Counter-empathic responses (e.g., pleasure in response to another's pain or displeasure in response to another's fortune) are important drivers of intergroup aggression. This observation is consistent with recent models linking antisocial aggression to the positive valuation of harm to others; it also corresponds with data showing impaired prefrontal modulation of striatal action valuation in antisocial syndromes. Moreover, it suggests that group status comprises an important factor for considering social context-related adjustment of harm valuation. While counter-empathic emotions correlate with ventral striatal activity, what is not known is whether prefrontal modulation downregulates these counter-empathic responses. We used excitatory transcranial direct current stimulation (etDCS) to untangle the role of dorsolateral prefrontal cortex (DLPFC) in modulating the counter-empathic response to competitive out-group members. Participants (N = 113) were randomly assigned to one of two teams, and they received either active or placebo stimulation while ostensibly competing in a problem-solving challenge. In contrast to our predictions, upregulating DLPFC function altered intergroup empathic, but not counter-empathic, responses. Specifically, etDCS attenuated the intergroup bias for negative empathy by increasing negative empathy toward out-group members and leaving in-group empathy relatively unchanged. By contrast, etDCS diminished the intergroup positive empathy gap by both increasing out-group empathy levels and simultaneously decreasing in-group empathy levels, by almost equal amounts. These surprising results suggest a potential role of the corticostriatal circuit in empathy and link to a growing literature examining the role of cortical asymmetry in empathic responding.

## A-3

# MIDBRAIN RESPONSES IN SOCIAL AVERSIVE LEARNING: NEURAL AND NEUROPHARMACOLOGICAL MECHANISMS

Jan Haaker - Department of Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden & Department of Systems Neuroscience, University Medical Center Hamburg-Eppendorf, Hamburg, Germany; Björn Lindström - Department of Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden & Department of Economics, University of Zurich; Jonathan Yi, Predrag Petrovic, Andreas Olsson - Department of Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden Social learning through observation of others shapes many of our expectations of aversive events. Yet, the precise neural processes that translate experiences observed in others into our defensive responses against aversive events are unclear. The midbrain PAG is a structure that is central in regulating how we learn from direct experiences of aversive events in order to orchestrate our defensive responses. However, the function of the PAG in responses to socially transmitted experiences is unexplored. We here show that conjunct activity within the PAG towards directly experienced as well as observed experiences in others is central for aversive learning to anticipate dangers. As such, the temporal dynamics of PAG responses were found to reflect others` and direct experiences of aversive events and modulation by expectancy. Furthermore, we provide evidence from another experiment that replicates the involvement of the PAG in social learning of threats through observation. Critically, PAG activity in this experiment is found to be sensitive to pharmacological blockade of opioid receptors as a critical neurochemical regulator in scaling social aversive learning. Diminished opioid receptor function led to enhanced PAG responses, which were functionally coupled to responses in the Superior temporal sulcus (STS) and strengthen long-term memory (tested 72 hours later). This collection of results suggests a functionality of the PAG within social aversive learning and orchestrating defensive responses in humans. Thereby, we provide a revisited model of social aversive learning that includes functions of the midbrain, in particular the PAG.
# TEENS CARE MORE ABOUT THEIR FRIENDS: AN ERP STUDY OF SOCIAL REWARD LEARNING IN ADOLESCENTS AND ADULTS

#### Chen Xingjie, Youngbin Kwak - University of Massachusetts Amherst

Adolescents spend a significant amount of time with their friends and peer relationships are particularly valued during adolescence. We investigated how adolescents and adults made decisions during the social gambling task (SGT) in which they earned money for themselves and their best friends. EEG was continuously recorded. Outside the task, participants were also asked how much they would share with the friend if they were given \$50 (intended share). Behavioral results suggested that adolescents (N=34, 10-17 yrs), compared to adults (N=30, 21-32 yrs), earned relatively more money for their friend than themselves during SGT. They also showed greater intended share with friend compared to adults. ERP analyses were focused on the fronto-central feedback-related negativity (FRN) and the attentionrelated P3, time-locked to choice outcomes. A three-way ANOVA with age groups (adolescents vs. adults), outcome valence (gain vs. loss) and recipient (self vs. friend) was used to compare the ERP magnitudes. For FRN, adolescents showed greater difference in gain vs. loss for friend than self, while the adults showed no difference across recipients. For P3, we looked at P3a focalized in the frontocentral electrode and P3b in the parietal electrode both relevant in late-attention evaluative processing. For both P3a and P3b, adults showed greater amplitude for self than friend, while adolescents showed no difference across self and friend. Moreover, within adolescents, greater loss - gain FRN was associated with greater intended share with friend. Collectively these results highlight how peer relationships shape adolescent's brain and influence their decisions involving friends.

#### A-5

# THE ROLE OF THE CEREBELLUM IN EXPLICIT AND INCIDENTAL PROCESSING OF FACIAL EMOTIONAL EXPRESSIONS: A STUDY WITH TRANSCRANIAL MAGNETIC STIMULATION

Chiara Ferrari - Department of Psychology, University of Milano-Bicocca, Milan 20126, Italy; Viola Oldrati - Department of Brain and Behavioral Sciences, University of Pavia, Pavia 27100, Italy, Marcello Gallucci - Department of Psychology, University of Milano-Bicocca, Milan 20126, Italy; Tomaso Vecchi - Department of Brain and Behavioral Sciences, University of Pavia, Pavia 27100, Italy; Zaira Cattaneo - Department of Psychology, University of Milano-Bicocca, Milan 20126, Italy Growing evidence suggests that the cerebellum plays a critical role in non-motor functions, contributing to cognitive and affective processing. In particular, the cerebellum might represent an important node of the "limbic" network, underlying not only emotion regulation but also emotion perception and recognition. Here, we used transcranial magnetic stimulation (TMS) to shed further light on the role of the cerebellum in emotional perception by specifically testing cerebellar contribution to explicit and incidental emotional processing. In particular, in three different experiments, we found that TMS over the (left) cerebellum impaired participants' ability to categorize facial emotional expressions (explicit task) and to classify the gender of emotional faces (incidental emotional processing task), but not the gender of neutral faces. Overall, our results indicate that the cerebellum is involved in perceiving the emotional content of facial stimuli, even when this is task irrelevant.

#### A-6

# MOTHER-CHILD FEEDING INTERACTIONS: ASSOCIATIONS WITH NEURAL RESPONSES TO FOOD CUES IN CHILDREN

#### Afroditi Papantoni, Liuyi Chen, Susan Carnell - Johns Hopkins University School of Medicine, Baltimore, USA

Maternal pressuring to eat has been associated with lower food intake and weight in children, while restrictive feeding has been associated with greater child food intake and weight. To explore potential neural mechanisms for these associations, we analyzed data from 76 children (14.1-18.9 y, mean BMI z-score 0.62±1.20, 39F, 37M) and their biological mothers. Mothers completed the Comprehensive Feeding Practices Questionnaire. Adolescents underwent fMRI scanning while viewing photos

representing high-calorie foods and low-calorie foods, in a fed and a fasted condition, and rating their desire to eat each food. Greater maternal scores on 'Pressure' were correlated with lower child BMI zscore (r=-0.27, p<.05) as well as with lesser child responses to high- vs. lowcalorie cues in visual areas in both conditions (fasted: superior occipital and fusiform gyri, fed: precuneus, p<0.001, k=20), consistent with a decreased salience of high calorie foods in children whose mothers pressure them to eat. Greater scores on 'Restriction for Weight Control' were correlated with higher child BMI z-score (r=0.42, p<0.001) as well as with greater inferior frontal gyrus activation during high- vs. low-calorie cues in the fasted condition, and lesser middle frontal gyrus activation in the fed condition, p<0.001, k=20), consistent with conscious efforts to inhibit desire to eat when fasted which become disinhibited following food consumption, among children whose mothers attempt to restrict their food intake. Genetic and longitudinal behavioral data support a bidirectional explanation of these findings such that mothers are responding to children's appetitive tendencies, as well as potentially influencing them.

### **A-7**

# FUNCTIONAL CONNECTIVITY BETWEEN REWARD REGIONS AND EXECUTIVE FUNCTION REGIONS DURING SELF-AFFIRMATION

#### Hayoung Woo, Janine Dutcher - Carnegie Mellon University

Self-affirmation, the process of focusing on important personal values, has been shown to have beneficial effects on our executive functions (EF) including enhanced academic performance, better processing of health messages, faster response speed in the Stroop task, and fewer errors in N-back task. Previous studies found increased neural reward-related activity during the self-affirmation process; however, functional connectivity between affirmation associated brain regions has not been studied. The present study investigates functional connectivity to understand the neural mechanism underlying the effect self-affirmation has on facilitating EF. We hypothesized that there would be a greater functional connectivity between a key reward-related region (ventral striatum) and EF regions including DLPFC, DMFPC, and VLPFC during a self-affirmation condition relative to a control condition. We conducted a psychophysiological interaction (PPI) analysis based on the neuroimaging data from Dutcher et al. (2016). During experimental blocks, participants made decisions about important values; during control blocks, they made decisions about less important values. Contrast estimates (selfaffirmation > control) from each subject's first-level PPI analysis were compared. We found an increased functional connectivity between the right VS and the left VLPFC during the self-affirmation. This strengthened connectivity provides supporting evidence that the self-affirmation process may be associated with increases in regulatory processes of EF. However, bilateral VS showed reduced functional connectivity with primary motor cortex, TPJ and DLPFC. These patterns imply that selfaffirmation's effects on EF may depend on the specific mechanism or process. The finding suggests a plausible neural link between self-affirmation and previously demonstrated increases in EF.

#### **A-8**

#### TITLE

Bruce P. Dore, Nicole Cooper, Christin Scholz, Matthew B. O'Donnell, Emily B. Falk - University of Pennsylvania

Persuasive messages can be an effective way to change attitudes and behavior, but their effects depend on how people think about and appraise their meaning. Drawing from research in attitude change and emotion regulation, we used neuroimaging to investigate neural mechanisms underlying cognitively regulating the affective and persuasive impact of advertisements targeting binge drinking, a significant public health problem. Using cognitive control to up-regulate (versus down-regulate) responses to anti-binge drinking ads increased negative affect and perceived ad effectiveness, and also increased ratings of ad self-relevance made after a one-hour delay. Neurally, cognitive regulation of responses to these ads engaged lateral prefrontal, posterior parietal, and lateral temporal cortical regions implicated in controlled processing, evoked goal-congruent changes in ventromedial prefrontal

cortex (vmPFC), and modulated expression of distributed whole-brain patterns indexing negative emotion and integrative value. Moreover, immediate effects of cognitive regulation on negative affect and ad effectiveness were predicted by vmPFC activity and expression of all three of these patterns, and lasting effects on self-relevance were predicted by vmPFC activity. These findings demonstrate robust effects of cognitive control on responses to persuasive messaging and identify mechanisms of emotional reactivity, controlled regulation, and integrative valuation that underlie these effects.

### A-9

# INVESTIGATING THE DEVELOPMENT OF LINGUISTIC DISTANCING IN EMOTION REGULATION FROM CHILDHOOD TO ADULTHOOD

Erik C. Nook, Constanza M. Vidal-Bustamante, Hyun Young Cho, Laurel E. Kordyban, Leah H. Somerville - Harvard University

Regulating one's emotions is a critical affective skill at all stages of development. Research suggests that cognitive reappraisal-changing one's interpretation of a stimulus to make it less aversive-is an effective strategy for down-regulating negative affect. Recent work suggests that adults spontaneously distance their language when engaging in cognitive reappraisal and that greater linguistic distancing is associated with more successful emotion regulation. Linguistic distancing involves shifting the words one uses when processing a stimulus to be less focused on oneself and the "here and now" by reducing use of present-tense verbs and first-person singular pronouns such as "I," "me," or "mine." However, the extent to which children and adolescents utilize linguistic distancing during emotion regulation remains unknown. Here, we address this guestion by investigating the developmental trajectory of linguistic distancing in emotion regulation. Participants (N=112) aged 10-23 completed a standard emotion regulation task in which they said their thoughts and feelings aloud while either responding naturally to negative images, cognitively reappraising negative images, or responding naturally to neutral images. Results replicated prior findings in this developmental sample: Participants spontaneously distanced their language while engaging in cognitive reappraisal and stronger linguistic distancing was correlated with more successful emotion regulation. Initial analyses suggest that linguistic distancing and emotion regulation success did not vary across age, but these analyses are ongoing. Greater insight into the cognitive underpinnings of emotion regulation across development may facilitate clinical interventions aimed at helping youth effectively manage their emotions.

#### A-10

# EFFECTS OF PERCEIVED SOCIAL STATUS ON PROSOCIAL BEHAVIOR AND SUBSEQUENT LEARNING IN ADOLESCENCE

Katherine Powers, Alexandra Rodman, Juliet Davidow, Laurel Kordyban, Katya Kabotyanski, Abigail Stark, Leah Somerville - Harvard University, Cambridge MA USA

During adolescence, peer relationships and social hierarchies take on heightened importance. Once low social status is conferred it remains remarkably stable over time, making it difficult for adolescents to shift into more desirable social ranks. Here we tested whether perceptions of social status selectively bias learning processes within peer groups to disregard favorable behaviors exhibited by low status individuals, cementing existing status structures. Adolescent and adult participants (N=101, ages 12 - 24) played an iterated trust game with hypothetical peers who occupied positions of high and low status. In the trust game participants decide whether or not to make financial investments with each peer and subsequently, through repeated interactions, learn how likely each individual is to return those investments. Unbeknownst to participants, all peers returned investments at an equivalent rate. We found that decisions to trust peers were influenced by initial perceptions of status, such that participants were less likely to invest money with the low status peer relative to the high status peer. This status-driven pattern of sharing was consistent across all ages, though adolescents were more prosocial in their decisions overall. Initial analyses indicated that adults more readily updated impressions of the peers based on the feedback received through repeated interactions, while this rate

of learning was attenuated in adolescence. This work reveals how initial impressions of status and subsequent social experiences interact to shape prosocial behavior, identifying ways in which fundamental learning biases may contribute to social hierarchy stability.

### A-11

# THE RELATIONSHIP BETWEEN A NEUROCOGNITIVE MEASURE OF EMOTION REGULATION AND INHIBITORY CONTROL IN CHILDREN

Rohini Bagrodia - Hunter College, CUNY; Sarah Myruski - The Graduate Center, CUNY; Tracy A. Dennis-Tiwary - Hunter College, CUNY

Although a positive association between inhibitory control and emotion regulation (ER) has been well documented (e.g. Dennis, O'Toole, DeCicco et al., 2012), less is known about associations between inhibitory control and neurocognitive indices of ER, especially early in development. We recently demonstrated that the late positive potential (LPP) is a behaviorally-relevant neurosignature of ER in children (Babkirk, Rios, Dennis, 2014). The present study examined the association between inhibitory control, LPP measures of ER, and parent report of child attention control problems. Forty-three 5-to-8year-old children (19 female, Mmonths = 84.97, SD = 13.11) completed a Directed Reappraisal Task (DRT) while EEG was recorded. LPP residual scores were computed such that more positive scores indicated successful reduction of LPP amplitudes following reappraisal versus negative interpretations of unpleasant images. Children completed the Hearts and Flowers task (HF) to measure cognitive inhibitory control, and parents reported on child attention control problems (CBCL; Achenbach & Edelbrock, 1983). Children who demonstrated greater reappraisal-induced reductions of the LPP had fewer parent-reported attention problems (r = -.304, p < .05). Then children were grouped according to whether they showed positive (effective reappraisal) or negative LPP scores. Those with positive [M(SE) = 767.81 (29.91)] versus negative [M(SE) = 897.31 (60.01)] LPP scores responded correctly more quickly during the HF task, F(1, 39) = 5.461, p = .025]. Findings demonstrate that LPP indices of ER are sensitive to individual differences in inhibitory control and attention control, two purported mechanisms underlying the development of adaptive ER across the lifespan.

### A-12

### BRAIN-TO-BRAIN SYNCHRONY AND LEARNING OUTCOMES VARY BY STUDENT-TEACHER DYNAMICS: EVIDENCE FROM A REAL-WORLD CLASSROOM EEG STUDY

Dana M Bevilacqua, Ido Davidesco - New York University; Lu Wan - University of Florida; Matthias Oostrik, Kim Chaloner, Jess Rowland - New York University; Mingzhou Ding - University of Florida; David Poeppel, Suzanne Dikker - New York University

How does the human brain support real-world learning? We used wireless electroencephalography (EEG) to collect neurophysiological data from a group of twelve senior high school students and their teacher during regular biology lessons. Six scheduled classes over the course of the semester were organized such that class materials were presented using different teaching styles (videos and lectures), and students completed a multiple-choice quiz after each class to measure their retention of that lesson's content. Both students' brain-to-brain synchrony and their content retention were higher for videos than lectures across the six classes. Brain-to-brain synchrony between the teacher and students varied as a function of student engagement, as well as teacher likeability: Students who reported greater social closeness to the teacher showed higher brain-to-brain synchrony with the teacher, but this was only the case for lectures, i.e. when the teacher is an integral part of the content presentation. Furthermore, students' retention of the class content correlated with student-teacher closeness, but not with brain-to-brain synchrony. Taken together, these findings provide further evidence pertaining to the neural basis of real-world learning, social dynamics, and academic outcomes in group settings such as the classroom.

# EXPOSURE TO VIOLENCE PREDISPOSES ANTISOCIAL BEHAVIOR BY BLUNTING AMBIGUITY SENSITIVITY DURING COST-BENEFIT DECISION-MAKING

Franchesca Ramirez - Harvard University; Arielle Baskin-Sommers - Yale University; Joshua Buckholtz - Harvard University

Exposure to Violence predisposes diverse forms of mental illness, and is a prominent risk factor for externalizing psychopathology (e.g. antisocial behavior, impulsivity, and substance abuse). Less clear are the underlying cognitive and neurobiological mechanisms that link exposure to violence and externalizing. Recent work suggests that externalizing behaviors are associated with aberrations in cost-benefit decision-making. For instance, blunted sensitivity to ambiguity during cost-benefit decisionmaking is observed in individuals with high levels of externalizing, and predicts real-world antisocial outcomes (e.g. criminal arrests). These findings raise the possibility that violence predisposes externalizing by disrupting the appropriate integration of reward and cost information during decisionmaking. To test this hypothesis, we used a financial decision-making task in a community-based sample enriched for externalizing. Participants' choice behavior was fit to an economic model of decision-making under conditions of ambiguity; a scaling parameter corresponding to ambiguity sensitivity ( $\lambda$ ) was derived for each subject. We found that 1) individual variation in exposure to violence predicted externalizing and 2) decreased sensitivity to ambiguity during choice was associated with both greater exposure to violence and higher levels of externalizing. Finally, we used conditional process modeling to test the hypothesis that blunted ambiguity mediates the relationship between exposure to violence and externalizing. A significant indirect effect was observed for  $\lambda$ , indicating that the relationship between exposure to violence and externalizing is mediated, in part, by the observed decrease in ambiguity sensitivity during choice behavior. Together, these findings identify a proximal cognitive mechanism underlying the effects of violence exposure on externalizing psychopathology.

#### **A-14**

### ASSOCIATIONS BETWEEN RELAPSE PREVENTION PROGRAMS FOR RECURRENT DEPRESSION AND MOOD-INDUCED NEURAL REACTIVITY

Philip A Desormeau - University of Toronto Scarborough; Norman AS Farb - University of Toronto Mississauga; Adam K Anderson - Cornell University; Zindel V Segal - University of Toronto Scarborough

Mindfulness-Based Cognitive Therapy (MBCT) is a group-based intervention that emphasizes the cultivation of metacognitive and decentering skills. Through these cognitive capacities, MBCT reduces vulnerability to depression by enhancing tolerance of negative affect and reducing rumination. Moreover, MBCT impacts stress reactivity at a neural level, increasing sensory processing of sadness while reducing its motivational salience. This differs markedly from Cognitive-Behavioral Therapy (CBT), which activates neural systems promoting cognitive elaboration of visceral representations. However, the neural signatures of treatment responders and relapsers from these interventions have yet to be compared directly. In the present study, a large cohort (N=83) of fully remitted MDD participants with ≥2 past depressive episodes were recruited and randomly assigned to either 8-week group-formatted CBT (n=36) or MBCT (n=47). Participants underwent pre- and post-intervention fMRI scans that measured neural reactivity, operationalized through the contrasting of brain activity between viewing sad and neutral film clips. Analyses did not reveal significant differences between interventions in treatment responders and relapsers, nor were shared neural activations detected across treatment responders. However, relative to responders, relapsers at pre- and post-intervention exhibited greater deactivation of the posterior insula and somatosensory cortex, which have been previously associated with viscerosomatic processing. These findings suggest that greater suppression of visceral processing is a marker of depressive vulnerability, and may reflect inflexible tendencies toward experiential avoidance-the avoidance of negative internal experiences. Taken together, these findings have important implications for addressing cognitive reactivity as a vulnerability factor in depression, informing accounts of maladaptive regulatory strategies.

# FACIAL FEEDBACK: ADAPTATION OF FACIAL MOTOR RESPONSES IN INTERACTIVE DYADS AS A FUNCTION OF PUNISHMENT.

Jonathan Yi, Philip Pärnamets, Andreas Olsson - Karolinska Institutet

Responding appropriately to others' facial expressions is key to social functioning, and depending on the identity of your interactive partner, it might save you from being harmed. Despite the large body of work on face perception and spontaneous responses to static faces, surprisingly little work has examined responses to dynamic faces in more naturalistic situations. No studies have investigated how goal directed responses to faces are influenced by learning during dyadic interactions. To study this, we developed a novel method based on online integration of electromyography (EMG) signals from the participants' face (frowning; corrugator supercilli and smiling; zygomaticus major). In two experiments, participants' EMG signals were recorded during their interaction with frowning and smiling dynamic target faces. The participants learned by trial-and-error to avoid mild electric shocks by expressing the same (congruent) or different (incongruent) expression. If incorrect facial expression was formed (measured by EMG), they received a mild electric shock to their wrist. Experiment 1 validated our new method and replicated classical visual motor findings, showing faster and more accurate responses in congruent vs. incongruent conditions. Experiment 2 manipulated facial dominance of the target faces to examine biased responding. Participants performed worse toward highly dominant vs. low dominant faces by habitually imitating their angry expressions. Our results introduce a new method to study decision-making in dynamic interactive social situations and help us understand gradual adaptation of motor responses to social contexts. Our method can be used to study decision-making biases caused by manipulating facial traits of an interactive partner.

#### A-16

### MICROSTRUCTURAL INTEGRITY OF A PATHWAY CONNECTING THE PREFRONTAL CORTEX AND AMYGDALA MODERATES THE ASSOCIATION BETWEEN COGNITIVE REAPPRAISAL AND NEGATIVE EMOTIONS

Tracy C. d'Arbeloff, M. Justin Kim, Annchen R. Knodt, Spenser R. Radtke, Bartholomew D. Brigidi, Ahmad R. Hariri - Duke University, Durham NC, USA

Cognitive reappraisal is a common form of emotion regulation that requires top-down executive control to re-construe a potentially emotional situation in order to mitigate its emotional impact. Individuals who typically employ reappraisal techniques in daily life report fewer depressive symptoms, less anticipatory anxiety, and greater over-all well-being. Here we report that an association between typical use of cognitive reappraisal in daily life and the experience of anxiety and depressive symptoms is moderated by the microstructural integrity of the uncinate fasciculus, which provides a major anatomical link between the amygdala and prefrontal cortex. Our findings are consistent with the nature of top-down regulation of bottom-up negative emotions and suggest the uncinate fasciculus may be a useful target in the search for biomarkers predicting not only disorder risk but response to psychotherapy utilizing cognitive reappraisal.

### A-17

# FOCUSING ON SELF VS. OTHERS: AN HD-TDCS STUDY OF ACHIEVEMENT GOALS AND DECLARATIVE MEMORY

### Yuliya Ochakovskaya - The Graduate Center (CUNY); Jennifer Mangels - Baruch College (CUNY); Elizabeth F Chua - Brooklyn College (CUNY)

Motivating students to perform better than others might facilitate achievement on a task, but may undermine longer-term learning. In contrast, mastery goals that focus students on developing their own knowledge may impart an advantage for learning, possibly by orienting attention toward deeper processing of corrective information. We addressed the effects of performance and mastery goals on incidental learning of corrective information, and examined whether goals were associated with differential engagement of brain regions associated with successful encoding. Students were asked to answer 4 blocks of difficult general knowledge questions and received active or sham brain stimulation (i.e., HD-tDCS) during the 3rd block. Active stimulation was administered over the left inferior temporal cortex (ITC; TP7), indexing ventral stream processing of verbal information, and over the left dorsolateral prefrontal cortex (DLPFC; F3), putatively involved in the sustained elaborative processing of that information. Following each question, students were presented with the correct answer, and learning of this corrective information (i.e., error correction) was assessed a week later on a surprise retest. It was expected that DLPFC stimulation would primarily benefit mastery goals, while ITC would benefit both relative to sham. Results show only ITC compared to sham, led to benefits in error correction across blocks and regardless of goals. The boost in error correction seen with ITC stimulation may lead to consolidation effects that benefited learning for both goals.

### A-18

#### AN FMRI LOCALIZER FOR DELIBERATIVE COUNTER ARGUING

Matthew Brook O'Donnell - University of Pennsylvania, Philadelphia, USA; Jason Coronel - Ohio State University, Columbus, USA: Christopher N. Cascio - University of Wisconsin-Madison, USA: Matthew D. Lieberman - UCLA, USA; Emily B. Falk - University of Pennsylvania, Philadelphia, USA When confronted with ideas that are counter value (e.g. differing ideological position) or calling for behavior change (e.g. health messaging) individuals are likely to engage in counter arguing. Unable to measure online counter arguing, behavioral tasks use post-message thought listing with valence classification and associate the presence of counter arguing with entrenchment of opinion. We designed an fMRI task to localize neural activity associated with forced deliberative counter argumentation to generic low-ideology statements (e.g. People should eat broccoli, text while driving). We hypothesized deliberative argumentation engaging the dorsolateral prefrontal cortex (DLPFC) and deliberative counter argumentation focused in the right DLPFC. We collected statements completing the stem People should (not)..., normed them on MTurk, producing 70 items--half easy to argue in favor of and half against. In deliberative conditions participants had to generate as many reasons in favor or against a statement as possible. The guick judgement condition required a single agree/disagree response. We examined two contrasts: 1. deliberative>guick-judgement and 2. against>in-favor deliberation. As hypothesized the first contrast resulted in bilateral DLPFC clusters ([-33,56,16] and [35,56,22]). The second produced a more posterior right DLPFC cluster ([46,15,55]) and also a right posterior parietal cluster [52.-67.43]. In a second study, we adapted the task to present ideological statements (e.g. gun control, affirmative action) with deliberative argumentation congruent with individuals' views. The against>in-favor contrast produced overlapping clusters with the general localizer in both the rDLPFC and rTPJ. We offer the general localizer task as a resource for discovering functional ROIs for deliberative counter arguing.

#### A-19

# INDIVIDUAL DIFFERENCES IN CONCEPTUAL KNOWLEDGE SHAPE FACIAL EMOTION PERCEPTION

#### Jeffrey A Brooks - New York University; Junichi Chikazoe, Norihiro Sadato - National Institute for Physiological Sciences; Jonathan B Freeman - New York University

Recent models of emotion perception and face-based person perception suggest that conceptual knowledge may dynamically influence face perception, including the representational structure of facial emotion categories. We used a representational similarity analysis (RSA) approach in which we collected perceptual similarity data (using a computer mouse-tracking paradigm) and conceptual similarity data for every pairwise combination of the 6 "basic" emotions anger, disgust, fear, happiness, sadness, and surprise. The mouse-tracking paradigm measures the extent to which faces co- activate multiple emotion categories simultaneously (e.g., both anger and disgust) through the trajectory of response-directed hand movements. We found that more conceptually similar emotions were also perceived more similarly (as assessed through category co-activation), even when statistically

controlling for the visual similarity of the stimuli used. These results suggest subtle individual differences in conceptual knowledge manifest in the process of perceiving a face's emotion. We also collected neuroimaging data for each participant, using a task in which they passively viewed emotional facial expressions. Multi-voxel pattern analyses, which are forthcoming, will identify regions with a representational structure of facial emotion categories and whether it is similarly shaped by conceptual knowledge. Theoretical implications of conceptually structured facial emotion categories will be discussed.

### A-20

# THE STRENGTH OF HUMAN CONSCIENCE: COLLECTIVE GUILT PROMOTES INTERGROUP RECONCILIATION

Zhiai Li - East China Normal University, Shanghai, China; Hongbo Yu - University of Oxford, Oxford, United Kingdom; Yongdi Zhou - East China Normal University, Shanghai, China; Xiaolin Zhou - Peking University, Beijing, China

In situations of group conflict, individuals may be more likely to legitimize harmful behavior towards innocent bystanders by in-group others (vs. by out-group individuals) due to feelings of in-group identity. Conversely, this sense of in-group identity may also cause individuals to exhibit stronger guilt responses to harmful behaviors by in-group than by out-group others. In this study, we conducted a group-based interpersonal transgression task in which participants observed third-party members receiving moderate electric pain when in-group or out-group others failed in a random dot estimation task. Behaviorally, participants reported stronger quilt when harm was caused by in-group than by outgroup others, a manifestation of collective guilt (Exp.1). Moreover, participants allocated more money to third-party victims when facing harm caused by in-group than by out-group others (Exps. 2 and 3). These results suggested that collective guilt serves a prosocial function by evoking stronger compensation behaviors and promoting intergroup reconciliation. To investigate the neural substrates of collective guilt, we recorded the BOLD activities of participants in Exp.3 and found that anterior middle cingulate cortex and bilateral insula were more activated when the harm was caused by ingroup than by out-group others. The functional connectivity between left anterior insula and left OFC negatively predicted the amount of monetary allocation. Overall, our results suggest that collective guilt promotes intergroup reconciliation by increasing compensation behaviors.

### A-21

# THE EFFECTS OF BOTULINUM TOXIN ON THE DETECTION OF GRADUAL CHANGES IN FACIAL EMOTION

Luis Carlo Bulnes - Université libre de Bruxelles (ULB), Consciousness, Cognition and Computation Group (CO3), Center for Research in Cognition & Neurosciences, ULB Neuroscience Institute, Brussels, Belgium; Peter Marien - Vrije Universiteit Brussel (VUB), Clinical and Experimental Neurolinguistics, Brussels, Belgium. & ZNA Middelheim, Department of Neurology and Memory Clinic, Antwerp, Belgium; Marie Vandekerckhove - Vrije Universiteit Brussel (VUB), Biological Psychology Research Unit (BIPS), Brussels, Belgium; Axel Cleeremans - Université libre de Bruxelles (ULB), Consciousness, Cognition and Computation Group (CO3), Center for Research in Cognition & Neurosciences, ULB Neuroscience Institute, Brussels, Belgium.

When we feel sad or depressed, our face invariably "drops". Conversely, when we try to cheer someone up, we might tell them "keep your smile up", so presupposing that modifying the configuration of our facial muscles will enhance our mood. A crucial assumption that underpins this hypothesis is that our mental states are shaped by information originating from the peripheral neuromotor system — a view operationalised as the Facial Feedback Hypothesis. We used botulinum toxin (BoNT-A) injected over the frown area to temporarily paralyze muscles necessary to express anger. Using a pre-post treatment design, we presented participants with gradually changing video clips of a face morphing from neutral to full-blown expressions of either anger or happiness, and asked them to press a button as soon as they detected a change in the display. Our findings indicate that while all participants

(control and BoNT-A) improved their reaction times from pre-test to post-test, the BoNT-A group was impaired when detecting anger in the post-test. Specifically, frown paralysis impaired the participant's ability to improve their detection of gradual changes involving anger. Our findings suggest that facial-feedback causally affects perceptual awareness and people's ability to use perceptual information to learn.

### A-22

### THE DEVELOPMENT OF SELF-PROTECTIVE BIASES IN RESPONSE TO PEER REJECTION

Alexandra M Rodman, Katherine E Powers, Erik K Kastman, Leah H Somerville - Harvard University The growing popularity of social media, especially among youth, has resulted in peer feedback (including rejection) pervading everyday life. Given that peer ostracism has been linked to depression and suicide, it is critical to understand the psychological impact of peer feedback from a developmental perspective. While adults have been shown to enact self-protective processes to buffer their self-views from evaluative threats like peer rejection, it is unclear whether adolescents avail themselves of the same defenses. The current study examines how social evaluation shapes views of the self and others differently across development. N=107 participants ages 10-23 completed a reciprocal social evaluation task that involved predicting and receiving peer acceptance and rejection feedback, along with assessments of self-views and likability ratings of peers. We show that, despite equivalent experiences of social evaluation, adolescents internalized peer rejection, experiencing a feedbackinduced drop in self-views, whereas adults externalized peer rejection, reporting a task-induced boost in self-views and deprecating the peers who rejected them. These results identify co-developing processes underlying why peer rejection may lead to more dramatic alterations in self-views during adolescence than other phases of the lifespan. Ongoing analyses investigate whether corticostriatal functioning supports these biases and associated changes in self-views during adolescence. More broadly, this work advances theoretical insights into how development shapes social-evaluative experiences, and informs sources of vulnerability that could put adolescents at unique risk for negative mental health outcomes.

### A-23

#### EMOTION PROCESSING IN YOUTH PRESENTING WITH SUBSTANCE USE PROBLEMS

Emily K. Leiker, Harma Meffert - Center for Neurobehavioral Research, Boys Town National Research Hospital, Omaha, NE; Joseph Aloi - Center for Neurobehavioral Research, Boys Town National Research Hospital, Omaha, NE; University of Nebraska Medical Center, Omaha, NE; Patrick Tyler -Center for Neurobehavioral Research, Boys Town National Research Hospital, Omaha, NE: Kayla Pope - Center for Neurobehavioral Research, Boys Town National Research Hospital, Omaha, NE; Creighton University, Omaha, NE; Karina Blair, Stuart White, Laura Thornton, R. James R. Blair -Center for Neurobehavioral Research, Boys Town National Research Hospital, Omaha, NE Background: Substance use is highly prevalent among adolescents, and associated with adverse health, poorer social outcomes and substance use in adulthood. Extensive evidence links adult substance use to reduced emotion regulation and attenuated sensitivity to affective stimuli in brain regions important for emotion processing. However, this relationship is less well studied in adolescence. This is surprising, given that substance use during this critical developmental period will likely have a strong impact on the neural mechanisms underlying emotion processing. Methods: 83 youths (14-18 years old) were recruited from a residential treatment facility and the surrounding community. Participants completed a gender discrimination task for faces displaying differing levels of fear or happiness. Alcohol and chemical use were assessed using the Alcohol Use Disorder Identification Test (AUDIT) and Chemical Use Disorder Identification Test (CUDIT). Reported alcohol and chemical substance consumption ranged from none at all to heavy, with 61% reporting some to heavy consumption. Results: A repeated measures ANCOVA was conducted on the emotional intensity modulated BOLD responses for Emotion (Fear, Happy), using AUDIT, CUDIT, and AUDIT x CUDIT as covariates. Substance use was associated with aberrant fearful face intensity modulation in

posterior cingulate, dorsolateral prefrontal cortex, and posterior parietal cortex. Discussion: These data suggest that substance use in youth does indeed impact the neural mechanisms underlying emotion processing. Given the critical role facial expressions play in social interactions, these early substanceuse induced impairments may be related to some of the later adverse effects associated with adolescent substance use.

### A-24

**NEURAL AND BEHAVIORAL MARKERS OF EMOTION FACE PERCEPTION ARE RELATED TO TRAJECTORIES OF CLINICAL AND REAL-WORLD FUNCTIONING IN PSYCHOTIC DISORDERS** *Kayla R Donaldson, Amri Sabharwal, Roman Kotov, Aprajita Mohanty - Stony Brook University, Stony Brook, NY, USA* 

Humans depend heavily on emotional face perception (EFP) for effective social communication. Individuals with psychotic disorders experience impairment in EFP which is associated with negative symptoms and deficits in global (social and occupational) functioning. However, it is unknown whether behavioral and neural measures of EFP impairment are related with course and progression of negative symptoms and global functioning over time. The present longitudinal study sought to examine this association in fifty-four participants with psychotic disorders (schizophrenia spectrum disorders, mood disorders with psychotic features, substance-induced psychotic disorders, and psychosis not otherwise specified) who were interviewed 6 times over 2 decades and, at year 20, underwent functional magnetic resonance imaging (fMRI) while performing an EFP task. Our results showed that worse EFP accuracy and elevated EFP-related insula and early visual cortical activity were linked with concurrent negative symptoms and worse functional outcomes in psychotic disorders. Furthermore, our results showed that individuals with psychotic disorders who showed low EFP-related accuracy and high EFP-related insula and visual cortex activity started out with worse negative symptoms and global functioning at baseline and continued to worsen, ending up with worse symptoms and global functioning at year 20. In contrast, individuals with high EFP-related accuracy and low visual cortex activity started out with lower symptoms at baseline which remained stable over time. Overall, these findings highlight that behavioral and neural EFP measures in psychotic disorders are markers not only of current symptoms and functioning, but also the trajectory of symptoms and social/occupational functioning over time.

### A-25

### DIVISIVE NORMALIZATION DRIVES TRANSITIVITY VIOLATIONS IN SOCIAL CHOICE

Linda W. Chang, Samuel J. Gershman, Mina Cikara - Harvard University, Cambridge MA, USA Classical rational theories of choice dictate that decision makers' preferences between any two options should remain the same irrespective of the number or quality of other options. However, previous research finds that people consistently exhibit violations of rational choice theory, including transitivityviolations, when they choose among several alternatives in a set. Many of society's most significant social decisions-hiring, voting-similarly involve the assessment of multiple candidates simultaneously. Across two studies we found that single-attribute transitivity violations generalize to two consequential social contexts: hiring scenarios and past U.S. congressional race outcomes. Importantly, we compared different models of value representation (untransformed, divisive normalization, range normalization) as sources of this context-dependence. Study 1 revealed that divisive normalization best characterized transitivity-violations across a series of hiring decisions. In Study 2, we used a combination of archival electoral data and survey data to examine whether normalization models could explain the outcomes of congressional elections. Transitivity-violations occurred along political candidates' inferred competence ratings and were again best characterized by divisive normalization. Our findings offer a formal account of when and how specific alternatives exert their effects on social evaluation and choice.

# BLAME ATTRIBUTIONS OF SOCIETAL THREATS MODERATE ISSUE-BASED PARTY EVALUATIONS

Elisa van der Plas - Donders Institute for Brain Cognition and Behaviour at Radboud University (NL), University of Twente (NL); Martin Rosema - University of Twente (NL); Jansen Giedo - University of Twente (NL); J. Sanfey Alan - Donders Institute for Brain, Cognition and Behaviour at Radboud University (NL)

Past research on vote choice has provided insights into the role of policy issues as well as emotions, but seldom on how their interplay influences evaluations of political actors. We synthesize such theories from political science with theories of associative learning and appraisal theories of emotion in order to better understand attitudes towards political parties. More specifically, we analyzed if issuebased voting is moderated by appraisals of blame with which societal issues are considered. In order to test our ideas, we developed videos about climate change, immigration and health care. The issues were either framed as being uncertain, personally relevant, or caused by a third party. The videos strictly followed a controlled interval format, which currently allows us to measure event related potentials from electroencephalogram, functional magnetic resonance and physiological recordings. 1825 Dutch citizens participated in a 3x3 between-subjects design and rated issue importance. emotional affect (12-item PANAS) and party-attitudes in an online survey. The results confirm the expectations derived from appraisal theories of emotion: personal emphasis triggered fear, whilst adding blame attributions triggered anger. The oversimplified framings increased party attitudes, yet strikingly, blame manipulations predicted party attitudes without mediation of issue importance. This effect was found for both inherently uncertain issues (e.g. climate change) and more often blamed issues (e.g. immigration). This suggests that considering the personal relevance of societal issues is crucial for their consideration, but that blameful appeals blunt the relation between issue importance and party attitudes. Implications for modern-day political communication in social media are discussed.

#### A-27

# **k** TESTOSTERONE ADMINISTRATION REDUCES GENEROSITY IN SOCIAL DISCOUNTING AMONG HEALTHY MALES

### Yin Wu, Jiajun Liao - Shenzhen University, China

Testosterone is thought to be associated with dominant and aggressive behavior. However, the evidence is mixed in the literature regarding if testosterone causes prosocial or antisocial behavior in social economic interaction. Here we used the social discounting task to address these two conflicting hypothesis. Healthy male participants (n = 63) received a single dose of 150 mg testosterone gel in a double-blind, placebo-controlled, crossover design. At 180 min post-administration, participants performed the social discounting task, where they make choices between selfish and generous rewards for themselves and for others that varied in social distance. Our results showed that testosterone reduced generosity towards others, i.e. they placed less value on others' well-being, using both non-parametric comparison (i.e. hyperbolic function) and after converting these values to parametric values (i.e. AUC). To further investigate if any change in social distance perception task. Participants were asked to use computer avatars to represent psychological distance between themselves and individuals of varying social distance. Testosterone has no observable influence on the representation of the social distance, highlighting the dissociation of valuation and perception in social preference.

### A-28 \*SANS Poster Award winner\* THE INFLUENCE OF OXYTOCIN AND SOCIAL STRESS ON OPTIMISTIC BIAS

### Ingrid Huang - International School of Beijing

Abstract: How we deal with our stress is key to our survival. Adapting to our dynamic environment requires learning and responding to different situations. Humans exhibit a positive learning bias: we

tend to form and update beliefs in an optimistic manner by incorporating desirable feedback into our beliefs and disregarding undesirable ones. In this study, stress heightened the positive effects of OT by increasing belief updates in response to desirable feedback. These findings reveal the nature of our responses to social stress, as well as how oxytocin can be used to increase learning of desirable feedback. This research suggested potentials of oxytocin in boosting optimistic updating within high-stress individuals such as those with social-anxiety disorder.

#### A-29

# THE IMMORAL OPPONENT IN POLITICAL ATTACK ADS: INTERSUBJECT CORRELATIONS ACROSS THE MORAL BRAIN DIFFER BY PARTY AFFILIATION

Benjamin O. Turner - Nanyang Technological University, Wee Kim Wee School of Communication and Information; Richard Huskey - The Ohio State University, Cognitive Communication Science Lab, School of Communication; Ori Amir, Rene Weber - UC Santa Barbara, Media Neuroscience Lab, Department of Communication

In this research we use political attack advertisements from the 2016 US Presidential election campaign as a test case for understanding the neurocognitive processes underlying Moral Foundation Theory (MFT, Haidt, 2001). Previous analyses of our data suggested that within localized moral intuition networks, participants of all party affiliations show greater activation for attack ads against Clinton relative to attack ads against Trump. Brady and colleagues (2017) have demonstrated that moral messages are more engaging. Schmälzle and colleagues (2015) have shown that more politically engaging messages elicit higher inter subject correlations (ISCs) in audiences. Here, we investigate how these findings are modulated by source and receiver characteristics. A total of 64 participants (22 Democrats, 22 Republicans, and 20 Unaffiliated; 50% women) evaluated 22 Trump/Clinton attack ads while undergoing fMRI. A region-of-interest based ISC analysis was used to examine a set of a priori defined structures previously implicated in moral judgment. We found that ISCs were modulated by partisan grouping and ad type (anti-Clinton or anti-Trump), but no single pattern emerged across all ROIs. Some results align with predictions on the basis of moral judgments. For instance, within anterior cingulate, which is often associated with conflict monitoring, Democrats have high ISCs in response to anti-Trump ads, whereas Republicans have high ISCs in response to anti-Clinton ads, and Independent viewers have low ISCs for both ad types. These results illuminate the ways in which audience characteristics interact with message content to shape neural responses to morally charged political attack ads.

#### A-30

# NEURAL REPRESENTATIONS OF MENTAL STATES REMAIN STABLE ACROSS MODALITIES AND TARGETS

# Miriam E. Weaverdyck - UCLA, Los Angeles, CA; Mark A. Thornton, Diana I. Tamir - Princeton University, Princeton, NJ

Humans possess a remarkable ability to richly represent other people's internal mental states, such as happiness, sleepiness, or planning. How do people deploy these representations across the diverse range of targets and contexts they encounter in the social world? Does reading about a person's suffering elicit the same thought as seeing their face in pain? Do we think about our own happiness in the same way as a stranger's? Three neuroimaging studies test whether mental state representations are stable across targets and modalities, or are instead context-dependent. In all studies, on each trial, participants were prompted to think about a target experiencing one mental state across a variety of scenarios. In Study 1, lexical stimuli prompted participants to mentalize about a generic other experiencing various mental states. In Study 2, lexical stimuli prompted participants to mentalize about three specific targets – the self, a close similar other, and a dissimilar stranger. In Study 3, pictorial stimuli prompted participants to mentalize about two targets – the self and a dissimilar stranger. Representational similarity analyses extracted neural pattern similarities between each mental state pair, then compared these similarities across targets and modalities. Results demonstrated stable

pattern similarity across targets (self, friend, stranger) and modalities (lexical, pictorial) throughout the social brain network. That is, people thought about each mental state in a similar way, regardless of who was experiencing it, or how it was elicited. These findings suggest that people deploy the same core conceptual knowledge about mental states across many contexts.

### A-31

### HERITABILITY OF NEURAL REACTIONS TO SOCIAL EXCLUSION IN MIDDLE CHILDHOOD

Mara van der Meulen - Leiden University; Nikolaus A.J. Steinbeis – UCL; Michelle Achterberg, Marinus H. van IJzendoorn, Eveline A. Crone - Leiden University

Observing social exclusion can be a distressing experience for children that can be followed by concerns for self-inclusion, as well as prosocial behavior to help others in distress. Behavioral studies have shown that observed social exclusion elicits prosocial compensating behavior, but little is known about heritability of this behavior. To distinguish between self-concerns and other-concerns when observing social exclusion in childhood in a twin sample (N=512), we used a four-player Prosocial Cyberball Game in which participants (aged 7-9) could toss a ball to three other players. When one player was excluded by two other players, participants showed consistent prosocial compensating behavior in response to this exclusion by tossing the ball more often to the excluded player. In a subsample (N = 283) we studied neural reactions to social exclusion. We found activity in social perception related areas (mPFC, IFG, and subACC) for the experience of exclusion, and activity in reward and salience related areas (striatum, insula, and ACC) for the experience of inclusion. Further, we found that activity in mPFC and right IFG was best explained by genetic and unique environmental factors, whereas activity in left IFG and right insula was best explained by shared and unique environmental factors. Activity in other regions was best explained by unique environmental factors and measurement error. This suggests that reactions to social exclusion are both heritable and driven by shared environmental factors, providing new opportunities for interventions aimed at parenting.

#### A-32

# THE ROLES OF BIOLOGICAL SEX AND AGE IN THE INTRINSIC BRAIN OF INDIVIDUALS WITH AUTISM

Dorothea L Floris - Hassenfeld Children's Hospital at NYU Langone Health, Department of Child and Adolescent Psychiatry, Child Study Center, New York City, USA; Meng-Chuan Lai - Child and Youth Mental Health Collaborative at the Centre for Addiction and Mental Health and The Hospital for Sick Children, Department of Psychiatry, University of Toronto, Toronto, Canada; Michael P Milham - Center for the Developing Brain, Child Mind Institute, NYC, NY, USA; Adriana Di Martino - Hassenfeld Children's Hospital at NYU Langone Health, Department of Child and Adolescent Psychiatry, Child Study Center, New York City, USA

The male preponderance in the prevalence of autism spectrum disorder (ASD) has sparked research into its sex differences. While sex-differences have been reported to vary with age in cognitivebehavioral studies of typical and atypical development, little is known about neural sex-differences across ages in ASD. Thus, we aim to explore the role of sex and age in the intrinsic functional properties of the brain in males and females with ASD relative to neurotypical males and females. We leveraged the combined large-scale Autism Brain Imaging Data Exchange repositories to select resting-state fMRI (R-fMRI) data between ages 5-30 years resulting in 422 males with ASD, 90 females with ASD, 218 neurotypical females and 464 neurotypical males. R-fMRI data was preprocessed using the Configurable Pipeline for The Analysis of Connectomes. We set a general linear model at each voxel of distinct R-fMRI metrics assessing the main effect of sex, age and diagnosis and their three-way-interaction while accounting for motion, sites and mean measure signal. We employed Gaussian random field theory correction with stringent statistical thresholds (voxel-level:Z≥3.1; cluster-level:p<0.05) There were significant main effects of diagnosis, sex, and age, along with their significant three-way interaction. A region in the right inferior parietal lobule showed decreases as a function of increasing age in females with ASD compared to males with ASD. The opposite pattern was evident in neurotypicals. The pattern in males with ASD resembles that seen in neurotypical females, and vice versa, suggesting that age-related factors come into play in models of 'gender-incoherence' of ASD.

#### A-33

# HEIGHTENED AFFECTIVE RESPONSES FOLLOWING SUBTOTAL LESIONS OF MACAQUE ORBITAL PREFRONTAL CORTEX

Maia S. Pujara - Section on the Neurobiology of Learning and Memory, National Institute of Mental Health, National Institutes of Health, Bethesda, MD; Peter H. Rudebeck - Friedman Brain Institute, Icahn School of Medicine at Mount Sinai, New York, New York; Elisabeth A. Murray Aspiration lesions of orbitofrontal cortex (OFC) in macaques typically produce blunted affective responses to threatening stimuli. Recent evidence involving restricted (excitotoxic, fiber-sparing) damage to OFC neurons has shown contradictory effects of either no involvement of OFC or heightened affective responses, but these studies differ with respect to the species studied and the extent of OFC damage. To address these discrepancies and further examine the putative role of OFC in emotion regulation, we studied rhesus monkeys (Macaca mulatta) with restricted bilateral excitotoxic lesions targeting either Walker's areas 11/13 (lateral OFC; n=4) or area 14 (medial OFC; n=4). The performances of these groups and a group with total bilateral lesions of OFC (areas 11, 13, and 14; n=7) were compared to that of a group of unoperated controls (n=12) on defensive responses to the presentation of a rubber snake, rubber spider, and neutral objects for comparison. Both subtotal lesion groups showed heightened defensive responses as indexed by latency to retrieve a food reward in the presence of the spider and snake. Surprisingly, the area 14 group showed greater food-retrieval latencies even in the presence of neutral objects, compared to unoperated controls. This effect could not be attributed to heightened defensive responses to the neutral object following exposure to the snake object, since food-retrieval latencies for the neutral trials before and after the presentation of the snake were not significantly different. Our data indicate that medial and lateral OFC make dissociable contributions to emotion regulation.

### **A-34**

### THE ROLE OF IMAGERY IN THREAT-RELATED PERCEPTUAL DECISION MAKING

Gabriella Imbriano, Tamara Sussman, Jingwen Jin, Aprajita Mohanty - Stony Brook University Making fast and accurate decisions about threats in our environment is critical for survival. Prioritized detection of threatening stimuli is traditionally attributed to their "automatic" or "bottom-up" processing. Emerging research shows that threat-related cues and contexts enhance the sensitivity and speed of subsequent perceptual decision-making more than neutral cues and contexts; however, the underlying mechanisms remain unclear. Several influential models of visual perception propose that the brain instantiates prior knowledge in the form of a template of the anticipated stimulus to which subsequent incoming sensory information can then be matched. Here, we examine whether the superiority of prior threat information in guiding perceptual decision-making is due to the vividness with which we can mentally image forthcoming threatening stimuli compared to neutral stimuli. Participants (N=123) completed the vividness of visual imagery questionnaire-2 (VVIQ2) and a task in which cues encouraged participants to use threat or neutral cue-induced "perceptual sets" to discriminate between perceptually degraded threatening and neutral faces. We show that threat cues improve accuracy, sensitivity and speed of perceptual decision-making compared to neutral cues. Higher VVIQ2 scores were associated better performance following threat and neutral cues. Importantly, in accordance with our hypothesis, greater accuracy and reduced false alarms following threat cues were associated with greater VVIQ2 scores even after controlling for performance related to neutral cues. The findings demonstrate that fast and accurate detection of threatening stimuli can be attributed not only to their "bottom-up" processing but also our ability to image them more effectively prior to their arrival.

### NEURAL RESPONSE TO EXTINCTION LEARNING IN PEDIATRIC CHRONIC PAIN

Laura E Simons, Lauren Heathcote, Inge Timmers, Corey Kronman - Stanford University; Farah Mahmud - Boston Children's Hospital; Maya Hernandez - Stanford University; David Borsook - Boston Children's Hospital

Recent research focused on anxiety patients and adult chronic pain patients demonstrates that impaired threat-safety discrimination and diminished response to extinction learning is indicative of enhanced vulnerability to chronic pain. Neural mechanisms of fear conditioning and extinction have not been previously examined in pediatric chronic pain. This study examines functional brain imaging responses in pediatric chronic pain patients and healthy peers to the screaming lady fear conditioning and extinction paradigm. Children ages 10-24 years with chronic pain (n=50) were recruited and cohort matched with healthy peer volunteers (n=19). Each participant was presented with two neutral stimuli. During the conditioning phase, one stimulus (CS+) was presented with an unpleasant scream (UCS), the other stimulus (CS-) was presented alone. During the extinction phase both stimuli were presented alone. fMRI data was collected during extinction using a Siemens Trio 3T MRI scanner and analyzed using SPM12. We conducted within group pairwise comparisons of evoked response to CS+ and CSduring early and late extinction. In early extinction, greater activation was observed in response to the CS+ compared CS- in healthy controls (e.g., thalamus; p<0.05), with no differences observed among patients. During late extinction, there was greater response to CS+ compared to CS- (e.g., ventromedial prefrontal cortex; p<0.05) in patients with no differences observed among healthy controls. These results indicate altered response among pediatric chronic pain patients in brain areas responsible for extinction learning while healthy peers appear to demonstrate efficient encoding of threat discriminatory learning.

### A-36

# HIPPOCAMPAL TRACKING OF SOCIAL SPACE IS RELATED TO SOCIAL AUTISTIC TRAITS IN HEALTHY INDIVIDUALS

Nadia Rahman, Catarina Saiote, Temidayo Orederu, Daniela Schiller - Icahn School of Medicine at Mount Sinai, Departments of Psychiatry and Neuroscience, and the Friedman Brain Institute Background: In a previous study, we found that participants with better social skills had a greater covariance between hippocampal activity and "movement" through "social space". Given that social dysfunction is a hallmark feature of Autism Spectrum Disorder (ASD), we sought to elucidate the relationship between ASD-related social impairment and hippocampal activation during a social navigation fMRI task. Method: Healthy participants were lead characters in a role-playing game in which they were asked to navigate various real-life social situations during fMRI. Following the task, participants filled out the Autism Spectrum Quotient (AQ), a self-report measure that assesses autism symptom severity comprised of 5 subscales, including social skills subscale (R=-.562, P=.0098) and no other AQ subscale. Conclusion: These results offer preliminary evidence suggesting that hippocampal dysfunction may underlie impaired social function in individuals with ASD.

### A-37

# MORNING BRAIN: EVIDENCE FROM EEG AND LEARNING OUTCOMES THAT HIGH SCHOOL CLASS TIMES MATTER

Suzanne Dikker - New York University, Utrecht University; Saskia Haegens - Columbia University Medical Center; Ido Davidesco, Dana Bevilacqua - New York University; Lu Wan - University of Florida; Kim Chaloner - Grace Church School; James McClintock - Trevor Day School; Tessa West - New York University; Mingzhou Ding - University of Florida; David Poeppel - New York University, Max Planck Institute for Empirical Aesthetics

Researchers (and parents) consistently observe in adolescents that there is a stark mismatch between biologically preferred sleep-wake hours and socially imposed sleep-wake hours. As a result, there is an

ongoing public debate about high school start times. To contribute neural evidence to this debate, we examined changes in high schoolers' brain activity throughout the school day. We collected electroencephalogram (EEG) data from 22 high school seniors at two different New York City schools during their regular classes. Classes were taught at three different times of day: early morning (8:30am), mid morning (10:30am), and afternoon (2:30pm; 17 recording days total). Class materials were presented using different teaching styles (videos and lectures), and students completed a multiple-choice quiz after each class to measure their retention of that lesson's content. Our analysis focused on power changes in the alpha frequency band (~ 7-14 Hz, mean peak latency 9.5 Hz), a well-known correlate of attentional state, where higher alpha is typically linked to lower focus. Students' baseline alpha power decreased as the time of day progressed, consistent with adolescents being least attentive early in the morning. During learning, academic performance was highest—and alpha power lowest—for mid-morning classes, consistent with previous research showing mixed effects: early morning performance is low for circadian reasons, whereas performance on tests taken at the end of a school day is low because of fatigue. Together, our findings demonstrate that class time is reflected in adolescents' brain responsivity and suggest that mid-morning may be the best time to learn.

### A-38 DANCING TOGETHER: THE NATURE OF INFANT-MOTHER LOCOMOTOR SYNCHRONY

Ori Ossmy, Justine E Hoch, Shohan Hasan - Department of Psychology, New York University, New York, NY 10003; Whitney G Cole - Max Planck Institute for Human Development, Berlin, Germany; Karen E Adolph - Department of Psychology, New York University, New York, NY 10003 Infants' and mothers' behaviors are sometimes so beautifully synchronized and coordinated in space and time that, in the case of face-to-face social interactions, researchers have referred to their joint behavior as a "dance." Here, we examined whether infants and mothers continue the dance during free play on the floor. We observed 30 infant-mother dyads during 20 minutes of free play in a laboratory playroom filled with toys, furniture, and elevations. We identified periods when each partner was stationary or locomoting, the number of steps and distance traveled per bout of locomotion, their stepto-step location in the room, and the distance between infant and mother at each moment. We show that more active infants had more active mothers in terms of accumulated steps, distance traveled, and unique locations visited. However, infants took more steps than their mothers and visited more unique room locations. Moreover, dyads showed temporal and spatial synchrony in their moment-to-moment spontaneous locomotor activity. Using dynamic time warping, we showed that that each infant's path was most similar to his or her own mother's path, and they were usually a meter apart throughout the session (roughly arms' reach). Finally, we determined whether one partner was more likely to take the lead and the other to follow. A multivariate Granger-causality analysis showed that when dyads were not seamlessly coordinated, infants usually took the lead. Results from this novel approach support the notion that freely mobile infants and their mothers are temporally and spatially coordinated as they "dance" through the playroom.

### A-39

# MBSR INCREASES PCC-DLPFC RESTING STATE FUNCTIONAL CONNECTIVITY RELATIVE TO ACTIVE CONTROL

# Theodore P Imhoff-Smith, Tammi RA Kral, Dan W Grupe, Richard J Davidson - University of Wisconsin-Madison, Madison, United States

Previous research found that a brief, intensive mindfulness intervention increased resting state functional connectivity (RSFC) between nodes of the dorsal attention network (dorsolateral prefrontal cortex; DLPFC) and default mode network (posterior cingulate cortex; PCC) (Creswell et al., 2016). We investigated whether these effects generalized to one of the most commonly used mindfulness meditation interventions - an 8-week mindfulness-based stress reduction course (MBSR). We compared the impact of MBSR on DLPFC-PCC RSFC to a health enhancement program (HEP), a

validated, active control intervention. Healthy adults were randomized to MBSR (N=27, mean age(SD)= 38.8(13.4) years) or HEP (N=30, mean age(SD)= 42.8(12.6) years), and completed a resting state scan pre-randomization (T1) and post-intervention (T2). We examined RSFC of a PCC seed (defined from Creswell et al., 2016) with DLPFC, both by conducting small-volume corrected voxel-wise analysis within the Harvard-Oxford atlas-defined middle frontal gyrus (MFG) and by extracting average connectivity weights from the MFG ROI. We also examined whole-brain RSFC with the PCC on a voxelwise level. Voxel-wise and ROI analyses revealed increased PCC-DLPFC RSFC (T2-T1) in MBSR relative to HEP (p < 0.05, corrected and p < 0.0003, respectively). Whole-brain analysis indicated increased PCC RSFC (T2-T1) with inferior frontal gyrus, middle temporal gyrus, and angular gyrus for MBSR relative to HEP (p < 0.05, corrected). Increased PCC RSFC was always significant within the MSBR group, but non-significant within HEP. These data provide a conceptual replication of prior work linking mindfulness meditation with increased RSFC between the DMN and the DLPFC in healthy adults.

### **A-40**

### META-ANALYTIC BRAIN NETWORKS UNDERLYING EMOTION REGULATION

Carmen Morawetz - Freie Universiaet Berlin, Berlin, Germany; Michael Riedel, Taylor Salo -, Angela Laird - Florida International University, Miami, USA; Simon Eickhoff - Heinrich-Heine University Düsseldorf, Düsseldorf, Germany; Nils Kohn - Radboud University, Nijmegen, Netherlands Recent models suggest that cognitive emotion regulation is based upon neural systems implicated in generation and regulation of emotional responses as well as systems with an undefined or intermediary role. Despite the wealth of research in this field, the exact neural networks underlying emotion regulation remain unknown. To shed light on this, we applied a meta-analytic grouping technique to identify networks of clusters of emotion regulation experiments and performed functional decoding using BrainMap metadata terms (107 studies, 385 experiments, 3204 subjects). The results revealed four clusters of meta-analytic groupings (MAGs): MAG1 included dIPFC, parietal cortex and posterior cingulate cortex and is associated with attention and working memory. MAG2 consisted of vIPFC, SMA, temporal and parietal areas and is linked to language, semantics and speech. MAG3 involved the amygdala, thalamus, hippocampus and anterior insula and is related to paradigms implicated in emotion processing. MAG4 consisted of the precuneus, posterior insula and superior parietal lobe and is associated with paradigms of action execution, somesthesis, and pain. In the context of emotion regulation, we propose that these networks take over different functional roles. MAG1 directs attention to the emotional stimulus and holds the goal of the emotion regulation strategy in mind, MAG2 facilitates the selection of goal-appropriate reappraisals and the active reinterpretation of the meaning of the emotional stimulus, MAG3 generates the emotional response and relates it to past experiences, which are controlled by top-down processes, and MAG4 forwards sensory predictions to somatosensory cortices to initiate a change in affect.

#### A-41

# INFANT REGIONAL CEREBRAL BLOOD FLOW IS CORRELATED WITH MATERNAL SENSITIVITY FOLLOWING SOCIAL STRESS

Amar Ojha - Stanford University; Maria C Camacho - University of Pittsburgh; Lucy S King, Kate L Humphreys, Ian H Gotlib - Stanford University

Background: Given the altricial nature of our species, caregivers are essential for development. Variation in human caregiving behavior is posited to affect brain development, including connectivity in brain regions associated with social cognition (e.g., anterior cingulate gyrus, orbitofrontal cortex, and ventromedial prefrontal cortex). The majority of infant functional neuroimaging research utilizes BOLD signal; however, the components of BOLD change with infant development. An alternative metric, perfusion MRI, directly quantifies regional cerebral blood flow (rCBF), making it ideal for studying in vivo infant neurodevelopment. Methods: Maternal sensitivity and intrusiveness for 19 infant–mother dyads was coded during a repeated Still Face Paradigm (M age child 29.59±1.91 weeks). Perfusion

MRI scans were collected from the infants during natural sleep to quantify rCBF. Whole-brain voxelwise linear models were conducted, co-varying for infant age, to examine rCBF related to dimensions of caregiving behavior. Permutation tests were conducted to reduce likelihood of false discovery. Results: We found positive associations between maternal sensitivity and rCBF in the following regions: anterior and posterior cingulate cortices, orbitofrontal cortex, ventrolateral prefrontal cortex, precuneus, middle frontal gyrus, inferior parietal lobule, cerebellum, and occipital lobe (all ts>3.08, df=18; cluster FWE corrected p<0.05). There were no negative associations between sensitivity and rCBF; intrusiveness was unrelated to rCBF. Discussion: We found that brain regions associated with social cognition had increased rCBF in infants with more sensitive caregivers. This suggests that sensitive caregiving in early infancy promotes neural development in these regions, and provides insight into the neurodevelopmental consequences of caregiving behavior.

#### A-42

### THE INFLUENCE OF STRESS AND CRAVING ON SUBJECTIVE VALUE: A TEMPORAL AND ATTRIBUTE BASED EXAMINATION

Nidhi V Banavar, Anna B Konova, Candace M Raio, Paul W Glimcher - New York University, New York, USA

Stress and craving are well-established drivers of reward-seeking behavior in health and psychopathology. Despite this, we still lack a basic empirical characterization of how these states affect reward valuation to bias behavior. Here, we developed an economic decision-making task designed to capture dynamic changes in subjective value (SV) for food rewards over time. Specifically, after a baseline period and before returning to the SV task, healthy non-dieters either underwent an acute stress induction (Cold-Pressor Test; 'Stress'), this same stress test paired with craving induction (brief multi-sensory food exposure; 'Stress+Craving'), or control procedures ('Control'). Results revealed an increase relative to baseline in the SV of food rewards in both the 'Stress' and 'Stress+Craving' groups compared to 'Control'. Interestingly, this increase peaked at different times: peak SV was observed immediately after induction in the 'Stress+Craving' group (+10 minutes), while peak SV was observed with delay in the 'Stress' group (+60 minutes). Individual differences in self-reported craving experience and perceived stress mirrored these distinct temporal profiles, with attribute ratings of food rewards eliciting further information about the SV change across conditions. Additionally, for the 'Stress' group, effects were enhanced for foods rated as most desirable prior to the study suggesting that, in the absence of explicit cue-exposure (as in 'Stress+Craving'), an individual's reward history guides the degree to which stress increases reward-seeking. Our results provide important insights into the mechanisms by which stress exposure and cue-induced craving influence SV and highlight differences in when individuals may be most susceptible to maladaptive choice behavior.

#### A-43

#### CAN TYLENOL AFFECT THE DECISIONS WE MAKE FOR OTHERS?

#### K M Sharika, Michael L Platt - University of Pennsylvania

Previous work in healthy humans has implicated the role of acetaminophen (active ingredient in Tylenol) in reduced empathy for others in distress (Mischkowski et al., 2016). In addition, imaging studies have shown dorsal anterior cingulate cortex (dACC) and anterior insula – areas associated with the affective component of pain (Rainville et al., 1997) – to be active while individuals empathized with others' pain (Singer et al., 2004). To further examine the hypothesis that acetaminophen reduces empathy for distress and probe the neural mechanisms underlying the processing of other's distress in self, we recorded the activity of ACC neurons while rhesus monkeys performed a 'willingness to pay' task in which they chose between two differently colored targets that were associated with varying magnitudes of juice across trials. In each trial, the juice on offer was cued to be either sweet tasting or bitter tasting for the actor monkey or a recipient monkey (sitting across the room and facing the actor monkey) by means of four differently colored reward cues. Early findings showed that not only did decisions made by the actor monkey indicate an awareness of vicarious reward outcomes learnt by

observation alone, the activity of ACC neurons distinctly represented positive and negative outcome for self and other as well. We also recorded the activity of ACC neurons following an oral dose of Tylenol to further investigate ACC's role in valence specific decision-making for self vs. other.

#### **A-4**4

# A MULTIPLICATIVE INCREASE IN SUBJECTIVE VALUATION UNDERLIES BOTH FOOD AND DRUG CRAVING

#### Konova B Anna, Lopez-Guzman Silvia, John Messinger, Kenway Louie, Paul W Glimcher - New York University

Craving is a specific desire state that biases choice toward the desired object. Despite its ubiguity and role in addiction and obesity we still lack a basic neurocomputational understanding of craving. In 2 studies, in health and in opioid users in treatment, we test the hypothesis that craving is a specific change in an individual's valuation process. In a novel experimental protocol we specifically test the algorithmic nature of this change. Healthy non-dieters (n=45) were offered 1-8 units at a time of three snack foods. We induced craving for one of the snacks by having subjects interact with the snack while recalling its taste. Because we could not ethically give opioids to recovering users, in study 2 (n=27) we offered instead personalized opioid use-related goods in a similar task. To capture dynamics in naturally occurring opioid craving patients were studied over multiple days. Subjective valuation for all goods in both studies was quantified repeatedly as a BDM bid. This allowed us to-for each subject, good, and moment-construct a function mapping objective (number of units) to subjective value (relative increase in value/unit added). We tested three possible transformations of this function during peak craving: addition, multiplication, and exponentiation. In health, craving induction selectively increased the craved snack's value. In opioid users, opioid craving increased the value of the opioid use-related goods. For both, multiplication best captured these increases suggesting a gain control-like process of craving. These findings offer new ways to model craving and other subjective states in economic terms.

#### A-45

# NEURAL PHENOTYPE OF OBESITY: A POPULATION-BASED PREDICTIVE MODELING APPROACH

### Samantha J Chavez, Robert S Chavez - University of Oregon; Dylan D Wagner, Sarah E Anderson - The Ohio State University

Health status is determined by multiple factors within individuals and their environments. Although there is broad interest in uncovering biomarkers that predict health outcomes, these efforts are often limited by the use of small convenience samples with little power to construct finely tuned models and independently test their accuracy. To address this, the current study combines population-based sampling methods with out-of-sample prediction testing to investigate how the structural connectivity of reward and inhibition systems predicts obesity status in a representative sample of 275 U.S. adults aged 18-85yrs. Probabilistic tractography was applied to diffusion data to delineate putative reward and inhibitory pathways. Next, we used a training dataset (n=193) to model predicted obesity status as a logistic function of proxy-measures (i.e., fractional anisotropy) for the structural integrity of these pathways. Then, we tuned this model with measures of sociodemographic status using bidirectional stepwise regression. Following model tuning, we defined a probability threshold for predicted obesity that maximized sensitivity and specificity and applied this model to an independent holdout sample (n=82). Classification accuracy in the holdout sample was 63.5% (sensitivity=72%; specificity=58%). Importantly, classification accuracy increased substantially (11.1%) when sociodemographic predictors were included, suggesting that they play a nontrivial role in brain-health relationships. Our results provide evidence for a neural phenotype of obesity, represented by the microstructural integrity of reward and inhibitory pathways. By using a representative sample and including sociodemographic

predictors, we demonstrate the predictive utility that an epidemiological perspective may lend to translational goals in the social neuroscience of health behaviors.

### **A-46**

# SELF-ESTEEM MODULATES MORTALITY SALIENCE EFFECTS ON BEHAVIORAL AND BRAIN RESPONSES TO SELF-FACE

Lili Guan - School of Psychology, Northeast Normal University, ChangChun 130024, China; Yufang Zhao - Faculty of Psychology, Southwest University, Chongqing 400715, China; Juan Yang - Faculty of Psychology, Southwest University, Chongqing 400715, China; Shihui Han - School of Psychological and Cognitive Sciences, Peking University, Beijing 100871, China

Behavioral findings suggest that mortality threats influence the processing of self-relevant information of individuals with low self-esteem. How mortality threats influence self-related processing by modulating its neural underpinnings remains unknown. We addressed this issue by scanning 66 healthy adults, using functional MRI, while viewing photos of faces of oneself, a friend, and a stranger after being primed with mortality salience (MS) or negative affect (NA). We found that participants responded faster to head orientations for own-face than friend-face and this self-face advantage was reduced by MS (vs. NA) priming particularly in low self-esteem individuals. Self-face vs. friend-face increased activities in the bilateral insula, inferior frontal gyrus, inferior parietal lobule/supramarginal gyrus, thalamus, right middle frontal gyrus in the MS (vs. NA) conditions. Self-report of closeness to death caused by priming mediated the priming effect on the right insula and left thalamus activities. Moreover, the relationship between self-esteem and self-face advantage in behavioral responses was mediated by left and right insula activities in the MS condition. Our findings indicate that self-esteem modulates MS influences on behavioral responses to self-relevant information and such modulation effects are mediated by the insula activity related to self-consciousness. The brain imaging findings suggest a neural mechanism underlying self-esteem buffer of MS effects on cognitive and affective processes of self-relevant information.

#### A-47

#### INDIVIDUAL DIFFERENCES IN THE NEURAL SUBSTRATES OF FOOD CHOICE

Wendy Sun. Rebecca Boswell, Hedy Kober - Yale University, New Haven CT USA Healthy food choice in the face of temptation may involve separate but interacting brain systems, including the medial prefrontal cortex (mPFC), implicated in value computation, and lateral prefrontal cortex (IPFC), implicated in cognitive control. However, individual differences in neural activity during food choice have not yet been investigated. Here, we specifically focused on the role of body mass index (BMI). Participants (NCURRENT=19; MBMI=26.26, RangeBMI:19.0-45.3) underwent fMRI and were presented with binary food choices between either 1) a healthy food and an unhealthy food (HU pair; defined as "self-control trials"), 2) two healthy foods (HH), or 3) two unhealthy foods (UU). Wholebrain analyses show that when participants chose a healthy vs. unhealthy food during self-control trials (HU-H>HU-U), this was associated with increased activity in IPFC. Further, trial-by-trial activity in IPFC increased as pre-scan health ratings of the chosen items increased, replicating prior work with nonbinary food choice. Additionally, healthy choices in self-control trials vs. non-control trials (HU-H>HH-H) were associated with greater activity in IPFC and mPFC. Importantly, IPFC activity correlated with BMI when participants chose the healthy option during self-control trials (HU-H>HU-U), such that those with higher BMIs recruited IPFC to a greater degree (r=.69, p<.001). These results speak to the current debate over self-control as value-based decision-making, and suggest that binary food choices involve co-activated brain systems, including the mPFC and IPFC. Importantly, recruitment of these systems varies based on individual differences, such as BMI. These findings have implications for understanding how our food choices occur, and individual differences therein.

# IMPLICIT EVALUATIVE PROCESSING OF MORAL AND EMOTIONAL CONTENT DURING DISCOURSE COMPREHENSION

Angelika Kunkel, Ian Grant Mackenzie - University of Tübingen; Ruth Filik - University of Nottingham; Hartmut Leuthold - University of Tübingen

Recently, using event-related potentials (ERPs), we showed that when participants read about daily moral transgressions, the task that they performed determined the processing of incoming linguistic information (Kunkel, Mackenzie, Filik, & Leuthold, in revision). Specifically, when explicit moral judgments were required a larger anterior negativity indicated increased cognitive processing of immoral than moral scenarios, whereas for emotional judgments a larger posterior positivity (LPP) indicated increased affective processing. The present two experiments examined which brain processes and embodied responses contribute to discourse comprehension if no task is required. Target sentences from negative vs. neutral emotional scenarios and from moral vs. immoral scenarios were presented using rapid serial visual presentation while ERPs (Experiment 1), and facial electromyogram (fEMG) and electrodermal activity (EDA, Experiment 2) were recorded. In Experiment 1, LPP (300-500 ms) was larger for negative and immoral compared to neutral and moral scenarios. In Experiment 2, fEMG and EDA results were not sensitive to experimental manipulations in either morality or emotion materials, despite participants showing clear fEMG/EDA effects to standard emotional pictures and words. We conclude that discourse comprehension involves the top-down affective evaluation (LPP) of incoming linguistic moral and emotional information but not the embodied simulation of emotion (fEMG, EDA).

### **A-49**

#### THE EFFECT OF SLEEP DEPRIVATION IN MORAL JUDGEMENT BEHAVIOR

Ruri Katsunuma, Yuki Motomura, Michitaka Yoshimura, Yoshiya Moriguchi, Kazuo Mishima - National Center of Neurology and Psychiatry, Tokyo, Japan

Sleep deprivation disturbs moral judgments (Killgore et al., 2007), a behavior known to be influenced by subjective pleasantness (Carmona-Perera et al., 2013). Present study investigated the neural associations of moral judgements when sleep deprived, using fMRI. Fifteen males (mean±SD age = 26.5±6.14) participated in a within-subject, crossover, two-day sleep interventional study consisting of two conditions; sleep deprived (SD; 3h sleep) and sleep controlled (CT; 9h sleep). Scanning was done on the last day, during moral judgement task: participants first viewed anonymous someone being ostracized in a virtual ball toss game (modified Cyberball paradigm; Williams et al., 2000), then, participants joined the game to be measured whether they toss to the excluded player (Excl) or the others (nonExcl). We focused on the right orbitofrontal cortex [OFC; (x,y,z) = (6,46,-15)(mm)], as the OFC is responsible for subjective pleasantness (Kühn and Gallinat, 2012) and was also a significantlyactivated area for task engagement in our study (F= 3.48, p<.001). Overall hemodynamic responses in the OFC during any ball tosses were not different between sleep conditions [F(1,14)=1.21, p=.29]. However, responses were greater when tossing to Excl than to nonExcl [F(1,14)=5.05, p=.04]. More specifically, the differential responses (tossing to Excl vs. nonExcl) were different between sleep conditions [two-way interactive effect of Target (Excl/nonExcl) x Sleep (CT/SD), F(1,14)=8.31, p=.012]. such that the differential responses were significant for CT [T(14)=5.87, p=.001] but not in SD [T(14)=.4, p=.69]. The result suggests that a sleep debt may affect moral judgments, which might be mediated by diminished activation in the OFC.

# INTERGROUP THREAT SHAPES THE COMPUTATIONAL MECHANISMS OF IMPRESSION FORMATION

Jenifer Z Siegel - University of Oxford; Jim A.C. Everett - Leiden University; Talia Longhorne -University of Oxford; Molly J Crockett - Yale University

People form moral impressions rapidly, effortlessly, and from a remarkably young age. An open question is whether the underlying mechanisms for social impression formation are dynamically related to inferred beliefs about how threatening an agent is. In three studies we investigated how social threats impact the cognitive and computational processes of impression formation using a novel moral inference paradigm. In all studies participants predicted sequences of moral decisions made by two agents - one characteristically 'bad' and one characteristically 'good' - where each decision involved choosing whether to profit by inflicting pain on another. We used a hierarchical Bayesian reinforcement learning model to describe participants' evolving beliefs about the moral character of the agents. In study 1, we show that beliefs about the morality of bad agents are more uncertain (and thus more volatile) than beliefs about the morality of good agents. In studies 2 and 3, we manipulated perceived threat about the agents by indicating their voting intentions in the recent U.S. and UK elections. We show that beliefs about agents who support the opposing political party (outgroup) are more uncertain and volatile (and thus more rapidly updated) than beliefs about agents supporting the same party (ingroup). Furthermore, the extent to which people's beliefs are more uncertain and volatile about outgroup agents is predicted by how threatened people feel by the outgroup. We suggest that the learning mechanisms described here promote cognitive flexibility in the service of building richer models of potentially threatening others.

#### A-51

#### COMPARING TWO FACETS OF EMPATHIC ACCURACY IN NEURODEGENERATIVE PATIENTS: DIAGNOSTIC DIFFERENCES AND NEURAL CORRELATES

Casey L. Brown, Alice Y. Hua - UC Berkeley; Lize De Coster, Howard, J. Rose, Bruce L. Miller - UC San Francisco; Robert W. Levenson - UC Berkeley

Empathy, the ability to understand other's emotions, is a multifaceted ability. In addition to recognizing specific emotions (e.g., happy sad), empathy also requires tracking others' changing emotions over time. Deficits in empathy are caused by neurodegenerative diseases, however, which facets of empathy decline and their neural correlates remain unclear. We examined empathy in 155 patients with a variety of neurodegenerative diseases and 24 controls using two tasks: a film based emotion recognition task where participants were asked to identify specific emotions experienced by different target characters in film clips, and a tracking task where participants continuously indicated the emotional valence experienced by a character in a film using a rating dial. We compared performance on these two tasks by diagnosis, and found that patients with Alzheimer's disease, behavioral variant frontotemporal dementia, and progressive supranuclear palsy had significantly worse performance on the tracking task compared to the emotion recognition task; whereas patients with semantic variant primary progressive aphasia had significantly worse performance on the emotion recognition task. Additionally, using whole brain voxel-based morphometry, we found grey matter atrophy in bilateral and predominantly right hemispheric regions such as the superior medial prefrontal, anterior cingulate cortex, and right insula was associated with worse performance on the tracking task. Atrophy in bilateral and predominantly left hemisphere regions was associated with worse performance on the emotion recognition task, including inferior frontal, left ventral striatum, and left posterior insula. These findings highlight the differing neural networks involved in two facets of empathy.

# RETHINKING THE MEANING OF VENTRAL STRIATAL ACTIVATION: VENTRAL STRIATUM ACTIVITY DURING ACUTE STRESS IN FEMALES

Carrianne J. Leschak - University of California Los Angeles; Janine M. Dutcher - Carnegie Mellon University; Kate E. Byrne-Haltom, Julienne E. Bower, Naomi I. Eisenberger - University of California Los Angeles

The ventral striatum (VS), with dopamine projections from the ventral tegmental area (VTA), is considered a key reward region in humans. However, within the animal literature, there is general agreement that different portions of both the VS (specifically, portions of the nucleus accumbens [nACC]) and VTA are functionally heterogeneous. For example, past work shows that the dorsal VTA and rostral nACC shell are associated with appetitive behavior, in line with assumptions regarding VS's role in reward, while ventral VTA and caudal nACC shell are associated with aversive and stressful events. In humans, the highlighted role of the VS continues to be reward-related, with little to no attention to its possible role in stress. In the present work, we explored VS activity in response to a standard social stress task (N = 39 breast cancer survivors). We found increased VS activity during stress trials (relative to non-stress control trials). Additionally, VS activity during stress trials was positively correlated with self-reports of stress (r = .49). These findings suggest that the human VS may have a dual function: The VS may be involved in stressful or aversive experiences, in addition to its acknowledged role in reward.

#### A-53

### THE ROLE OF AUTISTIC TRAITS IN REWARD ANTICIPATION

Magdalena Matyjek, Mareike Bayer, Isabel Dziobek - Berlin School of Mind and Brain, Humboldt-Universität zu Berlin, Berlin, Germany

Autism Spectrum Conditions may be associated with abnormal reward anticipation (Kohls et al., 2012). However, prior work concerning differences between social vs. non-social domains is inconclusive. The current ongoing study aims at identifying the influence of autistic traits in neurotypical participants (Autism Spectrum Quotient (AQ): Baron-Cohen et al., 2001) on reward anticipation. Hitherto 25 volunteers performed a cued incentive task with social and non-social rewards. During the performance, we recorded event-related potentials and pupillary responses. The pupillary data revealed decreased pupil sizes during anticipation of a reward in participants with higher AQ scores (p<.01, d=1.47). In a sample subset with extreme scores (low-AQ: n=7, m=9.86, sd=3.02; high-AQ: n=7, m=28, sd=5.03), the descriptive effects pointed at group effects in the contingent negative variation (CNV) amplitudes, regardless of the domain (d=.36). High-AQ was associated with descriptively smaller amplitudes of CNV (high-AQ: m=-.92, sd=1.86; low-AQ: m=-2.27, sd=2.4). According to power analyses based on these findings, sample size will be increased to n=50 (power at .85). The results from the full data set will be presented at the conference. Given the main effect of group in pupillary data, and the descriptive trends in CNV amplitudes, we conclude that the results point to atypical reward anticipation in individuals with higher AQ scores. This effect is insensitive to the reward domain (social vs. non-social), which suggests a general disturbance in reward processing associated with intensified autistic traits in undiagnosed individuals. By using a population-based approach, this study contributes to understanding reward sensitivity in autism spectrum.

### OXYTOCIN-ENFORCED NORM COMPLIANCE REDUCES XENOPHOBIC OUTGROUP REJECTION

Nina Marsh, Dirk Scheele - Division of Medical Psychology, University of Bonn Medical Center, Bonn, Germany; Justin Feinstein - Laureate Institute for Brain Research, Tulsa, Oklahoma 74136; Holger Gerhardt - Center for Economics and Neuroscience, University of Bonn, Bonn, Germany; Sabrina Strang - Department of Psychology, University of Lübeck, Lübeck, Germany; Wolfgang Maier -Department of Psychiatry, University of Bonn Medical Center & German Center for Neurodegenerative Diseases (DZNE), Helmholtz Association, Bonn, Germany; Rene Hurlemann - Department of Psychiatry, University of Bonn & Division of Medical Psychology, University of Bonn Medical Center, Bonn, Germany

The recent migration of Middle Eastern refugees requires the native populations of European societies to adapt to rapid growths in ethnic diversity, religious pluralism, and cultural differentiation. Resistance to this transition often goes along with xenophobic sentiment evident in a large divide in society between people who do and do not support the refugees. The biblical parable of the Good Samaritan (Luke 10:25–16:17) describes an ethical maxim of helping strangers in need and serves as an example of altruistic cooperation extending beyond the limits of the ingroup to members of the outgroup. Yet, the neurobiological conditions of outgroup directed altruism have not been determined. Only recently, the evolutionary conserved neuropeptide oxytocin has been identified as a key modulator of altruism. In three experiments settled in the context of the current refugee crisis, we used intranasal oxytocin and tested the propensity of 183 participants to make donations to people in need. Here we show for the first time that xenophobic rejection of refugees can be reversed by pairing enhanced activity of the oxytocin system with peer-derived altruistic norms. Neither intervention alone was sufficient to alter selfish responses in participants scoring high on a xenophobia inventory, whereas the combined administration of oxytocin and altruistic norms prompted the high scorers to increase their outgrouprelated donations by 74%. Collectively, our results suggest that efforts to induce outgroup-directed altruism are most effective under conditions of heightened oxytocin-system activity and social cues, which instill the notion that one's ingroup shows strong affection for an outgroup.

#### A-55

### INSTRUMENTAL SOCIAL VALUE MODULATES EARLY PERSON PERCEPTION: REINFORCEMENT LEARNING EFFECTS ON THE N170

Jeffrey J Berg - New York University; Dan Cao - Shanghai University; Zoe Kleiman, Nicholas G Matese, Melissa Wessel, David M Amodio - New York University

How do we form an attitude about someone through direct social interaction? And does this attitude affect how we see them? We proposed that people can form attitudinal preferences for others through instrumental learning, based on the reception of positive or negative choice feedback. Moreover, we examined whether these instrumental preferences, once formed, could influence the visual encoding of others' faces. To test these propositions, participants completed an instrumental reinforcement learning task in which they learned to associate faces with diverging levels of probabilistic reward feedback. In a subsequent task, participants viewed each face passively, without feedback, while electroencephalogram (EEG) was recorded. Participants then provided self-reports of their attitudes

electroencephalogram (EEG) was recorded. Participants then provided self-reports of their attitudes towards the faces. Results show that participants successfully learned the value of the target faces through reinforcement, and that their self-reported attitudes toward the faces closely corresponded to this learning. Furthermore, analysis of the N170 event-related potential (ERP)—an index of structural face encoding—revealed that early visual face processing was modulated by the face target's instrumental value. These findings suggest that people form social attitudes via instrumental reinforcement learning, and that this learning can influence structural face processing—the earliest stage of social perception.

# MEMORY FOR DANGERS PAST: THREAT CONTEXTS PRODUCE MORE CONSISTENT LEARNING THAN NON-THREATENING CONTEXTS

Akos Szekely, Suparna Rajaram, Aprajita Mohanty - Stony Brook University

It is hypothesized that threatening stimuli are detected faster and more accurately due to their salience or physical properties. Threatening stimuli typically occur embedded in a rich context and we have shown that individuals are able to learn the regularities within visual contexts and use this contextual information to guide detection of embedded threatening targets. However, in real life, contexts once associated with threat can become associated with non-threatening targets and vice versa. To examine how contextual learning changes when the salience of the target changes, we presented threatening and non-threatening face targets in new or old spatial configurations and changed the target salience halfway through the experiment. We found that detection of threatening targets was faster in old than new configurations and this learning persisted even after the target changed to nonthreatening. However, the same was not seen when the targets changed from non-threatening to threatening. Present findings show that detection of threatening targets is driven not only by stimulus properties as theorized traditionally but also by the learning of contexts in which threatening stimuli appear. Additionally, learning of the context associated with threatening targets is persistent and benefits detection of subsequent non-threatening targets presented in the same context. Neurally, it is likely that interactions between medial temporal lobe, amygdala, and frontoparietal spatial attention regions play an important role in contextual learning guided detection of threatening targets. Overall, our findings highlight the importance of top-down factors such as context and learning in the detection of threatening targets.

#### A-57

### DISTINCT NEURAL COMPUTATIONS MEDIATE OBSERVATIONAL LEARNING DERIVED FROM SOCIAL VERSUS NON-SOCIAL FEEDBACK

Damian A. Stanley - Adelphi University; Jessica Stanley - Trinity College, Dublin; Richard M. Piech -Anglia Ruskin University; John P. O'Doherty - California Institute of Technology We often learn not through doing, but through observing other people's actions and the outcomes they experience. An open question is how the source of information being observed influences observational learning. We investigated whether distinct neural computations underlie the contributions of non-social and social feedback to observational learning. 25 fMRI participants (observers) learned whether 6 lottery machines would deliver aversive (salty tea) or neutral (artificial saliva) outcomes by watching videos of 3 observees (interleaved), each playing a pair of lotteries (80:20/20:80 opposing contingencies; 1 reversal per lottery per experiment). Each observee belonged to 1 of 3 interleaved conditions: 1) Face Alone (FA), outcome depicted by facial expression alone; 2) Word Alone (WA), outcome depicted by a word alone. 3) Face+Word (F+W), outcome depicted by facial expression and a word. Accuracy was significantly above chance in all conditions (p<0.005) and significantly higher in the FW (p<0.005) than in the FA and WA conditions. Learning rates (Rescorla Wagner learning model) were also higher in the FW (0.51) than in the FO (0.37) and WO (0.38) conditions, though this difference was not significant. BOLD signals in the amygdala and face-selective temporal/occipital cortex correlated with aversive prediction error (i.e. highest for unexpected aversive outcomes) in conditions where face expressions depicted outcomes (FO & FW). Conversely, BOLD signals in the caudate head correlated with appetitive prediction error in conditions in which words described outcomes (WO & FW). These data suggest that observational learning from social and non-social observational feedback may depend on distinct neural substrates.

# DYNAMIC INTERACTIONS BETWEEN THE AMYGDALA AND AROUSAL NETWORK IN STIGMATIZED INDIVIDUALS; INSIGHTS FROM THE STARTLE REFLEX

Rachel C Amey, Mengting Liu, Adam B Magerman, Matthew Scott - University of Delaware, Chad E Forbes

The amygdala is an integrative hub for the experience of emotion and detection of self-threats. Often amygdala activity is examined via a startle reflex that manifests as a unique eye blink; the magnitude of the blink serves as a direct index of amygdala activity. Current best practices discard startle blinks below a certain criterion. However, past research demonstrates that amygdala activity can fluctuate over time in response to threatening stimuli suggesting that the exclusion of eye blinks below a certain threshold would eliminate meaningful data. The current study examined how interpretations of stress and emotion in a condition can change dramatically as a function of including startle blinks below standard thresholds. In a stressful context (stereotype threatening (ST) contexts) women and men completed math problems and were given veridical feedback after each trial yoked to random startle probes while continuous EEG data was recorded. Memory for presented feedback was tested after the task. Startle amplitudes and neural network connectivity in the arousal network were analyzed over time. Typical amyodala habituation patterns were seen in all participants except ST women, whose amplitudes exhibited a quadratic relationship over time. Arousal network connectivity was negatively correlated with startle amplitude; connectivity was highest when startle amplitudes were lowest. Memory encoding and performance were also affected as a function of amygdala activity. Findings suggest low amplitude startle trials contain valuable information that warrant inclusion and that stress prompts dynamic interactions between the amygdala and arousal network responses to affect performance and memory among stigmatized individuals.

#### A-59

#### DECODING THE EMOTIONS OF SOUND FROM PATTERNS OF NEURAL ACTIVATION

Matthew Sachs, Assal Habibi, Antonio Damasio, Jonas Kaplan - University of Southern California The ability to identify emotions from auditory stimuli and respond appropriately is a key component of effective social functioning. While the brain regions involved in processing the affective information conveyed by sounds are known, it is unclear if these regions respond in the same way to different emotions regardless of the sound source. Sounds from numerous different sources, such as human voice or the violin, have the ability to express discrete emotions, though the acoustical properties that express them can vary remarkably. To address this, we had participants (N = 38, 20 females) listen to brief audio excerpts produced by the violin, clarinet, and human voice, each conveying one of three target emotions-happiness, sadness, and fear-while brain activity was measured with fMRI. We used multivoxel pattern analysis to evaluate whether emotion-specific neural responses to the voice could predict emotion specific neural responses to musical instruments and vice-versa. A whole-brain searchlight analysis revealed that patterns of activity within the primary and secondary auditory cortex, posterior insula, and parietal operculum were predictive of the affective content both within and across instruments, indicating that these brain regions carry emotion-specific patterns that generalize across sounds with different acoustical properties. Additionally, classification accuracy within the anterior insula was correlated with behavioral measures of empathy, suggesting that individuals with greater empathic ability have more distinct neural patterns related to perceiving emotions. These results extend previous knowledge regarding how the human brain extracts emotional meaning from auditory stimuli. enabling us to communicate and connect with others.

### MODULATION OF NEURAL EMPATHIC RESPONSE TO PAIN VIA EXPRESSIVE SUPPRESSION

Steven R Anderson - Department of Psychology, University of Miami, Miami, USA; Wenxin Li, Shihui Han - School of Psychological and Cognitive Sciences, Peking University, Beijing, China; Elizabeth R Losin - Department of Psychology, University of Miami, Miami, USA

Neural empathic responses to the pain of others are consistently found to be modulated by characteristics of the individual in pain. However, considerably less is known about how characteristics of the pain observer modulate neural empathic responses. We used fMRI to investigate how the emotion regulation strategy of expressive suppression influences neural empathic responses. Participants were 30 healthy young adults (15 female) recruited from Peking University in Beijing, China. Participants underwent fMRI while completing an event-related expressive suppression task in which they viewed faces with painful or neutral expressions while engaging in expressive suppression (pain faces) or passive viewing (pain and neutral faces). After scanning, participants completed selfreport questionnaires measuring trait empathy and expressive suppression. In a region-of-interest (ROI) analysis, we found that passively viewing painful versus neutral faces resulted in increased brain activity in the right anterior insula (rAI), a region previously associated with empathy for pain. Analysis of the suppression condition revealed activation in the right amygdala and right inferior frontal gyrus (rIFG), regions previously associated with expressive suppression. In a correlation analysis, we found that activity within the rAI was negatively correlated with activity in the right amygdala and rIFG. This negative correlation was strongest for participants lowest in trait empathy and highest in habitual suppression. Together, our findings suggest that greater trait and experimental use of expressive suppression is associated with decreased neural empathy. These results add to our understanding of how observer characteristics modulate neural empathic responding and illuminate potential neurobiological mechanisms of this relationship.

### **Poster Session B**

Friday, May 4, 3:45 - 5:00 PM

### B-1

# SOCIAL CONTEXT INFLUENCES A NEUROCOGNITIVE SIGNATURE OF CHILD EMOTION REGULATION: A CROSS CULTURAL STUDY

Sarah Myruski - The Graduate Center, CUNY, New York, NY, USA; Samantha Birk - Temple University, Philadelphia, PA, USA; Aya Kamikubo, Midori Kazama, Hidemi Hirabayashi, Mayumi Karasawa - Tokyo Women's Christian University, Tokyo, Japan; Tracy A. Dennis-Tiwary - Hunter College, CUNY, New York, NY, USA

The late positive potential (LPP) is a neurocognitive signature of emotion regulation (ER). In adults, LPP amplitudes are reduced when unpleasant stimuli are reappraised in a positive light. Yet, it remains unclear whether this reappraisal effect on the LPP is present in children, since developmentallyappropriate and context-sensitive assessments are absent, particularly across cultures. This study measured the LPP in Japanese and U.S. children, systematically varying socialization context (parentscaffolding, parent-present, parent-absent). Fifty-eight 5-to-8-year-old Japanese children (26 female; Mmonth = 69.78, SD = 7.01), and 52 U.S. children (27 female; Mmonth = 76.19, SD = 8.88) completed a Directed Reappraisal Task (DRT). EEG was recorded during three conditions: unpleasant pictures interpreted negatively, unpleasant pictures interpreted with reappraisal, and neutral pictures interpreted neutrally. In the Parent-Scaffolding Group (njpn = 19; nus = 19), parents read scaffolding scripts before each picture. In the Parent-Present Group (njpn = 20; nus = 18), parents were present but not interacting. In the Parent-Absent Group (njpn = 19; nus = 15), children completed the DRT alone. Among Japanese children, only those in the parent-scaffolding group showed the predicted reappraisal effect, t(18) = 2.65, p = .02. Among U.S. children, those in the parent-scaffolding group and the parentpresent group showed the reappraisal effect, t(18) = 3.41; t(17) = 3.39, p's < .01. Results suggest that scaffolding helped children reappraise in both cultures, while the parents' mere presence was helpful for U.S. children. Findings highlight the need for culturally-sensitive and developmentally-informed methods in social-affective neuroscience studies of child ER.

### **B-2**

### FACTORS PREDICTING THEORY OF MIND SUCCESS ACROSS THE LIFESPAN

Elisabeth E.F. Bradford, Victoria E.A. Brunson, Heather Ferguson - University of Kent, Canterbury, U.K.

Engaging in social communication requires the ability to understand the mental states of other people, such as what they may know, believe, or see, and to consider how these mental states may differ from our own. In this study, a computerised false-belief task (the Self/Other Differentiation task) was utilized to assess the ease with which typically developed adults (aged 18-78 years) could attribute beliefs to both the 'Self' and 'Other'. Participants were presented with images of three containers and asked to identify where they or someone else would look for a particular object (e.g., '[You/John] are looking for some sugar, where would you look?]. The contents of the container was then revealed to be either congruent (e.g., sugar in the sugar bowl) or incongruent (e.g., marbles in the sugar bowl). Finally, participants were asked the critical probe question: 'What did [You/John] think was inside the container, before seeing inside?'). Results revealed a significant effect of perspective, with longer and more error prone responses to questions referring to another person's perspective compared to the 'self' perspective; this effect was larger in older adults, suggesting that differentiating between one's own and another person's perspective becomes more difficult with age, requiring more cognitive effort. Participants also completed tasks assessing executive functioning abilities, including inhibition, working memory, planning, and cognitive flexibility. Results indicated a key role of inhibition and working

memory abilities in predicting performance on the Self/Other Differentiation task, but only in older rather than younger adults.

### B-3

# VISUALIZING HUMAN BEINGS: IMAGE FRAMING IN PHOTOJOURNALISM & THE DEHUMANIZATION OF REFUGEES

Manos Tsakiris - Department of Psychology, Royal Holloway, University of London & The Warburg Institute, School of Advanced Study, University of London, UK; Sophie De Beukelaer, Ruben Azevedo -The Warburg Institute, School of Advanced Study, University of London, UK

The ways in which human beings are depicted in the media have far-reaching consequences for our attitudes towards them, their well-being and our democracies. Here, we examined how the ways in which refugees are visually framed in the media affect their dehumanization. We identified photojournalistic images depicting refugees and classified them according to the visual framing of refugees as individuals or in small groups with identifiable faces, or in large groups without recognizable facial feature, and tested if and how these two types of visual framing lead to their dehumanization. Relative to the small group condition, participants seeing refugees in large groups tended to assign less uniquely human emotional states to them. Moreover, visual framing effects were stronger in photos showing refugees arriving by sea, rather than in land, and the effects of visual framing were extended to a refugee's moral dilemma task. When using photos depicting survivors of natural disasters, visual framing did not result in their greater dehumanization. Lastly, in a withinsubjects design, refugees depicted in large groups, but not survivors of natural disasters, were rated lower in warmth. These studies demonstrate the power that prevalent depictions of large groups of individuals in the media have on the public's perception of refugees as human beings. There might not be neutral ways of visually depicting refugees, but our findings contribute to debates about the influence of the media's use of visual framing as vehicles for socially constructing our attitudes towards others.

### **B-4**

# ATTENUATION OF VALENCE-ACTION COUPLING PROMOTES BEHAVIORAL FLEXIBILITY DURING ADOLESCENCE

Hillary A Raab, Shivani Hiralall, Catherine A Hartley - New York University, New York, USA An intrinsic tendency to couple valence and action can bias individuals to approach rewards and to inhibit action in the face of punishment. For example, upon smelling a delicious treat, you might enter the nearby bakery, or upon hearing a threatening noise, you might freeze. Although approaching rewards and inhibiting action in anticipation of punishment may be useful behavioral heuristics, these responses may not always be aligned with one's goals (e.g., healthy eating or seeking help). Behavioral flexibility refers to the ability to adapt one's actions to environmental demands and opportunities in accordance with one's goals. In adults, behavioral flexibility is constrained by the tendency to couple valence and action. In the present study, we characterized the developmental trajectory of behavioral flexibility, disentangling the effects of valence and action on reinforcement learning. Participants (n=61; 8-25 years old) performed a Go/No-go task in which valence and action were orthogonalized, resulting in four trial types: Go to Win, Go to Avoid Losing, No-go to Win, No-go to Avoid Losing. Behavioral flexibility, indexed by relatively equal and accurate performance across trial types, was greatest in adolescents compared to children and adults. Conversely, children and adults' learning exhibited greater coupling between valence and action, reflecting less behavioral flexibility. Computational models fit to participants' data suggested that this flexibility in adolescence stems from an unbiased learning process. Greater behavioral flexibility during adolescence may foster accurate learning about the reward and punishment structure of one's environment, which may be particularly adaptive during the transition toward independence.

#### B-5

# NEURAL AND BEHAVIORAL DIFFERENCES LEADING TO INCREASED RISK-TAKING IN METHAMPHETAMINE USERS

Vita Droutman - University of Southern California; Feng Xue - University of California San Diego; Barkley-Levenson Emily - Hofstra University; Smith Ben, Bechara Antoine, Read Steve - University of Southern California; VITALIYA DROUTMAN

Neuroadaptations caused by chronic methamphetamine use are likely major contributors to high relapse rates following treatment. Thus, focusing intervention efforts at pre-empting addiction in vulnerable populations would seem to be a more promising strategy, since it would prevent meth-use induced neurological changes that make the recovery so challenging. Casual methamphetamine users (cMU), not yet addicted, but at high risk due to their experience with meth are a good target group. Unfortunately, research on neuro-cognitive differences of cMU is currently lacking. In this work we start to bridge this gap. While undergoing fMRI, cMU and non-meth using participants performed the CUPS task, in which they decided to accept or refuse a series of mixed gambles. We examined differences in neural processing during decisions and feedback processing using whole brain, region of interest and psychophysiological interaction (PPI) analyses. cMU took significantly more risk in the task and made 5 times more errors (missed trials that resulted in immediate monetary loss) relative to non-users (NU). Whole brain analysis identified an amygdala-striatal cluster with weaker activation in cMU compared to NU during the decisions. Activity in that cluster inversely correlated with decision to gamble: lower activation corresponded to higher risk-taking. Using this cluster as a seed in PPI analyses we identified a wide range of neural network differences between MU and NU. We identified key differences in reward processing, executive functioning and outcome learning that may contribute to increased laboratory and real-world risk-taking in cMU and can be addressed in future intervention.

### **B-6**

### PAYING TO SEEK OR AVOID SOCIAL INTERACTIONS

Johannes W Schultz, Tom Willems, Ghada Chakkour, Alexander Franke, René Hurlemann - Division of Medical Psychology, University of Bonn, Bonn, Germany

Interacting with other people is a major source of happiness for most human beings. However, social interactions do not always evolve according to expectations and may result in the reception of negative social feedback. While many people spend money to seek social interactions with other people, anxiety about possible negative social feedback may lead some people to withdraw from social interactions, causing in some cases considerable loss of private and professional opportunities. To quantify the costs of pro-sociality and social anxiety, we devised a psychophysic task allowing to determine how much money participants would spend to avoid or seek a simple social interaction with uncertain outcome. In a sample of healthy participants, the more anxious participants paid to avoid the interaction, while the less anxious paid to seek the interaction. These differences were not found in a control condition in which the interaction partner was a computer instead of a human, demonstrating that risk aversion differences cannot explain our findings. Separate valence ratings of the interaction outcomes did not significantly vary between participant groups, suggesting that the observed effects were not due to differences in the valuation of the outcomes themselves. Our results demonstrate that tendencies towards pro-sociality and social anxiety among healthy participants are both costly. Our experiment allows to directly compare the costs of these personality traits and may prove useful for investigating treatment effects of social anxiety. We are currently using it to investigate individual differences in the neural correlates of social decision-making.

#### B-7

# REWARD ENCODING IN SUBCALLOSAL ANTERIOR CINGULATE CORTEX, VENTRAL STRIATUM, AND AMYGDALA

Megan E Young, Kristen D Esannason, Sarita Tamang, Clayton Moser, Peter H Rudebeck - Icahn School of Medicine at Mount Sinai

Dysfunction within the circuits linking subcallosal anterior cingulate cortex (ACC), ventral striatum (VS) and amyodala is related to changes in affect. However, a mechanistic understanding of how the subcallosal ACC interacts with VS and amygdala during the anticipation and receipt of reward in normal function is lacking. Here we investigated how neurons in subcallosal ACC, VS, and amygdala interact while monkeys anticipate and receive reward. Two rhesus macagues performed Pavlovian and instrumental trace conditioning tasks while single-unit and local field activity in subcallosal ACC, VS, and basolateral amygdala were recorded. Autonomic measures of arousal, such as pupil diameter and continuous EKG, and task-related behavioral responses were continuously collected. We found that monkeys showed elevated behavioral and autonomic responses in anticipation of rewards, which were modulated by each animal's individual reward preferences. Neurons in subcallosal ACC, VS, and amygdala encoded upcoming reward during the stimulus and trace intervals, and this activity was similarly modulated by individual reward preference. However, the timing of these responses differed between areas, with amygdala neurons signaling reward value first, followed then by subcallosal ACC and VS. In conclusion, we found that neuronal activity in subcallosal ACC, VS, and amygdala correlates with sustained behavioral and autonomic responses in anticipation of rewards, and that these responses occur on different time scales. We are now exploring how these areas interact as a functional circuit by looking at measures of oscillatory coherence and spike-spike correlations within and between subcallosal ACC, VS, and amygdala.

#### **B-8**

### COMBINED FMRI-ADAPTATION (FMRI-A) AND MULTIVARIATE PATTERN ANALYSIS (MVPA) REVEAL DIFFERENCE BETWEEN MUSICIANS AND NON-MUSICIANS IN RESPONSE TO AUDITORY EMOTIONAL INFORMATION

Jocelyne C Whitehead, Jorge L Armony - McGill University, Montreal, Canada Emotions portraved in the auditory domain convey critical information that enables the listener to interpret the intent and affective state of the emitter. Recent work has shown musical expertise to shape how acoustic information is processed in the brain; however, little is known about its influence on emotional processing. To address this question, we employed an fMRI-adaptation (fMRI-a) paradigm with a fast multiband sequence (TR=0.529s, voxel: 2mm isotropic), where musicians (N =15) and nonmusicians (N=15) passively listened to pseudospeech and musical excerpts, expressing a neutral or fearful emotion. FMRI-a, in combination with multivariate pattern analysis (MVPA) allowed for a more detailed and comprehensive view of the differences in neural responses to voice and music, as well as how these may be modulated by emotion. We observed a difference in processing music between musicians and non-musicians that was not present for voice. Moreover, only musicians showed musicspecific adaptation effects, with the bilateral amygdala, thalamus, hippocampus and superior temporal gyrus (STG) contributing the most to this effect. In addition, only musicians showed a distinction in processing fear from neutral music, with the greatest contributions coming from the bilateral STG, thalamus, Heschl's gyrus, and left amygdala. These findings provide strong support for a role of expertise in the processing of musical emotions. Moreover, they demonstrate the advantage of using high-resolution fMRI and combining adaptation paradigms with multivariate analytical approaches.

### B-9

### **GROUPS OF UNFAIR INDIVIDUALS BENEFIT FROM DECREASED SOCIAL PUNISHMENT**

Marwa El Zein, Chloe Seikus, Lee De-Wit, Bahador Bahrami - University College London In the last few decades, research on collective decisions has focused on the accuracy of collectives, ignoring an important aspect of collective behaviors: the diffusion of responsibility. In a group, individuals share responsibility for their actions, which may protect them against negative consequences of these actions. In particular, when actions could trigger punishment (unfair behaviors. crimes), being in a group could decrease this punishment, as it is shared among several individuals. While it has been shown in previous studies that people in a group show increased free riding, no study has looked at how groups vs. individuals are punished. Following our reasoning that groups share responsibility for harmful acts, we predicted that a group would be punished less than an individual for the same act. We tested this hypothesis using two well-known cooperation games; the ultimatum and the dictator game (with third party punishment). One (individual condition) vs three (group condition) proposers made offers to recipients. In the ultimatum game, recipients could reject (i.e. social punishment) or accept the offer. In the dictator game, a third party could punish the proposer or proposers for their unfair offer at his/her own cost. In both games, groups were punished less than individuals who made the same unfair offers. Our results demonstrate a most useful adaptive value of collective actions: two heads are better off than one.

### B-10

#### TEMPORAL DYNAMICS OF THE REPRESENTATION OF SOCIAL CLOSENESS OF FACES

Sarah L. Dziura, James C. Thompson - George Mason University

The ability to perceive and understand social information rapidly is important in a highly interconnected world. While identification of identity from faces occurs within the first few hundred milliseconds of perception, timing of the retrieval of the social connections of an individual is unknown. We used eventrelated potentials and temporal representational similarity analysis (RSA) to examine the neural processing of social network information activated when viewing a face. Participants learned a social network through watching three episodes of an unfamiliar television show and reported the perceived closeness of ten characters. Closeness ratings were significantly related to the number of scenes and time in which characters were both present (p<0.001). Participants then viewed photos of the characters while EEG was recorded from 64 scalp sites. RSA was used to compare ERP neural similarity data among these faces with models of face processing at different stages. Computational models of visual similarity, face space, (expression-independent) identity, and ratings of social network closeness were correlated with the similarity of neural responses to the faces at different time points. Visual similarity, face space, and identity representations became significant at approximately 60-100 ms after face onset (p<0.001; 10.000 randomizations). Social network closeness then became significant between approximately 200-300 ms after face onset (p<0.001). These findings indicate that information about social network relationships is accessed shortly following the visual perception of faces. This data supports the proposal that information about social connections is closely linked to representations of face identity.

#### B-11

## MAKING SOCIAL NEUROSCIENCE LESS WEIRD: NEURAL SIGNATURES OF INTERPERSONAL INFLUENCE IN THE MIDDLE EAST AS MEASURED WITH FNIRS

Shannon M Burns, Lianne N Barnes, Macrina Cooper-White – UCLA; Ian A McCulloh - Johns Hopkins University; Munqith M Dagher - IIACSS Research Group; Douglas Storey - Johns Hopkins University; Emily B Falk - University of Pennsylvania; Matthew D Lieberman – UCLA

The large majority of social neuroscience research uses WEIRD populations – participants from Western, educated, industrialized, rich, and democratic. This makes it difficult to claim whether neuropsychological functions are universal or culture specific. In this study, we demonstrate how we

can address the imbalance by using portable neuroscience equipment in two studies of persuasion and interpersonal influence conducted in Jordan with an Arabic-speaking sample. Participants were shown persuasive videos on various health, safety, or public affairs topics while their brain activity was measured using functional near infrared spectroscopy (fNIRS). In one study, participants also discussed the videos with another person in a dyadic neuroimaging design. Consistent with previous research conducted with American subjects, this work found that activity in the medial prefrontal cortex predicted how persuasive participants found the videos and how much they intended to engage in the messages' endorsed behaviors. Further, interpersonal neural synchrony during discussion of video topics was evaluated as a prediction of discussion outcomes. Implications for these results on the understanding of the brain basis of interpersonal influence and on future directions for neuroimaging in diverse populations are discussed.

B-12

### LEARNING ABOUT THE SELF IN THE PRESENCE OF OTHERS: THE IMPACT OF SOCIAL ANXIETY ON MENTALIZING AND UPDATING PROCESSES

Laura Müller-Pinzler, Nora Czekalla, Frieder M. Paulus, Sören Krach - University of Lübeck, Department of Psychiatry and Psychotherapy

In a social context self-related information needs to be constantly integrated to form beliefs about the self in order to adapt behavior to the demands of the environment. Studies indicate that people show a positivity bias when processing self-related feedback possibly stabilizing beneficial self-concepts. We hypothesized that self-related updating is altered by the mere presence of others, a fundamental aspect of any given social situations. The presence of others typically makes us think about their views of us, which then draws attention away from other sources of information relevant for self-related learning. In this line, we could show that receiving negative self-related feedback in a public context induced embarrassment, increased neural activation in the so-called mentalizing network and the anterior insula. Specifically, individuals high in social anxiety (SA) shifted attention towards the audience and showed increased mentalizing activation in line with attention biases towards cues for social threat. In a novel social learning paradigm we assessed participants' expectation updating in response to self-related positive and negative performance feedback. Participants showed a strong modulation of prediction error updating in public in line with a shift of attention away from the feedback towards the audience, another usually relevant source of social self-related information. Interestingly, individuals high in SA showed an overall greater updating after negative compared to positive prediction errors. This supports the notion of attention biases towards negative social information and points towards a mechanism contributing to negative self-related beliefs and a constant negative view of the self in SA.

#### B-13

# TRICK OR TREAT: NEURAL SENSITIVITY TO SOCIAL RISK IN ADOLESCENTS WITH SEVERE CONDUCT PROBLEMS.

Michael T Perino - University of Illinois at Urbana-Champaign; Ethan M McCormick, Eva H Telzer -University of North Carolina at Chapel-Hill

Adolescents' neural and behavioral responses differ from their child and adult counterparts, suggesting disinhibition to appetitive cues may be particularly explanatory for increased risk-taking. However, much of this work has relied upon community samples, and may not generalize to the situations, mental processes, and populations most engaged in destructive risk-taking. We utilized a social variant of the Balloon Analog Risk Task during fMRI, to assess differential responses to social-risk cues. Our sample included adolescents with no disciplinary record (N=27), and adolescents engaged in delinquent behaviors, as measured by suspensions, expulsions, and arrests (N=25). Behaviorally, adolescents from the delinquent and community sample engaged in similar patterns of risk-taking; however, activation patterns suggested significant differences in the neural processing of risk. Specifically, we observed significant interactions in tracking of increasing social risk in the dorsal

anterior cingulate (dACC), posterior cingulate (PCC), ventromedial prefrontal cortex (vmPFC), dorsolateral prefrontal cortex (dIPFC), bilateral ventral striatum (VS), bilateral insula, right temporoparietal junction (TPJ), and right posterior superior temporal sulcus (pSTS) that differentiated our community and delinquent sample. Greater tracking in these regions related to reduced risk-taking behaviors in the delinquent sample but increased risk-taking and currently discussed in the developmental neuroscience literature may not apply to delinquent samples. We suggest that theories of risk-taking that lack explicit focus on delinquent samples may have limited generalizability, requiring the field to re-evaluate our scope to inform interventions for those most susceptible to destructive risk-taking behaviors.

### B-14

#### DEGRADED VISUAL INPUT EXACERBATES WEAPON IDENTIFICATION BIAS

#### Benjamin S. Stillerman, Jonathan B. Freeman - New York University

The racially biased identification of weapons is, at least in part, a result of stereotypes linking Black Americans to crime. In real-world scenarios of police officers identifying objects as potential weapons, viewing conditions are not always optimal and the visual stimuli can be ambiguous. This bears on recent models (Freeman & Johnson, 2016), which claim that social perception is the result of a dynamic process integrating bottom-up visual input and top-down stereotype information. We investigated whether degraded visual input would make way for a greater biasing influence of stereotypes. Using a modified Weapon Identification Task (WIT) combined with mouse-tracking, we investigated whether degraded visual input exacerbated the commonly observed weapon identification bias effect. Participants (N = 199) completed a WIT using both clear or degraded (visual noise superimposed) target objects. We found that mouse trajectories on Black-primed tool trials showed a greater attraction to gun responses than White-primed tool trials, suggesting that the Black primes partially activated the gun category. Additionally, this effect was greater for degraded objects, indicating a greater level of bias when the objects provided less reliable bottom-up information. We discuss putative neural mechanisms supporting the automatic activation of stereotypes and their influence on object identification, linking the present work to recent MVPA evidence. We also discuss consequences for bias reduction interventions.

#### **B-15**

#### ATTENUATED PAVLOVIAN LEARNING BIASES IN ADOLESCENCE

# Juliet Y. Davidow, Rahul Bhui, Catherine Insel, Amanda M. Brandt, Abigail M. Stark, Katherine E. Kabotyanski, Leah H. Somerville - Harvard University

Adolescence is a time of life rich with affective learning experiences. Affective learning in adults has been linked to both Pavlovian (i.e. reflexive) and more flexible instrumental learning systems. When information is consistent, these systems can cooperate supporting goal-directed decision-making; however, when information conflicts, e.g. when action and outcome valence are opposed, strong influence from the Pavlovian system can disrupt the instrumental system, decreasing learning. The influence of these differential learning systems under conflict on goal-directed decision-making has not been studied over development. Participants 11–22 years old (N=87) learned from probabilistic reinforcement to execute or withhold a button press (action factor) to obtain reward or avoid punishment (valence factor); the intersection of these factors is congruent (press to obtain reward, withhold press to avoid punishment) or incongruent (press to avoid punishment, withhold press to obtain reward). We employed a computational model to estimate psychological parameters characterizing learning and biases in decisions. For learning, we found a significant interaction of age on action-by-valence. We investigated the direction of this complex interaction by fitting linear and non-linear models of age to a Pavlovian bias parameter estimated by the computational model. We found a significant U-shaped fit with lowest Pavlovian parameters in late adolescence. This better explained the

group data than a linear age model, suggesting that during adolescence there is an attenuation of Pavlovian learning biases. This could allow for better instrumental learning when information is in conflict, to optimize learning during adolescence. Additional parameters, and competing computational models, will be discussed.

### B-16

### CAN PSYCHOLOGICAL TREATMENT SLOW DOWN CELLULAR AGING IN SOCIAL ANXIETY DISORDER? AN INTERVENTION STUDY EVALUATING CHANGES IN TELOMERE LENGTH AND TELOMERASE ACTIVITY

Kristoffer N T Månsson - Stockholm University, Stockholm, Sweden; Karolinska Institutet, Stockholm, Sweden; Uppsala University, Uppsala, Sweden; Daniel Lindqvist - Lund University, Lund, Sweden; University of California San Francisco (UCSF), School of Medicine, San Francisco, CA, United States; Owen Wolkowitz - University of California San Francisco (UCSF), School of Medicine, San Francisco, CA, United States; Gustav Nilsonne - StockholmStockholm University, Stockholm, Sweden; Karolinska Institutet, Stockholm, Sweden; Josef Isung - Karolinska Institutet, Stockholm, Sweden, Cecilia Svanborg - Karolinska Institutet, Stockholm, Sweden; C-J Boraxbekk - Copenhagen University Hospital Hvidovre, Copenhagen, Denmark; Umeå University, Umeå, Sweden, Håkan Fischer - Stockholm University, Stockholm, Sweden; Catharina Lavebratt - Karolinska Institutet, Stockholm, Sweden, Tomas Furmark - Uppsala University, Uppsala, Sweden

Mental illness, including anxiety disorders, is linked to accelerated cell aging. This is evidenced by shorter leukocyte telomere length. Cells with critically short telomeres may undergo apoptosis. In dividing cells, telomere shortening is counteracted by the telomerase enzyme. Telomerase is reportedly low following chronic psychological stress. We hypothesized that a psychological treatment may increase telomerase activity, and be associated with less telomere attrition and greater symptom improvement. Forty-six patients (91% SSRI naïve) with social anxiety disorder (SAD; mean age 31, 63% females) underwent a 9-week waiting period, and 9 weeks of Internet-delivered cognitive behavior therapy (CBT). During treatment, symptoms were assessed weekly using the Liebowitz Social Anxiety Scale (LSAS-SR). Fasting blood samples (before 11 am) were collected twice before treatment, and at post-treatment. Genomic DNA was extracted using DNeasy® Blood & Tissue Kit (Qiagene) to assess leukocyte telomere length. Telomerase activity was detected by real-time telomeric repeat amplification protocol (RT-TRAP). Patients improved significantly on the LSAS-SR (p<.001; Cohen's d=1.5). Prepost changes in telomerase and telomere length correlated positively (Pearson's r=.31, p=.05). Patients exhibiting reduced telomerase activity (<33th percentile) was associated with less improvement and increased activity (>66th pctl) with more improvement on the LSAS-SR (Z=-2.4, p=.02). We demonstrate, to our knowledge for the first time, that altered telomerase activity is associated with clinical response to a psychological treatment in a psychiatric population. The observed CBT effect on telomerase in patients with SAD is consistent with results from animal trials and a small previous study of antidepressants in humans. Thus, telomerase activation may play an important role in clinical recovery.

### B-17

### LATENT-CAUSE INFERENCE IN SOCIAL BIASES

Yeon Soon, Yael Niv - Princeton University, Princeton, NJ, USA

When making decisions in a social environment, how do we form impressions about a group of people whose members are diverse? When the majority of members are alike and only a few are dissimilar from the rest of the group members, how does experience with those rare members influence the overall impression? Here, we explored how highly variable and/or rare events can gain prominence in overall estimation if people form impressions using semi-rational inference of latent causes—causal structures of the world that generate a set of observations—and heuristic averaging over these causes. We hypothesized that events that are sparse (due to being rare or variable) will be attributed to a large

number of latent causes. This tendency to separate sparse events to small latent causes, while grouping common events in large latent causes that explain multiple events, can result in overweighting of sparse events if later averaging is across (unweighted) latent causes rather than individual events. We tested this hypothesis by manipulating sparsity of non-overlapping event distributions in model simulations and behavioral decision-making experiments. To test for estimation biases isolated from other social evaluation biases, subjects observed a sequence of coin donations and were subsequently asked to estimate the average donation amount. As predicted by the latent-cause model, the average donation estimation was incorrectly biased toward the sparse donations These results suggest that social biases that have been found in empirical social cognition research may be the results of a semi-rational Bayesian latent cause inference process.

#### B-18

### AGE-RELATED DIFFERENCES IN NEURAL ACTIVATION DURING THE RECOGNITION OF VOCAL EMOTIONAL PROSODY BY YOUTH

Michele Morningstar, Joseph Venticinque, Stanley Singer, Jr., Whitney I. Mattson, Eric E. Nelson -Research Institute, Nationwide Children's Hospital

Changes to the social brain network during adolescence have been linked to age-related maturation of social cognition ability, which includes skills such as emotion recognition (ER), or the ability to understand others' affect. Most studies on the development of this ability have focused on the recognition of facial expressions of emotion, but vocal ER skills also mature during adolescence. However, little is known about the neural underpinnings of this ability. The current study examined agerelated changes in youth's neural activation during a vocal ER task. Twenty-five youth aged 9-18 heard recordings of emotional voices and selected the portraved expression from 5 labels (anger, happiness, fear, sadness, neutral) while undergoing functional magnetic resonance imaging. Multivariate analyses were conducted to examine the effect of emotion type and age on neural activation during the task compared to baseline. Youth made fewer errors in labelling vocal prosody with increased age. Neural activation did not differ by emotion type, but the bilateral middle frontal gyrus, left inferior frontal gyrus, and left middle occipital gyrus showed linear increases in activation with age. Greater activity in these areas was linked to reduced ER errors. Maturational change in neural activation during the interpretation of vocal affect was primarily noted in frontal areas involved in top-down language processing and mentalizing, rather than in primary sensory areas like the auditory cortex or superior temporal sulcus. The development of vocal ER skills during adolescence may be supported by increased recruitment of brain structures involved in the cognitive processing of affect.

#### B-19

#### MODULARITY OF INTRINSIC FUNCTIONAL BRAIN NETWORKS PREDICTS AGE-RELATED CHANGES IN BASIC SOCIAL COGNITIVE FUNCTIONS

Colleen Hughes, Brittany S. Cassidy, Joshua Faskowitz, Andrea Avena-Koenigsberger, Olaf Sporns, Anne C. Krendl - Indiana University, Bloomington, Indiana, United States

Aging has been widely associated with declines in basic social cognitive functions (e.g., inhibiting prejudice, theory of mind). However, the mechanisms underlying age-related changes in those processes are poorly understood. Neuroimaging is uniquely suited to shed light on these mechanisms because it investigates aging at multiple levels of analysis. For example, prior work has identified specific neural regions underlying social cognitive processes (e.g., medial prefrontal cortex) whose function changes over the lifespan. However, the complexity of these changes may be further characterized by the intrinsic (i.e., undirected, resting-state) connectivity of many coordinated regions. Thus, we examined whether age-differences in the modularity (i.e., the strength of coupling within, and weakness of coupling between, networks of brain regions) of intrinsic networks predicted age-differences in social cognitive functions. Forty healthy young (18-33 years) and 35 healthy older (61-86 years) adults completed behavioral measures of implicit bias (e.g., race, age) and theory of mind several days prior to undergoing fMRI. Network modularity was obtained via resting-state fMRI.
Consistent with prior work, older adults had higher implicit bias than did young adults. Older versus young adults also had less modular networks indicating potential dysregulation of the functional specialization of the networks. Critically, the modularity of the default mode network, which includes brain regions that have been widely implicated in social cognition (e.g., medial prefrontal cortex), predicted age-differences on behavioral tasks. These results suggest that age-related changes in the diffusivity of intrinsic connectivity in specific networks, implicating dysregulated specialization, may explain deficits in social cognitive functions.

## B-20

## EFFECTS OF SOCIAL STRESS ON SELF-RELATED LEARNING PROCESSES

Nora Czekalla, Frieder M. Paulus, Sören Krach, Laura Mueller-Pinzler - University Lübeck, Department for Psychiatry and Psychotherapy

To flexibly act in a social environment, we must continuously integrate feedback about ourselves or others and adapt our expectations accordingly. Feedback about the self is often received in a context of social stress, e.g. after a public speech. It is known that people usually overweight positive information when learning self-related feedback (Sharot & Garrett, 2016). However, the influence of stress on feedback-based learning, especially regarding self-related information in a social context, has not been examined so far. In the current study we designed a learning paradigm to measure updating of self-related performance expectations after a social stress induction or control task. In an estimation task subjects were repeatedly asked to rate their performance expectations and received positive or negative performance feedback. Results show that participants updated their self-evaluations according to the given feedback. Self-evaluations of stressed individuals were significantly more positive compared to participants in the control group. This elevation effect correlated with cortisol levels. Stressed participants showed greater updating (linear regression between trial-by-trial prediction errors and updates) compared to the control group especially after positive prediction errors. The elevation and updating effect of the stressed participants is in line with theories claiming that a stressinduced modulation of the dopaminergic system could lead to a reward-biased learning (Mather & Lighthall, 2012). Our study gives first behavioral insights into self-related feedback learning in a social context and its relation to physiological stress responses providing an interesting starting point for future investigations on the neural systems level.

#### B-21

# COMPUTATIONAL MODELING OF VALUE, WEIGHTING AND ATTENTION IN MULTI-ATTRIBUTE CHOICE

#### Daniel J Wilson, Cendri Hutcherson - University of Toronto

Some of the most important decisions we make on a daily basis involve the complex consideration and (noisy) integration of multiple attributes rather than a single discrete value. However, the computational process by which these multi-attribute values are constructed remains poorly understood. How are different attributes attended, and what shapes the relationship between an attribute's value, its weight, and the attention it receives? To answer these questions, we develop a computational model that describes the dynamics by which people search and attend to multiple attributes in a value-based decision making task as a function of their value and weight. In our paradigm, participants made choices about whether to accept combinations of attributes represented by house and face images associated with different positive or negative values. Critically, we manipulated the relative importance of these attributes through a "multiplier" applied on each trial to the value of the face, house, or both. We tracked attention to each attribute by requiring participants to press a button to switch between the face and house images in order to interpret the summed value. Computational model of choices and attentional allocation suggested that in contrast to assumptions made by the standard attentional drift diffusion model, fixation durations are not independent of value and weight. Our models suggest that

attention itself is a value-based choice informed by both attribute value and context-dependent attribute weighting. EEG and fMRI data collection to further elucidate neural mechanisms is ongoing.

#### B-22

#### **OXYTOCIN AND VASOPRESSIN EFFECTS ON MENTALIZING**

Mark A Straccia, Matthew D Lieberman - University of California Los Angeles, Los Angeles, CA, USA; Benjamin A. Tabak - Southern Methodist University, Dallas, TX, USA

In the past decade, research on oxytocin has sky rocketed. Oxytocin has been shown to have wideranging effects from increasing pair bonding to increasing trust to increasing fear of strangers. We examined whether oxytocin and vasopressin would also increase Theory of Mind performance on a mentalizing task. We recruited 186 undergrad students in a double blind fMRI study to respond to the Why-How task (i.e. answering the 'why' or 'how' of a person's action) after an intranasal administration of oxytocin, vasopressin, or a placebo. We found no improvement on accuracy or reaction time on the Why-How task for either oxytocin or vasopressin including when we controlled for sex. Even though we found very robust typical activation patterns for why vs. how, we did not oxytocin or vasopressin moderation effects on these activations. We also did not find tasked based differences in functional connectivity within and between the default mode network ('why' network) and mirror neuron network ('how' network). With more explorative analysis, we did not find consistent results of multiple individual differences (e.g. Autism-Spectrum Quotient, Empathy Quotient, perspective taking, etc.) moderating connectivity depending on oxytocin or vasopressin. Given the large sample size of our study, it is reasonable to infer we could not find evidence of either oxytocin or vasopressin altering mentalizing ability and brain activation in the areas required for these tasks.

#### B-23

### **NEUROMARKERS FOR PERCEIVED CONTROL: A MEGA-ANALYTIC STUDY**

Catherine Cho - Sungkyunkwan University; Mauricio Delgado - Rutgers University-Newark; Tor D. Wager - University of Colorado Boulder; Perceived Control Mega-Study Initiative Group; Choong-Wan Woo - Sungkyunkwan University

A sense of control over our environment is empowering, and can mitigate the consequences of pain and other adverse events. Although a considerable number of neuroimaging studies have explored the neural mechanisms underlying perceived control over emotional events (i.e., aversive stimuli, monetary rewards and losses), there have been limited efforts to develop models of brain systems that correlate with and can be used to predict control experiences. Here, we launch a collaborative initiative involving more than 10 laboratories and 15 studies to aggregate data across multiple studies and sites. Using a mega-analytic approach combined with machine learning, our purpose is to identify population-level multivariate fMRI patterns that are sensitive and specific to perceived control across conditions, tasks, and datasets, and can be used to predict the degree of perceived control in out-of-sample participants. Furthermore, multivariate patterns of brain activity will be used to probe the representational geometry among different task designs and conditions. Preliminary analyses discriminated conditions with high perceived control vs. no control with 79-86% accuracy in forced-choice tests (n = 85). Our analyses also revealed cross-prediction across multiple datasets, with some of the pattern-based models generalizing to independent studies. Once data collection from participating laboratories is completed, in-depth analyses will be conducted to refine neural signatures for perceived control and to better understand pattern-level neural information across studies. The quantitative synthesis of data through collaborative efforts will provide a cumulative understanding of neural mechanisms underlying perceptions of control and suggests potential uses in applied settings.

### MOTIVATED IMPRESSION UPDATES VARY AS A FUNCTION OF IMPRESSION DIMENSIONS

BoKyung Park, Liane Young - Boston College

Previous studies found that failure to recruit regions associated with social prediction error (e.g., temporo-parietal junction; TPJ) can hinder incorporating negative information of in-group members, contributing to in-group favoritism (Hughes, Zaki, & Ambady, 2017). We investigated whether the dimension of the impression that participants are asked to update can modulate these effects. Specifically, we investigated whether participants would become more defensive when they rate their relationship with an in-group member (i.e., a friend) compared to when they rate non-relational dimensions, such as personality traits. We recruited 181 participants and asked them to rate either to what extent a target person (their friend or a stranger) is trustworthy, or how close they feel towards the target person, based on the target's behavior (the target either gave or took money to/from the participants). We found that participants were less likely to update their impressions of friends, especially when they rated closeness (p=.086, t=1.72). Moreover, participants' reaction time modulated these effects; the faster they made the ratings, the closer they rated their relationship with their friends, whereas the longer they took to make the ratings, the closer they rated their relationship with strangers (p=.069, t=-1.82). These results suggest that immediate and intuitive processing of new information helped the participants to maintain their perception of closeness with friends. Ongoing neuroimaging work will test whether failure in recruiting TPJ can account for participants' reduced updating of perceived closeness with friends. These findings suggest that motivated impression updating can be modulated by the type of specific impression dimensions.

#### B-25

#### DOES MANIPULATING VISUAL SCANPATHS DURING FACIAL EMOTION PERCEPTION INFLUENCE BRAIN ACTIVATION IN FACE-PROCESSING REGIONS IN SCHIZOPHRENIA PATIENTS AND CONTROLS?

Michael J. Spilka, Daniel J. Pittman, Signe L. Bray - University of Calgary; Vina M. Goghari - University of Toronto Scarborough

Individuals with schizophrenia have deficits in the ability to perceive and recognize emotions from faces. This impairment has been linked separately to functional activation abnormalities in the neural system for facial emotion perception, and to making fewer fixations to salient facial features compared to healthy controls. The present study investigated whether gaze behaviour modulates brain activation during facial emotion perception. Twenty-three individuals with a diagnosis of

schizophrenia/schizoaffective disorder and 25 community controls underwent fMRI while viewing pictures of emotional faces. During the Typical Viewing condition, a moving fixation cue directed participants' gaze primarily to the eyes and mouth, while gaze was directed to peripheral facial features during the Atypical Viewing condition. Both conditions elicited activation in the distributed neural system for facial emotion perception. In both groups, Typical Viewing led to greater activation in extrastriate visual cortex, while Atypical Viewing elicited greater activation in primary visual cortex and regions involved in eye movement control. Region of interest analyses revealed greater activation during Typical than Atypical Viewing in the "occipital face area" but not in other face and emotion processing regions. No significant interactions between viewing condition and group were observed. The present study failed to find that increasing gaze toward salient facial features leads to greater activation throughout the facial emotion perception network, contrary to previous studies. However, we found that gaze behaviour modulates activation in an early face-processing region, suggesting that abnormal gaze behaviour may contribute to findings of dysfunction in this region during facial emotion perception in schizophrenia.

#### SINGLE-DOSE INTRANASAL OXYTOCIN ADMINISTRATION IS ASSOCIATED WITH LARGER AMYGDALA GREY MATTER VOLUME IN YOUNGER, BUT SMALLER VOLUME IN OLDER ADULTS

Håkan Fischer, S. Cortes Diana, Laukka Petri, N.T. Månsson Kristoffer - Stockholm university, Sweden; C. Ebner Natalie - University of Florida, USA

Introduction There is ample evidence regarding the role of intranasal oxytocin in social-cognitive and affective processing. Currently still understudied are the brain mechanisms underlying oxytocin's effects on structural neuroplasticity, such as in amygdala, a region central for social-cognitive and affective function and rich in oxytocin receptors. Further, emerging evidence suggests that oxytocin may target brain regions differently with age. Methods: Using a randomized, double-blind, placebo controlled within-group design, we investigated the extent to which a single-dose 40 IUs ntranasal oxytocin administration affects amyodala volume in younger (N = 47; age range 20-30 years) and older (N = 43; age range 64-76 years) adults 40 minutes prior to MRI scanning. Voxel based-morphometry was used to assess grey matter (GM) volume in the Computational Anatomy Toolbox implemented in SPM12. Voxel-wise analyses were small volume corrected on bilateral amygdala with a family-wise error (FWE) correction to determine statistical significance (controlling for total brain volume). Results: We found a significant condition x age interaction in the amygdala (xyz[-22,-6,-18], Z=4.25, pFWE=.001; xyz[22,2-,21], Z=3.08, pFWE=.055). In particular, for younger adults amygdala GM volume was larger in the oxytocin compared to the placebo group. In contrast, older adults' amygdala GM volume was smaller in the oxytocin group, relative to the placebo group. Discussion: These findings provide first evidence in humans that amygdala neuroplasticity is affected by acute single-dose intranasal oxytocin administration. Further, our data suggest age-differential effects of oxytocin on brain structure across adulthood. Future studies will have to determine the structure-function relationship pertaining to these effects.

#### B-27

## COMPUTATIONAL MODELING OF PREFERENCES AND INFERENCES ABOUT OTHER PEOPLE WITHIN RELATIONSHIPS

Michael Moutoussis - Wellcome Trust Centre for Neuroimaging, University College London, UK; Max Planck University College London Centre for Computational Psychiatry and Ageing Research, London, London, UK, Tobias Hauser - Wellcome Trust Centre for Neuroimaging, University College London, UK; Max Planck University College London Centre for Computational Psychiatry and Ageing Research, London, London, UK, Geert-Jan Will - Institute of Psychology, Leiden University, Leiden, The Netherlands; Leiden Institute for Brain and Cognition (LIBC), Leiden University, the Netherlands, Gita Prabhu - Max Planck University College London Centre for Computational Psychiatry and Ageing Research, London, London, UK, Karl Friston - Wellcome Trust Centre for Neuroimaging, University College London, UK; Max Planck University College London Centre for Computational Psychiatry and Ageing Research, London, UK, Raymond J. Dolan - Wellcome Trust Centre for Neuroimaging, University College London, UK; Max Planck University College London Centre for Computational Psychiatry and Ageing Research, London, UK, Raymond J. Dolan - Wellcome Trust Centre for Neuroimaging, University College London, UK; Max Planck University College London Centre for Computational Psychiatry and Ageing Research, London, London, UK

Computational models of inter-personal interactions have often used neuroeconomic games to study relationships. These models often condense relationship goals, and deduce feelings about others, via a few constants such as the 'guilt parameter' for unequal rewards. However, our preferences and goals depend on our beliefs about our partners' character situated within relationships. We suggest that such preferences are best modelled as joint (goal) probabilities, i.e. 'with someone like you, I hope our interaction to be thus'. Here, we present a rigorous computational model, broadly based on the 'active inference' approach. We used the model to construct computer avatars that interacted with people, in a variant of the iterated prisoner's dilemma. Real participants instructed the avatars about their own goals, or personality, in terms of joint preferences ('who I want us to be like') and initial beliefs about others. The model then proceeded by way of Bayesian inference including theory of mind (I act according to how you see my actions, but no deeper). The avatars then interacted with 24 people. Avatars behaved in a similar manner to the people that instructed them (p=0.008, r=0.53), but also

induced in others similar feelings (approval ratings) as their 'instructors' mentalized their own behaviour to induce ( $\rho$ =0.46, p=0.022). Modelling approval ratings gave a consistent account of interpersonal evaluations, that is, self-of-other vs. mentalized other-of-self. Our approach formulates interactions in a new way and lays important grounds to study the neural mechanisms underpinning how we judge each other's character and set our goals within relationships.

### B-28

# INVESTIGATING THE NEURAL AND COGNITIVE MECHANISMS BEHIND 'LATITUDES OF ACCEPTANCE' FOR THE OPINIONS OF OTHERS

Macrina A. Cooper-White, Daniel L. Ames, Shannon M. Burns, Kevin A.M. Tan, Grace S.R. Gillespie - University of California, Los Angeles; Matthew D. Lieberman

How do individuals decide whether other people's opinions are reasonable, and what are the social consequences of these decisions? Previous work on attitude change has explored how individuals categorize opinions as reasonable (falling inside their "latitude of acceptance") or unreasonable in the abstract. However, few studies have investigated how people evaluate opinions of specific individuals. Furthermore, little is understood about how these evaluations lead to downstream consequences. We conducted behavioral studies and an fMRI study (N=37) to explore these phenomena. In the behavioral studies, we observed that it is essential to measure participants' reactions to opinions associated with specific targets ("target-specific" opinions) in order to make predictions about their behavior toward hypothetical social targets. Participants consistently underestimated the number of opinions they would consider to be reasonable when asked in the abstract. Participants' judgments of target-specific opinions more consistently predicted social preferences as compared to abstract latitude measures. Similarly, in the fMRI study, we observed robust activations for contrasts between target-specific opinions judged by participants in the scanner as reasonable or unreasonable. Minimal differences in activation were seen between opinions that were sorted based on whether they fell inside or outside the latitude measured before scanning. We predicted that target-specific unreasonable opinions would activate negative affect related regions (insula, dACC), whereas target-specific reasonable opinions would recruit reward and self-processing related regions (VS, mPFC). Our results provide evidence for the former but not the latter, suggesting interventions for widening latitudes should focus on reducing negative affect versus invoking perceptions of similarity.

#### B-29

#### **REWARD PROCESSING AND LASTING WELLNESS**

Le-Anh Laurence Dinh-Williams, Norman Farb, Philip Desormeau - University of Toronto; Adam Anderson - Cornell University; Zindel Segal – University of Toronto

A major challenge in the treatment of Major Depressive Disorder (MDD) is its inherently chronic and recurring nature. Individuals who have recovered from a first depressive episode are at risk of experiencing 4 to 8 additional episodes during their lifetime. Identification of the mechanisms that support enduring MDD vulnerability has great public health significance. To date, most established vulnerability factors emphasize responses to negative events. However, MDD is also characterized by the tendency to discount the positive, including reduced neural responses to the anticipation and enjoyment of a reward. The issue is that there is limited understanding of the role of these rewardrelated responses in the recurrence of depression. To address this gap, we conducted a prospective, randomized, clinical study. Seventy-seven previously depressed participants were randomized to receive one of two evidence-based interventions developed to reduce the risk of relapse. Using fMRI, we examined BOLD reward-related responses during a gambling task before and after treatment, and monitored for the return of depressive symptoms during a two-year follow-up. Only regions that survived FWE corrections were retained. This design allowed us to identify common MDD vulnerability biomarkers that were present before treatment, resistant to change, and associated with the return of depression. This study found that individuals whom relapsed demonstrated chronic reductions in the ventromedial prefrontal cortex during the anticipation of a rewarding event. This finding suggests that

the ability to effectively track reward-related probabilities and its incentive value during periods of uncertainty is an important predictor of the return of depression.

## B-30

## INTERHEMISPHERIC PAIRED ASSOCIATIVE STIMULATION OF THE PREFRONTAL CORTEX JOINTLY MODULATES FRONTAL ASYMMETRY AND EMOTIONAL REACTIVITY

Samuel Zibman, Edan Daniel, Uri Alyagon, Abraham Zangen - Ben Gurion University of the Negev A major challenge in determining the role of frontal asymmetry in emotion is that while the correlation between deficits in lateralization and in cognitive functions has been established, a causal relationship has not been fully demonstrated. One technique that can be used to alter connectivity and establish causality in the brain is paired associative stimulation (PAS) which, through the coordinated stimulation of two regions by two TMS coils, targets the intervening connectivity. 27 healthy subjects were recruited for a three session, sham-controlled crossover study, receiving left to right PAS (LR-PAS), right to left PAS (RL-PAS) and sham during different weeks. The protocol consisted of 210 pulse pairs with an ISI of 8ms. Subjects performed the emotional Stroop task, assessed by measuring attentional bias, and brain activity was recording with EEG prior to and following the stimulation period. Our results reveal that LR PAS increases attentional bias while increasing right frontal asymmetry whereas RL PAS decreased the attentional bias while decreasing right frontal asymmetry (F(2.24) = 3.266, P=0.05and F(2.27) = 5.936, P=0.005 for attentional bias and frontal asymmetry respectively). These results confirm a relationship between frontal alpha asymmetry and attentional bias. This is the first demonstration of PAS's effectiveness in inducing cognitive changes by targeting interhemispheric PFC connectivity in a directional manner. Furthermore, by combining TMS with EEG, we provide a toolbox for evaluating effectiveness of PAS protocols that may facilitate development of novel therapies.

## B-31

#### HIGH STAKES ENHANCE REINFORCEMENT LEARNING

## Mahalia Prater Fahey, Catherine Insel, Mia Charifson, Gia Falcone, Leah H. Somerville - Harvard University

Reinforcement learning allows individuals to approach positive outcomes and avoid negative outcomes in the environment. This process involves using incremental feedback to update value representations about cues in the environment. Prior work suggests that feedback valence shapes learning, and individuals often learn better in the context of approaching financial gains than when avoiding financial losses. However, it remains unclear whether stakes, the relative value of prospective rewards and punishments, modulate reinforcement learning strategies. To test this, 33 young adults completed a probabilistic reinforcement learning task. In this task, participants repeatedly selected between fractals in a pair and received probabilistic monetary outcomes based on their choices. There were four fractal pairings that represented different monetary stakes: high gain (+50c/+0c), low gain (+25c/+0c), high loss (-50 c/-0c), and low loss (-25 c/-0c). Contrary to prior work, there was no effect of valence (gain/loss) on performance accuracy (proportion optimal choice), demonstrating that participants learned similarly from gains and losses. Notably, learning was impacted by stakes (high/low), and performance improved for high stakes incentives. Computational models identified how learning rate, a parameter measuring trial-by-trial sensitivity to feedback, varied as a function of motivational condition. Consistent with the performance effects, there was no significant difference between gain and loss learning rates. However, there was a significant difference between high stakes and low stakes learning rates, such that learning rates were higher in high stakes conditions. Together, these results suggest that individuals learn best when high value rewards and punishments are at stake.

## PERSON KNOWLEDGE DISRUPTS DISTRIBUTED NEURAL RESPONSES TO ATTRACTIVENESS

Tzipporah P. Dang, Bradley D. Mattan, Tianyi Li, Jennifer T. Kubota, Jasmin Cloutier - University of Chicago

Using partial least squares analysis (PLS), we examined the degree to which person knowledge availability would impact brain networks supporting attractiveness evaluations. Participants (N=45) explicitly evaluated the attractiveness of familiar actors (person knowledge present) and novel models (not associated with person knowledge). Analyses focused on the following four conditions: attractive actors, unattractive actors, attractive models, and unattractive models. Task PLS revealed a significant latent variable (LV) (p<.001) that explained 79.616% of the crossblock covariance. Results indicated two separate networks preferentially responsive to attractive actors and models and to unattractive models, respectively. Notably, responses to the unattractive actor condition did not reliably contribute to the LV. For unattractive models (but not actors), we observed increased co-activation in the mentalizing network (e.g., bilateral TPJ, precuneus). For attractive models and actors, we observed increased co-activation between regions involved in face processing (e.g., fusiform) and person evaluation (e.g., rectal gyrus in the OFC). Notably, the distributed neural responses for attractive actors and models were similar despite differences in person knowledge availability between these conditions. Taken together, our results indicate that the distributed neural response during evaluations of attractiveness can differ as a function of person knowledge availability, particularly for targets low in attractiveness.

#### B-33

#### SAME, SAME BUT DIFFERENT? EVIDENCE ACCUMULATION ACROSS MORAL AND NON-MORAL DOMAINS

## Philip Pärnamets - Karolinska Intstitutet, Stockholm, Sweden; Lars Hall, Petter Johansson - Lund University, Lund, Sweden

Much human decision making, including that between moral or social alternatives, can be characterized as based on gradual accumulation of evidence, formally described by neutrally plausible sequential sampling models. While this has previously been documented in experiments focusing on individual domains, less is known how the same participants' decision process can be characterized comparing across domains. Sixty participants made a total of 300 binary choices each across three decision domains- economic, social and moral. The domains differed in what alternatives where given; snack food items, charitable donations or positive moral action descriptions. The economic and social choices were additionally incentivized. Participants had free response times and their eye gaze was measured concurrently during choices. We found that participants in all three domains were highly sensitive to the underlying valuation differences, producing highly similar choice curves, and, similar but linearly shifted, response time profiles. Economic decisions were fastest and most accurate, while moral decisions slowest and least accurate when compared to initial ratings of alternatives. Computational modeling, using the drift diffusion framework, indicated that error rate increases, particularly for moral choices, derive from a combination of increased decision barriers with a greater difficulty to sample evidence per unit time (lower drift rates for similar value differences). The effects of visual fixation patterns on drift were largest for economic decisions and smallest for moral decisions. Our results suggest that the same computational process captured by a simple computational model of choice can explain the decision and response time patterns in all tasks.

#### **B-34**

### A SOCIAL ANALGESIC? ACETAMINOPHEN DECREASES RESPONSIVENESS TO THE PAIN OF OTHERS

*Dominik Mischkowski, Jennifer Crocker, Baldwin M. Way - The Ohio State University* For over a decade, functional magnetic resonance imaging (fMRI) showed that physical pain and the experience of others' pain activated similar brain areas in the anterior insula and the dorsal anterior cingulate cortex, suggesting that the psychological experiences of pain and empathy for pain rely on overlapping brain mechanisms. However, recent advances in fMRI data analysis based on multivoxel pattern analysis (MVPA) have questioned this conclusion: Pain and empathy for pain may share adjacent, but not overlapping neuronal representations. To advance this debate, other methodological approaches are needed to test the relation between physical pain and responsiveness to others' pain. Participants in four double-blind, placebo-controlled pharmacological studies received 1000 mg acetaminophen or a placebo and completed measures of empathy (in two of those studies) and aggression (in all four studies). Integrating findings across studies, we found that acetaminophen relative to placebo reduced perceived pain, experienced distress, and empathic concern when witnessing others in pain, both in hypothetical scenarios and actual events in the lab. Furthermore, when meta-analyzing studies acetaminophen increased the willingness to inflict painful, but harmless noise blasts on other study participants, indicating increased aggression. These findings provide additional evidence for the important role of physical pain in regulating interpersonal processes. Furthermore, they raise serious questions about the broader - and potentially harmful - societal sideeffects of acetaminophen, which about a quarter of US-Americans adults consume each week. In future studies, we will use fMRI to test the effect of acetaminophen on empathy and aggression on the neuronal level.

#### B-35

# EXPLORING THE ROLE OF THE BRAIN'S DEFENSIVE SYSTEM IN PERSONAL SPACE REGULATION

## Joana B Vieira, Stephen R Pierzchajlo, Derek GV Mitchell - Brain and Mind Institute, University of Western Ontario

In social interactions, humans regulate interpersonal distance to preserve personal space and avoid the discomfort that arises when it is breached, suggesting defensive mechanisms might be involved in personal space maintenance. This study characterized the involvement of the brain's defensive system in response to social and non-social stimuli, and its role in interpersonal distance regulation. Thirty healthy volunteers underwent fMRI scanning while viewing looming or receding faces (Social condition) and insects/arachnids (Non-social condition), and rated their level of discomfort upon watching them. Faces were either neutral (Low threat) or angry (High threat), and insects/arachnids were colourful beetles (Low threat) or tarantulas/scorpions (High threat). Preferred distance was assessed behaviourally by asking participants to adjust the size of the same stimuli on a computer screen outside the scanner. Results showed that, irrespective of threat, looming social and non-social stimuli both elicited enhanced activation in the midbrain, a region that is critically involved in defensive responses. However, functional connectivity analysis revealed midbrain activation was more strongly coupled with activity in the amygdala, ACC, thalamus, caudate and SMA in response to looming social versus nonsocial stimuli. Relative to non-social stimuli, and controlling for level of discomfort, looming faces also elicited greater activation in the FFA, TPJ, and dIPFC. TPJ activation correlated with preferred distance to faces (r=-.44, p=.02), but not insects/arachnids. These findings suggest the involvement of partially dissociable circuits in response to social versus non-social stimuli, as well as in the regulation of preferred distance.

#### B-36

## PSYCHOPHYSIOLOGICAL CORRELATES OF LOW AND HIGH APPROACH MOTIVATION SADNESS.

Olga K. Kamińska, Mikołaj Magnuski - University of Social Sciences and Humanities; Cindy Harmon-Jones - University of New South Wales; Aneta Brzezicka - University of Social Sciences and Humanities; Eddie Harmon-Jones - University of New South Wales

Sadness is widely considered as a negative emotion with low arousal. But results of studies on psychophysiological and cognitive correlates of sadness exhibit inconclusive effects, which are often contradictory. In this study, we hypothesized that sadness is heterogenous affective state, which can be characterized by either low or high approach motivation. Additionally, we examined the

neurophysiological underpinnings of those two states based on the frontal alpha activation, which has been found to be related to valence and motivational direction of emotions.

To test these ideas, we first measured 41 participants EEG activity during 4 minutes of resting baseline EEG. Next, participants were exposed to a neutral state induction. Afterwards, depending on the randomly assigned condition, participants were exposed to stories designed to induce either low or high approach motivation sadness (3 stories in each condition). After each story, one minute of EEG signal with eyes closed was recorded. We analyzed spectra from frontal regions in alpha frequency range centered with respect to individual alpha frequency. The interaction was tested by comparing differences between pre and post-story spectra between motivation conditions. To correct for multiple comparisons, we used cluster-based permutation tests revealing significant difference between the conditions (p=0.001). For high approach motivation sadness condition after exposure to the stories frontal alpha power was elevated, while in low approach motivation sadness it was reduced both in comparison to neutral story. These results suggest that sadness can be differentiated due to the intensity of approach motivation.

#### B-37

# MVPA REVEALS DECISIONS TO CONSUME OR SHARE NEWS INVOLVE DISTRIBUTED PROCESSING IN MEDIAL PREFRONTAL CORTEX

Jacob M Parelman, Bruce P Doré, Elisa C Baek, Christin Scholz, Matthew B O'Donnell, Emily B Falk -University of Pennsylvania

A critical skill for humans is the ability to discern information as relevant for oneself and for others. Previous studies suggest that this ability is linked to the medial prefrontal cortex (mPFC). Studies of univariate mean activation differences in mPFC suggest a self-other gradient in processing, in which self-related processing occurs more ventrally and other-focused thinking more dorsally, though both processes have been localized along the full medial wall. One possibility, then, is that univariate mean activation analyses may obscure the complexity of these psychological processes. To investigate the role of different portions of mPFC in decisions to select and share information, we used fMRI to measure brain responses to article summaries, estimating both univariate and multi-voxel patterns (MVPs) within the vmPFC and dmPFC. Participants were asked to consider reading the article themselves ("select"), sharing the article with others ("share"), or to assess the article content ("control"). We used machine learning to classify conditions on the basis of univariate activity and MVPs. When selecting articles to read oneself (vs control), classification based on univariate activity performed above chance within the vmPFC but not the dmPFC, whereas classification based on MVPs performed above chance for both vmPFC and dmPFC. Similar univariate and MVP classification performance was found for the share (vs control) condition in the vmPFC and dmPFC. These results suggest that both ventral and dorsal mPFC are involved in self-focused decisions to consume information and socially-focused decisions to share information, expanding prior models of self- and social-judgment within the mPFC.

#### B-38

#### SIMULTANEOUS REPRESENTATION OF ORTHOGONAL GROUP MEMBERSHIPS

*Jeremy C. Simon, John C. Ksander, Angela H. Gutchess, Jennifer N. Gutsell - Brandeis University* Most social targets share some but not all social categories with their perceivers, requiring perceivers to reconcile conflicting social group membership information. Recent fMRI research suggests that competing "in-groups" and "out-groups" are both expressed in neural coding (Cikara, Van Bavel, Ingbretsen, & Lau, 2017). We directly tested the relationship structure of these representations using an electroencephalographic (EEG) dataset in which targets' minimal group membership was orthogonal to race (black or white; Simon & Gutsell, under review). White participants (n=36) assigned to minimal groups watched videos of black and white in-group and out-group members performing the same motor activity. Using a Representational Similarity Analysis framework (RSA; Kriegeskorte, Mur, & Bandettini, 2008), we created hypothetical EEG similarity structures under two alternate assumptions: group information is either strictly orthogonal, or it reflects graded target dissimilarities. We evaluated these models against the EEG timecourses to test representational orthogonality, and whether participants represented racial or minimal groups more dissimilarly. We found that orthogonal models robustly coded for both group types throughout the timecourse (race: 100% of timecourse, p<.001; minimal group: 97.86% of timecourse, all ps<.017). However, for both orthogonal and graded models, target representations were most dissimilar according to shared race. These results suggest that both group memberships were represented simultaneously and, despite behavioral responses indicating the salience of minimal groups, that there was a greater distinction between racial group representations. Thus conflicting group memberships were simultaneously and asymmetrically encoded.

#### B-39

# PERCEIVING SOCIAL INTERACTIONS SUPPRESSES CONNECTIVITY BETWEEN THE DEFAULT MODE NETWORK AND VENTRAL STRIATUM

Hyden Zhang, Vinod Venkatraman, David V. Smith - Temple University, Philadelphia, USA The striatum and cortical regions within the default mode network (DMN) play key roles in disparate domains of social cognition. For example, the striatum is often implicated in processing social rewards while DMN is associated with interpreting social stimuli. Yet, it remains unclear how perception of social interactions impact striatal connectivity with the DMN. Corticostriatal interactions encode multiple types of reward and are central to cognition, but their role in social cognition has remained ambiguous. To address this conceptual gap, we analyzed network connectivity in 186 unrelated subjects' fMRI data from the Human Connectome Project. All participants performed the Frith-Happe animation task frequently used to study theory of mind. In this task, participants were presented with alternating blocks of social and random moving shapes. We first compared neural responses to social blocks and nonsocial blocks. This analysis revealed increased activity within the regions of the DMN (e.g., temporoparietal junctions and medial prefrontal cortex) for social blocks compared to random blocks. We next conducted a network psychophysiological interaction analysis using the DMN to assess taskspecific network connectivity. Our connectivity results indicated that the ventral striatum showed diminished connectivity to the DMN during social blocks compared to the random blocks. demonstrating that coupling between the ventral striatum and DMN is sensitive to social context. This finding suggests that corticostriatal interactions play a role in social perception and further develops the conceptual link between reward processing and social cognition.

#### B-40

## I'M SO HAPPY FOR YOU! FAMILIARITY INFLUENCES A NEURAL INDEX OF REWARD TO OTHER'S OUTCOMES IN A GAMBLING TASK

Aziz Abubshait, Paul Beatty, Craig McDonald - George Mason University; Cameron Hassall, Olav Krigolson - University of Victoria; Eva Wiese - George Mason University

Perceived ownership, or the extent to which people act on behalf of themselves or others, influences social-cognitive processes involved in reward processing. Specifically, individuals playing gambling games experience positive outcomes for themselves as more rewarding than positive out-comes that affect unfamiliar others. This differential experience has been shown to be indexed by an eventrelated brain potential (ERP) component termed the reward positivity (RewP). What has not been investigated is the extent to which RewP is modulated by familiarity with others and the degree to which social bonding takes place between interaction partners. Since social bonding is associated with higher oxytocin release, we hypothesize that reward potentials of observing positive outcomes for others varies as a function of familiarity with the "other". Here, participants received positive outcomes of a gambling task for themselves (selfownership) or for the robotic agent Cozmo (other-ownership), with whom they either did (social bonding) or did not interact with (no social bonding) before the gambling task. We hypothesized that participants who bonded with Cozmo would show larger RewP amplitudes than participants who did not. Preliminary data suggest that participants who bonded with

Cozmo show larger RewP amplitudes than participants who did not. Also, participants who did not bond with Cozmo, showed larger RewP when gam-bling for themselves. No differences in RewP are found between participants who won for themselves and participants who won for Cozmo after familiarization. These results suggest that social bonding and familiarity influences the degree to which positive outcomes are perceived as rewarding.

## B-41

# EYE-TRACKING AND COMPUTATIONAL MODELLING REVEALS NOVEL INSIGHTS INTO ALTRUISTIC CHOICE UNDER TIME PRESSURE.

Yi Yang Teoh - University of Toronto, Toronto, Canada; Ziqing Yao - South China Normal University, Guangzhou, China; Vignash Tharmaratnam, William Cunningham, Cendri Hutcherson - University of Toronto, Toronto, Canada

Why are some people generous and others, selfish? Research on altruistic choice has often revolved around whether human beings are intuitively and automatically pro-social or if self-control is required to override selfish impulses. The available research using time pressure to answer this question yields contradictory results, with some reporting increases in pro-sociality and others reporting decreases. Recently developed computational models provide an alternative account (Hutcherson et al, 2015) and indicate that, beyond changes in preferences, choice outcomes could depend on other factors. To disentangle these possibilities, we applied computational model-fitting to a series of four studies manipulating time pressure within dictator game paradigms. In studies 1-3, we found little overall change in generosity under time pressure. Computational modelling also showed little change in preferences and only disproportionate increase in noise. However, further analyses revealed consistent and systematic individual differences in the effects of time pressure on altruistic choice; selfish individuals became more selfish while generous individuals became more generous. We hypothesised that time pressure may have exacerbated attentional biases during choice. To test this hypothesis, we included eye-tracking in study 4. Results suggested that increased selfishness was associated with biased initial fixations on self-related value-stimuli and that time pressure exaggerated this bias. These findings have important implications in understanding altruistic choice, suggesting that time pressure results in re-prioritization of information gathering, exacerbating individual biases and preferences.

## B-42

## EARLY ADVERSITY DISRUPTS THEORY OF MIND AND ITS NEURAL BASES

Charlotte Heleniak, Kelly Sambrook, Katie, A. McLaughlin - University of Washington Children who experience interpersonal violence are at markedly elevated risk of perpetrating violence later in development. This is concerning, given that one-third of American youth have been exposed to violence by the time they reach adolescence. Although atypical emotional processing has long been proposed as a determinant of psychopathology following violence exposure, scant research has examined aspects of social cognition as potential mechanisms in the cycle of violence. To that end this study examined the impact of interpersonal violence exposure on the development of cognitive and affective theory of mind (ToM), and their neural bases, as a mechanism linking interpersonal violence exposure and aggressive behavior. Using fMRI, we assessed behavioral and neural responses during cartoon vignettes requiring cognitive ToM, affective ToM or physical feature comprehension (control) in 50 adolescents (14-19 years, 25 with violence exposure). Interpersonal violence exposure predicted slower reaction time (RT) during the affective, but not cognitive, condition of the ToM task. Slower affective ToM RT was also associated with externalizing psychopathology. Interpersonal violence exposure and aggression were associated with diminished recruitment in brain areas associated with representing the emotions of others in socially complex situations including the temporoparietal junction and the superior temporal sulcus during affective ToM, as well as diminished recruitment of cognitive control brain regions involved in monitoring of subtle and conflicting social information including the dorsolateral prefrontal cortex during both affective and cognitive ToM. Results highlight the importance

of considering social cognitive processes in models of the developmental consequences of violence exposure in children.

### B-43

#### ENDOGENOUS OXYTOCIN RELEASE DURING AFFECTIVE TOUCH

Giovanni Novembre - Center for Social and Affective Neuroscience, Linköping University, Sweden; Linda Handlin, Helene Lindblom - University of Skövde, Skövde, Sweden; Robin Kämpe, India Morrison - Center for Social and Affective Neuroscience, Linköping University, Sweden Oxytocin has been implicated in numerous aspects of social affiliation, particularly social touch interactions. However, little is known about how endogenously-released oxytocin contributes to social touch interactions in humans, and what cortical regions may be implicated. To investigate this, we collected serial, within-subject samples of plasma oxytocin (9 samples/participant) and stress-related cortisol (7 samples/participant) while female participants (n = 35) were caressed, either by their male romantic partner or by an unfamiliar male stranger, who was perceived as trustworthy. Half of the participants were stroked by their partner in the first 7-minute run of the experiment, and by the stranger in the second run, with this order reversed for the other half. Plasma oxytocin showed significant increases from baseline during caresslike touch, with levels depending on who was touching and when. Oxytocin levels increased from baseline for partner, but not stranger, touch in the first run. Participants who experienced partner before stranger touch showed a greater increase for stranger touch during the second run, compared with those who experienced "stranger first." The "partner first" group also rated stranger touch as more pleasant than the "stranger first" group, and showed lower plasma cortisol levels. FMRI results did not reveal a relationship of cortical somatosensory and operculoinsular regions with plasma oxytocin, but discriminated between arm and palm touch. Taken together, these findings indicate that partner touch boosts plasma oxytocin and feelings of pleasantness, reduces stress responses, and may even change the gain on receptivity for touch from an unfamiliar yet non-threatening person.

#### **B-44**

PRIORITIZED NEURAL CODING OF EMOTION CUES DURING PERCEPTUAL DECISION-MAKING Emilie Meaux - Laboratoire de Neurosciences Cognitive - Ecole Normale Supérieure, Paris, France; Marwa El Zein - Institute of Cognitive Neuroscience - UCL, London, UK; Valentin Wyart, Julie Grezes -Laboratoire de Neurosciences Cognitive - Ecole Normale Supérieure, Paris, France Animals including humans are very good at detecting and categorizing emotions in conspecifics, even based on ambiguous perceptual cues. It remains unclear whether the processing of emotion cues through decision making engages specific neural substrates or whether it relies on the same mechanisms used to process other, non-social, cues. To address this guestion, we designed a perceptual detection task in which we manipulated orthogonally the relevance and ambiguity of emotion vs. non-social cues. We presented morphed facial displays of emotion (from neutral to anger) on top of a colored background (from grey to violet). Participants were asked to report the presence or absence of either emotion (anger) or color (violet) in the stimulus, while ignoring the other taskirrelevant dimension. Importantly, we equalized detection sensitivity across dimensions using an adaptive titration procedure. Quantitative psychometric modeling of behavior and electrical brain activity revealed that emotion cues benefit from a prioritized neural coding. First, we show that the neural coding of perceptual evidence arises earlier when the decision concerns emotion rather than color. Second, when emotion cues become decision-irrelevant, neural signatures of top-down attention occur earlier and stronger - suggesting an increased cognitive load to inhibit the socially-relevant yet decision-irrelevant sensory cues. Third, the neural coding of emotion cues at early latencies varies across individuals as a function of social anxiety. Together, these preliminary findings indicate a selective, prioritized neural representation of socially-relevant perceptual cues during perceptual decision-making.

#### **NEURAL CORRELATES OF PRIDE: THE IMPORTANCE OF SUBJECTIVE CONTROL**

David S Stolz, Janine Baumann, Laura Müller, Sören Krach, Frieder M Paulus - Social Neuroscience Lab I SNL, Lübeck University

The self-conscious emotion authentic pride (AP) is relevant for motivating behavior and building selfesteem. AP is experienced when individuals attribute positive events to unstable, internal and controllable causes (Tracy & Robins, 2007). We designed an experimental paradigm aiming at manipulating the level of subjective controllability of an outcome while keeping the probability of positive and negative outcomes across conditions constant. Results from two separate samples (total N = 68) show that pride (as compared to happiness) ratings for positive outcomes were higher in conditions that were perceived as more controllable. In addition, fMRI data showed activations within the reward circuitry (accumbens, ventromedial PFC) specifically for positive outcomes. Independent of reward value, outcomes from events that were perceived as controllable induced stronger activations of cortical midline structures such as the rostral anterior cingulate cortex (rACC) and the precuneus. Furthermore, we found a trend towards increased functional connectivity between left rACC and left nucleus accumbens for positive as compared to negative outcomes. Additionally, the activation of the precuneus in response to positive, controllable outcomes was associated to individual differences in the experience of AP in everyday life. By employing a new paradigm that is not based on imagination techniques or vignettes, we substantiate the theoretically assumed importance of subjective controllability for pride experiences, and show that these might be partly mediated by increased connectivity between cortical midline structures and reward circuitry. In sum, we underline that to understand psychological well-being it is relevant to consider individuals as agents seeking to take influence.

#### B-46

## THE SOOTHING FUNCTION OF SOCIAL TOUCH: ELECTROPHYSIOLOGICAL AND PHARMACOLOGICAL STUDIES ON THE SOCIAL MODULATION OF PAIN

Aikaterini Fotopoulou, Mariana van Mohr – University College London; Krahé Charlotte – King's College London

Social touch has important physical and mental health benefits in development and adulthood. The mediating neurophysiological and epigenetic mechanisms are well characterised in non-human animals, but less is known about how social touch attenuates the effects of physical and social threat in humans. We present a set of studies on the role of a specific type of social-affective touch, mediated by the so-called CT neurophysiological system, on the perception of pain, as captured by subjective ratings and early (N1) and later (N2-P2) evoked brain responses to noxious stimuli recorded using EEG (laser-evoked potentials, LEPs). We found that this affective touch (versus neutral touch) from a romantic partner (N = 32), reduced subjective pain ratings and attenuated both N1 and N2-P2 LEPs. While higher-order pain regulation by activity in areas such as the anterior insula and the anterior cingulate cortex has been shown in previous fMRI studies, this is the first study to show early neural modulation of pain by active, partner touch. Interestingly, in previous studies, we found that similar touch by a stranger, where social trust and attachment cannot be assumed, attenuated feelings of social exclusion during the Cyberball paradigm (von Mohr et al., 2017) and also modulated early N1 responses to noxious stimuli but only in interaction with individual attachment style differences (Krahé et al. 2016). We discuss implications for neurophysiological mechanisms of embodied social support, particularly in light of our previous work showing that intranasal oxytocin attenuates similar neurophysiological responses to pain (Paloyelis et al., 2016).

# SINGLE-DOSE INTRANASAL OXYTOCIN ADMINISTRATION REDUCED BRAIN ACTIVITY TO NEGATIVE EMOTION DISPLAYS IN YOUNGER AND OLDER MEN AND WOMEN

S. Cortes Diana, Månsson Kristoffer NT, Laukka Petri - Stockholm University; Ebner Natalie C. -University of Florida; Fischer Håkan - Stockholm University

Findings suggest that intranasal administration of oxytocin improves emotion recognition. The brain mechanisms underlying these effects, however, are underexplored. A major caveat in this line of work is that it is almost exclusively based on young males, which limits current knowledge and potential for generalizability across gender and age. Adopting an adult developmental approach, the present research addresses this research gap by determining the effects of a single-dose intranasal oxytocin administration on recognition of positive and negative stimuli in younger and older men and women. Utilizing a randomized, double-blind, placebo-controlled, within-subjects study design, 44 younger (mean age 25, 50% women) and 44 older (mean 70, 50% women) healthy adults participated in two fMRI sessions during which they viewed dynamic videoclips of positive and negative emotions displayed. Forty minutes before scanning, participants either self-administered 40 IUs of oxytocin or placebo. Oxytocin-induced brain activity reductions during exposure to negative (relative to positive) stimuli in bilateral fusiform gyrus (Z>4.16, pFWE4.53, pFWE3.69, pFWE4.34, pFWE <0.002), insula (Z>3.69, pFWE<0.045), and superior temporal gyrus (Z>4.34, pFWE<0.008), and, right-lateralized reductions in amygdala (Z=3.73, pFWE=0.005) were found. There were no interaction effects between age, gender and oxytocin. These findings are in line with previous studies showing decreased brain activity to negative stimuli after intranasal oxytocin administration and suggest that this pattern generalizes to older populations and women. Future studies with larger samples sizes should replicate and extent these preliminary results broader aspects of socioemotional functioning and prosocial behavior in older men and women.

## B-48

## **REGULATION OF FOOD CRAVING IN BINGE EATING DISORDER**

Rebecca G Boswell, Wendy Sun, Hedy Kober - Yale University, New Haven CT USA Binge eating disorder (BED) is marked by discrete episodes of eating an unusually-large amount of food while experiencing loss of control. A candidate mechanism underlying BED is failed regulation of food craving. We have previously shown that cognitive strategies modify neural responses to food and drug-related cues and reduce eating behavior. However, no previous work has investigated these processes in BED, or compared them in BED to overweight and lean controls (OC/LC). We administered the Regulation of Craving (ROC) task to well-matched BED, OC, and LC (N=78) during fMRI. On each trial, participants were presented with photographs of high-calorie foods and instructed to (1) LOOK: "respond naturally," or (2) NEGATIVE: "think of the long-term negative consequences of consuming the food." Then, they rated their craving. Participants also completed a "taste test" postscan, where their food consumption was surreptitiously measured. Across participants, there was greater activation in the inferior frontal gyrus (IFG) and less activation in the striatum during regulation (NEGATIVE>LOOK). There were group differences in IFG activation: (1) BED spontaneously recruited IFG less (LOOK) and (2) BED and OC recruited IFG less than HC during regulation (NEGATIVE). Whole-brain correlations showed that the amount of activation in the IFG during regulation (NEGATIVE>LOOK) was associated with eating during the "taste test", such that more IFG activation was associated with lower calorie consumption (r=.26, p<.001). These results demonstrate group differences in ROC and a relationship between neural activation during regulation and eating behavior. Our findings have important clinical implications and applications.

### A BOOST IN SELF-ESTEEM PREDICTS INCREASED SOCIAL LEARNING

Verena Ly, Charlotte Van Schie - Leiden University; Jennifer Cook - University of Birmingham; Bernet Elzinga - Leiden University

A 'self-esteem system' has been proposed to regulate social bonding, which is essential to human survival and well-being. This regulatory role involves moment-to-moment adjustments of self-esteem in response to perceived social acceptance and rejection. It remains unclear whether these fluctuations in self-esteem may in turn shape our social decisions. Here, we investigated whether social feedback influences self-esteem and subsequent social learning in a behavioral experiment involving two confederates. Eighty-seven participants underwent a social feedback paradigm, in which they received either positive (n=43) or negative feedback (n=44) from confederate 1 based on an interview. Subjective ratings of self-esteem were assessed before and after the social feedback paradigm to determine changes in self-esteem in response to the feedback. Subsequently, participants performed a social learning task, which assessed how much individuals learned from, supposedly, social information given by an 'advisor' (confederate 2) versus non-social information (individual experience based on outcome history). We found that positive (versus negative) social feedback increased selfesteem. Interestingly, the impact of positive (versus negative) social feedback on self-esteem predicted learning from social (versus non-social) information. Specifically, a higher increase in self-esteem, as induced by positive (versus negative) social feedback, was associated with increased learning from social (versus non-social) information. These data suggest that increases in self-esteem in response to perceived positive social feedback can positively affect social learning. In other words, the inclination to learn from social information may involve interactions with a system that monitors and updates our selfevaluative beliefs.

#### B-50

# FOOD PICTURES BOTH ATTRACT ATTENTION AND DISTRACT PERFORMANCE ON A MODIFIED FLANKER TASK

#### Catherine Norris, Emma Close - Swarthmore College

A healthy lifestyle involves attention to diet, exercise, and other habits, as well as the ability to control impulsive behavior that may undermine healthy choices. Food in particular may be an emotional stimulus that both attracts attention and distracts from performing a difficult task. In the current study, we examined the effects of food stimuli on performance on a modified Flanker task. Event-related brain potentials (ERPs) were collected while participants responded to a series of Flanker stimuli superimposed on pictures of food or non-food items. Participants exhibited a typical Flanker effect, as they were faster to respond to congruent versus incongruent Flanker stimuli. In addition, they were faster to respond when Flanker stimuli were superimposed on food (versus non-food) pictures, indicating that food pictures focused their attention. Accuracy was highest for congruent Flanker trials, regardless of picture content. Participants were less accurate on incongruent Flanker trials, particularly when they were superimposed on food (versus non-food) pictures also distracted from their ability to respond to difficult Flanker stimuli. Results from the N2 and P3 components of the ERP, relating to attentional control and allocation of attention resources, respectively, generally supported our conclusion that food pictures may both focus attention on an easy task and distract attention from a difficult task.

# SOCIAL ANXIETY AND MENTALIZING IN MIDDLE CHILDHOOD: EXPLORING BRAIN-BEHAVIOR CORRELATIONS IN A SOCIAL-INTERACTIVE CONTEXT

Rosenthal Tova - Department of Psychology, University of Maryland, College Park; Alkire Diana -Neuroscience and Cognitive Science Program, University of Maryland, College Park; Warnell Katherine - Department of Psychology, Texas State University; Redcay Elizabeth - Department of Psychology, University of Maryland, College Park

Individuals with social anxiety (SA) struggle with social interactions and perform worse than control groups on mentalizing tasks, but it remains unclear how mentalizing relates to their social difficulties. Furthermore, though SA often onsets during childhood, few studies have examined how the brain's developing mentalizing system is affected by SA traits, and none have done so within a socialinteractive context. The current fMRI study examined children (n=27) aged 8-12 who engaged in mental and non-mental reasoning about either a live chat partner or story character in a 2x2 design. Participants also completed the Social Anxiety Scale for Children - Revised, which produces scores for total anxiety and three subscales: Social Avoidance and Distress-Specific to New Peers or Situations (SAD-New), Social Avoidance and Distress-General (SAD-General), and Fear of Negative Evaluation. To identify how mentalizing activity varied as a function of SA, beta values were extracted from regions of interest identified by the main effect of mentalizing. Individual differences in right temporoparietal junction (RTPJ) activation to mental vs. non-mental reasoning significantly correlated with SAD-New and total anxiety when correcting for multiple comparisons. Participants low in SA displayed greater RTPJ activation to mental than non-mental conditions, while higher-SA participants showed reduced differences between conditions. Higher-SA participants (SAD-General) also showed reduced differences between peer and character conditions in the left superior temporal sulcus. These results may suggest that SA involves constant heightened mentalizing in the form of self- and other-monitoring during social interactions, and this could lead to difficulties with mentalizing and social interaction.

#### B-52

### DISSOCIABLE ROLES FOR THE DMPFC AND RTPJ IN SELF-OTHER PROCESSING: A HIGH-DEFINITION TDCS STUDY

Andrew K Martin, Jasmine Huang, Marcus Meinzer - University of Queensland, Brisbane, Australia The dorsomedial prefrontal cortex (dmPFC) and right temporoparietal junction (rTPJ) are engaged during higher-order social tasks requiring the integration and distinction between self and otherrepresentations. However, little is known about whether the regions have dissociable roles. 52 healthy young adults (18-36yrs) were stratified into two groups; 26 received dmPFC anodal HD-tDCS and 26 received rTPJ anodal HD-tDCS in double-blind, sham-controlled, crossover studies. Both groups completed a social cognitive battery measuring self-other processing across implicit and level one and two explicit visual perspective-taking (VPT) tasks, as well as self and other encoding effects on episodic memory. Anodal stimulation to the dmPFC increased the integration of other into self for both level one and two explicit VPT tasks, indexed by a greater interference effect of the allocentric perspective when judging a scene from the egocentric perspective. No such effect was identified for implicit VPT. Anodal stimulation to the dmPFC removed the bias towards self-encoded memories, without affecting overall memory performance. Anodal stimulation to the rTPJ increased inhibitory control of the egocentric perspective, indexed by a reduced interference of the egocentric perspective when taking the allocentric perspective only during level two VPT. No stimulation effects were identified for implicit or level one VPT. Anodal stimulation to the rTPJ had no effect on self or other encoded memories. This is the first causal evidence for dissociable roles of the dmPFC and rTPJ in self-other processing in a task-specific manner. The results have important implications for understanding and potentially modulating the social brain.

# FEEL RIGHT OR FEEL GOOD? COMPARING AN INDUCED 'EXPERIENTIAL EMOTION REGULATION' TO A 'COGNITIVE REAPPRAISAL' IN EMOTIONAL PROCESSING

Yulin Wang - Vrije Universteit Brussels; University of Gent; Debo Dong - University of Electronic Science and Technology of China; Luis, Carlo Bulnes - Université Libre de Bruxelles; Ilse Van Diest -Catholic University of Leuven; Daniele Marinazzo - University of Gent; Marie Vandekerckhove - Vrije Universteit Brussels

Adaptive emotion regulation (ER) is conducive to physical and mental health, whereas dysfunctional ER is central to psychopathology. Emotion can be regulated with 'experiential ER', which refers to the affectively attending, acknowledging and getting awareness of the bodily felt feeling in an accepting and welcoming way. Also, emotion can be regulated with 'cognitive reappraisal' by which reinterpretations of a situation can change one's emotions about it. To address the effectiveness of these two ER strategies, a series of experiments has been conducted in our lab. Study 1 compared both experiential ER and reappraisal relative to a neutral ER baseline and its impact on sleep physiology in 43 healthy participants. Stress was triggered with an emotional failure induction, after which ER was induced twice. The use of reappraisal resulted in more fragmented and restless sleep when compared to experiential ER or neutral baseline. Study 2 further compared experiential ER and reappraisal based on their repeated usage in 69 healthy female participants using physiological measurements. Compared to watch negative condition, the skin conductance response was decreased by experiential ER in the third time (p=0.017) while the zygomatic activity (p=0.012) and respiration amplitude (p=0.016) were increased by reappraisal in the third time. Our results suggested experiential ER works effectively in decreasing the arousing level of emotions after a repeated usage, might be effective in treating insomnia related hyperarousal while cognitive reappraisal works effectively in creating a positive way of feeling.

#### **B-5**4

### AN ERP INVESTIGATION OF CHANGES IN THE NEGATIVITY BIAS WITH AGE FOR SELF-RELEVANT AND NON-SELF-RELEVANT STIMULI

Eric C. Fields - Boston College, Chestnut Hill, MA, USA; Brandeis University, Waltham, MA, USA; Holly J. Bowen - Boston College, Chestnut Hill, MA, USA; Katelyn R. Parisi - Boston College, Chestnut Hill, MA, USA; Brandeis University, Waltham, MA, USA; Ryan T. Daley - Boston College, Chestnut Hill, MA, USA, Angela H. Gutchess - Brandeis University, Waltham, MA, USA; Elizabeth A. Kensinger - Boston College, Chestnut Hill, MA, USA; College, Chestnut Hill, MA, USA; College, Chestnut Hill, MA, USA, MA, USA; Elizabeth A. Kensinger - Boston College, Chestnut Hill, MA, USA; College, Chestnut Hill, Chestnut

Young adults often show a bias for negative information in attention and memory, but this negativity bias is reduced or eliminated in older adults. In ERP studies, the emotion-related late positive component (LPC) shows a negativity bias in younger adults, but equal amplitude to positive and negative images in older adults. In other work, the effect of emotion on the LPC has been shown to interact with the self-relevance of stimuli, but this effect has only been investigated in young adults. The present work explored whether self-relevance modulates changes in the negativity bias with age. Participants read two-sentence social vignettes in 2nd person (self condition) or 3rd person (other condition). We examined ERPs time-locked to a positive, negative, or neutral critical word in the second sentence. Main effects of emotion replicated previous findings with a negativity bias for younger adults while older adults showed equally increased amplitude to negative and positive words. In younger adults, this pattern was driven by negative words in the self-relevant condition, which elicited a larger LPC than all other conditions. In older adults, both emotion effects and the moderating effect of self-relevance were smaller, but self-relevant negative and positive words elicited the largest LPC amplitudes and were approximately equal to each other. Our results suggest that changes in the negativity bias with age are particularly strong for stimuli that are self-relevant, which is consistent with theories suggesting the negativity bias declines due to motivational processes aimed at increasing emotional well-being later in life.

# FUNCTIONAL CONNECTIVITY OF BRAIN NETWORKS AS A MARKER FOR TREATMENT RESPONSE AND RELAPSE VULNERABILITY IN DEPRESSION

Kathleen M. Walsh - University of Toronto Scarborough; Norman A. S. Farb - University of Toronto Mississauga, Adam K. Anderson - Cornell University; Zindel V. Segal - University of Toronto Scarborough

The more depressive episodes someone experiences, the more their relapse risk increases. If remission can be sustained, this relapse risk will decrease, highlighting the importance of relapse prevention treatments. However, treatment response and relapse vulnerability remain highly variable between individuals. This present study aimed to find relapse vulnerability markers and predictors of treatment response to two relapse prevention treatments, mindfulness based cognitive therapy (MBCT) and cognitive therapy with a well-being focus (CBT-WB), by exploring the resting state functional connectivity (RSFC) of four large scale brain networks. Participants were randomly assigned to 8weeks of MBCT (n = 46) or CBT-WB (n = 36). At pre- and post-treatment, participants completed an fMRI brain scan and self-report measures of acceptance, decentering, and depressive symptoms. Participants were followed for two years to assess for depressive relapse. Relapse vulnerability was associated with strong positive correlations between the salience (SN), default (DMN), and central executive network (CEN), and strong negative correlations between the SN and sensory cortices. This RSFC pattern was associated with greater depressive symptoms, and less of an ability to decenter and accept, suggesting an enduring negative bias in attentional processing. Additionally, treatment specific effects were observed, suggesting that different relapse prevention treatments may work through different neural mechanisms; MBCT was related to an increase in sensory integration, whereas CBT-WB was related to an increase in communication between brain networks responsible for internal attention, external attention, and goal-directed cognition.

## **B-56**

MULTIPLE FORMS OF OUTCOME REPRESENTATIONS IN HUMAN PAVLOVIAN CONDITIONING Eva R. Pool, Wolfgang M. Pauli, Carolina S. Kress, John P. O'Doherty - Computation and NeDivision of Humanities and Social Sciences, California Institute of Technology, Pasadena, CA A common symptom across many clinical conditions, such as drug addiction, is the willingness to go to extraordinary lengths in order to obtain an object of desire, even though once obtained the object is not experienced as pleasurable. What are the mechanisms that make the human brain vulnerable to situations where choice behavior is hijacked in the service of outcomes that are not valued by the individual? To address this guestion, we conducted a series of studies combining classical experimental paradigms developed through the study of animal behavior (i.e., Pavlovian conditioning and selective satiation procedures), with eye-tracking techniques. During Pavlovian conditioning, participants generated a set of conditioned responses to a conditioned stimulus that predicted the subsequent delivery of an affectively significant outcome, namely food. After conditioning, this outcome was experimentally devaluated by feeding it to satiety (selective satiation). Pavlovian responses to conditioned stimuli were subsequently tested under extinction. Our results suggest that Pavlovian conditioning involves two distinct types of learning processes: one that learns the value of the outcome, and one that learns the sensory properties of the outcome. Pavlovian responses based on the representation of the outcome's value were flexibly adapted to outcome devaluation, whereas Pavlovian responses based on the sensory properties' representation were resistant to outcome devaluation. These findings shed some light on the mechanisms underlying Pavlovian conditioning and provide new insights into the understanding of persistent reward-seeking behaviors when the reward is no longer valued by the individual.

# ASSOCIATIONS BETWEEN WHITE MATTER MICROSTRUCTURE AND SOCIAL NETWORK POSITION

Ryan H. Hyon - University of California, Los Angeles; Thalia Wheatley - Dartmouth College; Adam M. Kleinbaum - Tuck School of Business, Dartmouth College; Carolyn M. Parkinson - University of California, Los Angeles

Human behavior is embedded in social networks, and individuals vary in the structural positions they occupy within these networks. Certain social network position characteristics (e.g., connecting otherwise disconnected individuals, having many connections) are considerably stable within individuals across contexts and comprise significantly heritable individual difference variables. The genetically-derived variation in such variables could be mediated via passive or active characteristics. Whereas passive characteristics (e.g., attractiveness) would shape an individual's social network position by shaping how others perceive and behave toward him/her, active characteristics would impact an individual's social network position by shaping his/her own socio-behavioral tendencies directly. Although any such heritable socio-behavioral tendencies would presumably be mediated by underlying neural mechanisms, the relationship between social network characteristics and neuroanatomy remains poorly understood. Here, we adopted a full network approach, which provides insight into not only the size of someone's social network but also the features of social network position that depend on patterns of relationships among one's friends and the broader network topology. We reconstructed the full social networks of three graduate school cohorts (N=275; N=279; N=286), a subset of whom (N=112) were scanned using diffusion tensor imaging. Social network centrality was associated with white matter microstructural integrity within longrange associative pathways that support communication between brain regions involved in social perception and action and that are associated with individual differences in empathic responding. These findings offer preliminary insight into the relationship between anatomical and social connectivity, as well as the socio-behavioral tendencies that might mediate this relationship.

## B-58

## PREFERRED INTERESTS INTERFERE WITH SELF-CONTROL IN AUTISM

# Benjamin M Silver, Dienke J Bos, Eliana L Ajodan, Melanie R Silverman, Jonathan Power, Rebecca M Jones - Weill Cornell Medical College

Introduction: Individuals with Autism Spectrum Disorder (ASD) often have intense or odd interests that can hinder social interactions. It is unknown whether these interests bias self-control. Objective: The aim of this study was to use a novel go/nogo task on an iPad and during fMRI to investigate impulse control towards interests in ASD. Methods: 100 children, 6-12 years of age, who were typically developing (TD) (N=38) or had ASD (N=62), performed a go/nogo task to interest cues and noninterest cues on an iPad. Participants chose their favorite (interest) and least favorite (non-interest) hobby/topic from 23 options. A subset of 14 ASD participants performed the task during fMRI.

Results: ASD children were more impulsive towards their interests, as shown by an interaction effect between task condition and diagnostic status on d' (F(1,73) = 5.4, p = .024). This interaction was driven by a lower d' to interests compared to non-interests in ASD children, and lower d' to interests in ASD children compared to TD children. TD children did not demonstrate a difference in d' to interests versus non-interests. Preliminary fMRI data demonstrated a frontostriatal circuit, including inferior frontal gyrus, caudate, and putamen, was engaged while ASD individuals performed the task. Conclusion: ASD children had greater difficulties exerting self-control towards their interests relative to non-interests, whereas TD children did not demonstrate this pattern of behavior. A larger sample is currently being recruited to test differences in frontostriatal circuitry in ASD to interest versus non-interest cues to understand the observed differences in behavior.

# NEUROLIME: A NOVEL TOOL FOR EXPLAINING THE PREDICTIONS OF COMPLEX BRAIN MODELS

Eshin Jolly - Dartmouth College; Marianne C. Reddan - University of Colorado at Boulder; Peter J. Gianaros, Stephen M. Manuck - University of Pittsburgh; Luke, J. Chang - Dartmouth College; Tor D. Wager - University of Colorado at Boulder

Recent methodological advances in social and affective neuroscience have proven very successful at identifying brain-signatures that can reliably predict psychological states in new individuals (e.g. pain, negative affect). With the advent of more sophisticated modeling techniques such as deep neural networks, researchers are faced with a trade-off between model complexity and interpretability. Provided enough data, complex models have the potential to better characterize brain responses and make more accurate predictions, but simpler models are more interpretable and immediately useful for testing hypotheses about psychological functioning. Here we leverage recent advances in the machinelearning community to provide some resolution to this trade-off, using our novel tool 'NeuroLIME.' Although mapping between brain function and complex model architecture is challenging, we demonstrate that explaining any given prediction from a particular model is far more tractable and can be directly mapped to voxel responses. As a proof-of-concept, we trained a multi-layer neural network to predict negative affect ratings from brain responses to IAPS images. Although our model is highly performant (92% accuracy on previously unseen data), explaining the relationship between brain responses and each layer in our model is non-trivial. Instead, using NeuroLIME, we were able to generate reliable explanatory brain maps for each prediction, which, critically, replicate previous work identifying a brain-signature of negative affect (e.g. amygdala, PAG, aINS, preSMA, dMPFC, PCC, somatomotor, and occipital cortices). We believe this approach has the potential to enable researchers to both build more powerful brain models while also understanding how such models make predictions.

#### **B-60**

### PLACEBO EFFECTS ON HUMAN SOCIAL TRUST AND APPROACH BEHAVIOR

Yina Ma, Xinyuan Yan, Huang Wenhao – State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University

Placebo effects refers to the beneficial changes induced by the use of inert treatment, such as relief of physical pain and attenuation of negative affect. To date, we know little about whether placebo treatment could facilitate social cognition and behavior – crucial aspects for well-being of a social species. In 7 studies (N=651), we develop and validate a paradigm to induce placebo effects on social trust and approach behavior (referred as social placebo effects), and show robust evidence that placebo treatment promotes trusting behavior and increases preference for closer interpersonal distance. We further examine social placebo effects in real-life situation and show that place treatment makes single males, but not males in romantic relationship, to keep a closer distance between themselves and an attractive first-met female, and perceived less anxiety in the female. Finally, we show evidence that the effects of social placebo treatment on social trust and approach behavior can be as strong as the effect of intranasal administration of oxytocin – a neuropeptide well-known for its function in facilitating social cognition and social adaptation. The unveiling of placebo effect on social behavior extends our understanding of placebo effects on improvement of physical, mental and social well-being, and suggests clinical potentials in the treatment of social deficits.

#### B-61 \*SANS Poster Award winner\* AMYGDALA-MPFC DEVELOPMENT ASSOCIATED WITH INDIVIDUAL DIFFERENCES IN VALENCE BIAS

Nathan M Petro, Daniel Henley, Tien T Tong, Maital Neta – University of Nebraska-Lincoln, Lincoln, Nebraska, USA

Facial expressions are a ubiquitous social cue predictive of motivationally relevant outcomes. The tendency to interpret more ambiguous relative to clearly valenced expressions as negative shows wide

inter-individual variability. This negative valence bias is more common in younger children, an effect thought to reflect the development of systems which regulate emotion. One neurophysiological component associated with improved regulation of emotional processes is increased negative functional connectivity between the medial prefrontal cortex (mPFC) and the amygdala. In the current study, children (6-13 years) provided valence ratings for faces expressing either surprise or a clear valence (angry, happy). One week later, children viewed surprised and neutral faces in an MRI. Reactivity of the amyodala and mPFC to surprised expressions was larger for younger relative to older children. Further, the connectivity between these structures was more positive for both younger children and those who rated the surprised faces as more negative, whereas those who provided more positive ratings showed more negative connectivity. Together, these results are consistent with previous work and the notion that the development of this pathway is involved in age-related changes in emotion regulation. In addition, visual cortical regions were more positively connected with the amygdala in those giving more positive ratings, suggesting that modulation of sensory regions (sustained engagement) may be an additional component of the valence bias. Future work aims to extend these results to other domains of emotion regulation, and determine if longitudinal decreases in connectivity are associated with greater resilience in the face of uncertainty.

#### **B-62**

## SOCIAL STATUS IN HEALTHY VOLUNTEERS USING NOVEL PET KAPPA OPIOID RECEPTOR IMAGING

David Matuskey – Yale University; Mark Dias; Mika Naganawa; Shannan Henry; Songye Li; Nabeel Nabulsi; Jim Ropchan; Richard E Carson; Yiyun Huang

Previous positron emission tomography (PET) studies by our group and others in non-human and human primates have demonstrated a relationship between dopamine D2/D3 and social status. However, dysphoria and aversive effects also plan an important role in assessing value. The objective of this work was to investigate whether kappa-opioid receptors (KOR), an aversive system, are related to social status in humans. Eighteen medically healthy participants were asked to complete the Barratt Simplified Measure of Social Status (BSMSS), Subjects received a MRI and then underwent 120-min HRRT PET scan with the novel radiotrace [11C]EKAP. Regions of interest were based upon a MR template and included reward/aversion brain areas and secondary non-reward areas. MA1 was applied to a regional time-activity curves to calculate [11C]EKAP VT. All correlations were adjusted for BMI, gender, and age. Regional [11C]EKAP VT and BSMSS were found to be negatively correlated in the amygdala (r= -0.685, p=0.005), caudate (r= -0.656, p=0.008), pallidum (r= =0.607, p=0.0016), putamen (r= -0.630, p=0.012) and frontal cortex (r= -0.531, p=0.042). In secondary (non-reward) regions, correlations of [11C]EKAP VT and BSMSS were all non-significant. There was an inverse correlation between social status and binding of KOR that was specific to the reward/aversion areas of the brain. This finding suggests the KOR system may act in opposing ways to the dopamine system as a mediator for the negative effects of social behaviors in humans.

## **Poster Session C**

Friday, May 4, 6:15 - 7:30 PM

C-1

# PTSD AND THE SOCIAL BRAIN: AFFECT DISRUPTS DEFAULT NETWORK AND MIRROR NEURON ACTIVITY DURING SOCIAL INFERENCE

Kevin M Tan, Lisa J Burklund, Michelle G Craske, Matthew D Lieberman - University of California, Los Angeles

Social-cognitive impairments, specifically in mentalizing and emotion recognition, are common and debilitating symptoms of post-traumatic stress disorder (PTSD). Despite this, little is known about the etiology of these impairments, as there have been no neuroimaging investigations of social inference in PTSD. To examine PTSD's impacts on the social brain, 35 trauma-exposed veterans performed the "Why/How" social inference task during fMRI. The PTSD group (N=18) had two fMRI sessions, between which they underwent affect labeling therapy. The Why/How task dissociates the two primary brain networks underlying social cognition: the default-mode network (DMN) and the mirror-neuron system (MNS). DMN is strongly associated with mentalizing, while MNS is thought to identify facial expressions and body language. We found that photos of emotional expressions, but not intentional actions, elicited hyperactivity throughout DMN and MNS in the PTSD group relative to controls. Moreover, symptom severity and treatment outcomes were predicted by activity in DMN and MNS regions that are associated with the dorsal and ventral attention networks. These effects were primarily driven by emotional stimuli, and were strongest in posterior cingulate cortex (PCC), temporoparietal junction (TPJ), and posterior MNS regions. Broadly, these results suggest that affect-related processing is a critical component of social dysfunction in PTSD. Specifically, both top-down and stimulus-driven visual attention may be inordinately selective for affective social stimuli, resulting in marked TPJ-mediated attentional reorientation from perceptual MNS-based processing to internal DMN-based mentalizing. Hyperactivity in PCC, a core DMN hub, may reflect key PTSD symptoms during mentalizing: aberrant emotional memory and salience processing.

#### C-2

#### NEURAL MECHANISMS OF SELF AND OTHER OWNERSHIP

Patricia L Lockwood, Marco Wittmann, Matthew A J Apps, Miriam Klein-Flugge - University of Oxford; Molly J. Crockett - Yale University; Glyn W. Humphreys; Matthew Rush

Social environments demand that we distinguish what in the world is "ours" and what belongs to other people. Converging evidence shows how acquiring a sense of ownership over objects profoundly changes our perception, memory, attention and decision-making. However, how ownership associations are formed, and the computational and neural mechanisms that underpin them, are poorly understood. Associative learning theory provides a powerful theoretical framework to understand the behavioural and neural basis of learning in self and social contexts. Can the sense of ownership be understood using the same associative processes assumed to underlie reward-based learning? During fMRI, participants (n=39) performed an associative learning task in which they learnt which pictures belonged to themselves, their best friend or to a stranger, in a novel 'minimal' ownership paradigm. After, participants rated how much they liked each picture. We demonstrate a self-ownership bias at multiple levels of behaviour, from reaction times through to preferences and computational learning rates. Distinct areas of medial prefrontal cortex tracked associative strength between pictures and all three agents, with an increased response in vmPFC and ACC sulcus to self vs. stranger. However, no brain area only tracked self-relevant information. Instead, the ACC gyrus signalled stranger ownership prediction errors exclusively. These findings could have important implications for everyday learning and decision-making and their disruption in social disorders.

# PERSUASIVE SKILL OVERRIDES STATUS IN PREDICTING PHYSIOLOGICAL LINKAGE AND PERCEPTIONS OF LEADERSHIP WITHIN GROUPS

Katherine R. Thorson, Oana D. Dumitru - New York University, New York, NY, United States; Wendy Berry Mendes - University of California San Francisco, San Francisco, CA, United States; Tessa V. West - New York University, New York, NY, United States

Many of the most important decisions in our society are made within groups. In the current work, we used an experimental method to disentangle the roles of social status and persuasive skill to understand who captures attention from others during group decision-making. We instructed groups of five people to select the best of five executive search firms. We randomly assigned two people from each group to high- and low-status roles and three to middle-status roles, ostensibly because of their leadership experience. Unbeknownst to other group members and to each other, high- and low-status group members were instructed to argue for specific (but different) choices. As a dynamic measure of attention, we tested the extent to which group members showed physiological linkage to each otherhow much one person's physiology predicted another person's physiology 30 seconds later. Four key findings emerged. One, high-status people were more successful at persuading others to select their firm than low-status people. Two, successful persuaders maintained autonomic nervous system reactivity over time while unsuccessful persuaders declined, regardless of their status. Three, group members showed physiological linkage to people who were successful persuaders but not those who were unsuccessful persuaders, regardless of their status. Four, group members rated successful persuaders as higher on leadership skill than unsuccessful persuaders, regardless of their status. The present results challenge many long-standing assumptions of how status affects group decision-making by suggesting that persuasive ability, not status, drives who we automatically attend to in groups and who we see as leaders.

## C-4

#### COMPUTATIONAL AND NEURAL MECHANISMS OF BIASES IN THREAT DETECTION

Jingwen Jin, Tamara Sussman, Akos Szekely, Aprajita Mohanty - State University of New York at Stony Brook

We frequently use prior knowledge to anticipate and detect stimuli in our environment. However, most research has attributed prioritized detection of threatening stimuli to automatic processing, while the role of top-down factors remain ignored. We examined whether prior knowledge regarding threat and its probability facilitates perceptual decision-making. Firstly, cues encouraged participants (N=29), to use a "fearful face set" or a "neutral face set" to discriminate between fearful and neutral faces. Cues also provided information regarding the likelihood (25%/50%/75%) of encountering the target face. Results showed greater perceptual sensitivity (d') for threat vs. neutral, F=18.24, p<.001 and high vs. low probability, F=5.26, p<.005) cues. Computational modeling (using Drift Diffusion Model) showed that higher probability threat cues improved speed of decision making by biasing starting point towards the threat decision. In the next study (N=11), we used multivariate pattern analyses (MVPA) of functional magnetic resonance imaging activity to examine how prior threatrelated information is coded in the brain and how it guides perceptual decision making more effectively than prior neutral information. MVPA results showed that pattern representations of 75% and 50% threat cues can be classified by threatening vs neutral face classifiers in superior temporal gyrus, a region that is important in processing emotional expressions. The present study provides clear evidence indicating that superior predictive representations of threatening targets may explain why they are detected faster and more accurately. In a literature focused on bottom-up processing of threatening stimuli, present resultselucidate the psychological and neural top-down mechanisms of threat detection.

# INFORMATION ABOUT OTHERS' CHOICES DIFFERENTIALLY INFLUENCES ADOLESCENT AND YOUNG ADULT DECISION MAKING

B.R. Braams, C.M. Vidal Bustamante, K.E. Kabotyanski, J.Y. Davidow, L.H. Somerville - Harvard University

Recent studies have found increased risk taking under peer influence in adolescence. However, it is unclear what aspects in the social context influence adolescent decision-making. In this study we take a decision science approach to further investigate 1) boundary conditions of peer influence and 2) influence of peers on different aspects of decision-making (i.e. risky vs ambiguous decisions). Participants (N=99, age range 12-22) completed an economic choice task. Choice options were systematically varied on levels of risk and ambiguity. On each trial a safer choice (low variability in outcome) and a riskier choice (high variability in outcome) were presented. Participants made choices in three conditions: a social information condition in which they saw choices of peers, a non-social information condition in which they saw choices of a computer, and a solo condition, Results showed that participants' choices conform to the choices made by the peers, but not the computer. Furthermore, when peers chose the risky option, especially young adults (19-21 years) were more likely to also make a risky choice. Whereas adolescents (15-17 years) were more likely to follow safer

choices made by the peer. We did not find evidence that peer influence was related to risk or ambiguity level of the gamble. These results show that peer influence on decision-making can both increase risky choices as well as increase safe choices and that the direction is dependent on the age.

Furthermore, increased risk taking in the context of peers might be dependent on type of peer influence manipulation.

#### C-6

## STRIPPING SOCIAL COGNITION TO ITS BARE BONES: A NEUROCOMPUTATIONAL MECHANISM OF SELF-OTHER DISTINCTION IN MENTALISING

## Sam Ereira - UCL, London, UK; Zeb Kurth-Nelson - Google DeepMind; Raymond J. Dolan - UCL, London, UK

Humans have a remarkable ability to simulate the minds of others, but it's not known how the brain distinguishes between mental states attributed to self and other, an ability impaired in many psychopathologies. We investigated how fundamental neural learning signals are selectively attributed to different agents. Specifically, we asked whether learning signals are encoded in agent-specific neural patterns, or whether a self-other distinction depends on encoding agent identity separately from this learning signal. We tasked subjects to learn continuously two models of the same environment, where one was selectively attributed to self and the other was selectively attributed to another agent. Combining computational modeling with magnetoencephalography (MEG) enabled us to track neural representations of prediction errors (PEs) and beliefs attributed to self, and of simulated PEs and beliefs attributed to another agent. We found that the representational pattern of a PE reliably predicts the identity of the agent to whom the signal is attributed, consistent with a neural self-other distinction implemented via agent-specific learning signals. Strikingly, subjects exhibiting a weaker neural self-other distinction also had a reduced behavioural capacity for self-other distinction, and displayed more marked subclinical psychopathological traits. Thus, we show that self-other distinction is realised through an encoding of agent identity intrinsic to fundamental learning signals. We hypothesise that the degree of this neural distinction reflects the frequency with which two agents are co-represented, and thus their associative strength. Our ongoing work assesses this by examining how prior social experiences impact on this neural self-other distinction.

### AGING EFFECTS ON THE INSULAR CORTEX, INTEROCEPTION AND EMOTIONAL SENSITIVITY

Terasawa Yuri, Umeda Satoshi - Department of Psychology, Keio University, Tokyo, Japan Interoceptive accuracy is defined as the accuracy for detecting internal bodily sensations. The accuracy relates sensitivity to the emotions of self and others. Although a previous study reported that the accuracy declines with age, it is still unclear whether the declination associates with changes in emotional experience along with aging. In this study, thirty five older adults participated (mean 59.7 years ±6.1). 17 out of 35 participants were involved in an MRI study. 30 undergraduate and graduate students also participated as younger adults. When compared performance of the heartbeat perception task and the emotional sensitivity task between younger and older adult groups, the older group showed significantly lower interoceptive accuracy. Participants who showed higher interoceptive accuracy showed lower ability for detecting emotions from subtle facial expressions of emotion. Interestingly, adverse relationship was observed in younger group. In older group, we conducted Voxel Based Morphometry (VBM) analysis to examine the neural correlates supporting the relationship between interoceptive accuracy and emotional sensitivity. Insula cortex was set as the Region of Interest and negative correlations were observed between sensitivity to anger expression and gray matter volume of bilateral insula cortex cns after controlling for age. Our findings suggest to consider the change in interoceptive accuracy based on insular degeneration for understanding effects of aging on emotional experience.

### C-8

PARASYMPATHETIC CARDIAC CONTROL IS ASSOCIATED WITH PAIN REVERSAL LEARNING

Elizabeth A. Necka - Division of Intramural Research, National Center for Complementary and Integrative Health, NIH; Esther E. Palacios-Barros - Department of Psychology, University of Pittsburgh; Troy C. Dildine - Division of Intramural Research, National Center for Complementary and Integrative Health, NIH; Department of Psychology, Karolinska Institutet; Lauren A. Banker - Department of Applied Physiology, University of Florida; Lauren Y. Atlas - Division of Intramural Research, National Center for Complementary and Integrative Health, NIH; Division of Intramural Research, National Institute on Drug Abuse, NIH

The heart is under tonic inhibition by the parasympathetic nervous system (PNS). This parasympathetic cardiac regulation reflects activity of a central system involved in many physiological, cognitive, and affective processes, and varies substantially between individuals. A growing body of work suggests that high-frequency heart rate variability (HF-HRV, a measure of parasympathetic cardiac control) is related to adaptive responding to the environment, including associative learning. We examined whether individual differences in HF-HRV influenced cue-based pain modulation during reversal learning. During an initial visit, we collected baseline electrocardiograms and derived HF-HRV. Subsequently, thirty-six participants received noxious thermal stimulation and rated their pain. During conditioning, low and high intensity heat was preceded by low or high pain cues, respectively. Medium intensity heat was then administered in 50% of trials, preceded by low or high pain cues, to test expectancy effects. Throughout the task, cue-outcome associations reversed multiple times, such that the cue that originally predicted 'high pain' came to predict 'low pain', and vice versa. We predicted that individuals with lower HF-HRV would adapt less to changing cue-outcome associations, rating pain consistent with original, rather than reversed, associations. As hypothesized, participants with lower HF-HRV failed to update cue contingencies after reversal, p=.008, such that the cue originally associated with high pain continued to elicit higher pain ratings even after it became associated with low pain. These findings extend the role of the PNS in adaptive responding to pain and reversal learning.

# INDIRECT REINSTATEMENT OF PAVLOVIAN THREAT MEMORY IN RATS AND HUMAN THROUGH OTHERS

Lorenzo Diaz-Mataix - 1. Center for Neural Science, New York University, New York, NY, USA; 2. Emotional Brain Institute, Nathan Kline Institute for Psychiatric Research, Orangeburg, NY; Jan Haaker -3. Department of Systems Neuroscience, University Medical Center Hamburg-Eppendorf, Germany; 4. Section for Psychology, Department of Clinical Neuroscience, Karolinska Institutet, Sweden; Sara A. Stark - 1. Center for Neural Science, New York University, New York, NY, USA, Lea Kern - 4. Section for Psychology, Department of Clinical Neuroscience, Karolinska Institutet, Sweden; Joseph E. Ledoux -1.Center for Neural Science, New York University, New York, NY, USA; 2. Emotional Brain Institute, Nathan Kline Institute for Psychiatric Research, Orangeburg, NY; Andreas Olsson - 4. Section for Psychology, Department of Clinical Neuroscience, Karolinska Institutet, Sweden. Reinstatement is the process by which attenuated threat memories can be recovered through new traumatic experiences causing severe health consequences to individuals. Yet, it is unclear if social

traumatic experiences causing severe health consequences to individuals. Yet, it is unclear if social information, like observing threat responses in another individual, can reinstate the memory in the observer. We addressed this by using Pavlovian Threat conditioning (PTC) in rats and humans. In PTC, a neutral conditioned stimulus (CS) becomes aversive after being presented to individuals in association with an unpleasant unconditioned stimulus (US), eliciting defensive conditioned responses (CR) such as freezing or an increase in skin conductance responses. The threat memory is attenuated through inhibitory learning (extinction) by multiple presentations of the unreinforced CS. Whereas a traditional, direct reinstatement procedure induces the return of memory following the direct experience by the subject of unexpected USs, (U-US) here we examined if threat memories can be reinstatement). Rats (housed in pairs), underwent conditioning and extinction, but only one of each pair directly experienced the UUS while the other was present but not shocked. Post-reinstatement memory returned in both animals with remarkably similar intensity. These results are mirrored by our findings in humans, revealing that observational reinstatement was specific to the context in which the others'

aversive experience was observed. Our findings across species suggest that reinstatement of threat memories, shaped by direct experiences, can be induced by socially transmitted information.

#### C-10

# PSYCHOPHYSIOLOGY OF EMOTION REACTIVITY AND REGULATION IN MINDFULNESS-BASED INTERVENTIONS: A RANDOMIZED CONTROLLED TRIAL

Ava Cheaito, Patrick Kreidler, Kristina Eichel, Willoughby Britton - Brown University The current study investigated the effect of three different variations of 8-week mindfulness-based interventions (MBI) on objective indicators of emotion regulation. Three types of MBIs were investigated: Mindfulness-Based Cognitive Therapy (MBCT), Focused Attention (FA), which involves paying attention to a specific object (e.g. breath), and Open Monitoring (OM) practice, which emphasizes a choiceless and non-judgmental awareness of whatever arises in consciousness. 104 participants with mild-severe depression, anxiety and stress were randomized into one of the three treatment arms. Before and after the treatment, participants viewed pictures of negative, neutral, and positive valence, while activity of corrugator supercilii, an indicator of negative affect, was measured via surface electromyography (sEMG). Emotional reactivity was assessed during the first four seconds of stimulus presentation. A prompt then instructed participants to engage in an emotion regulation task corresponding to either FA (focus on breath) or OM practice (label emotions) for ten seconds. EMG-based emotional reactivity to negative pictures was attenuated after treatment, across all arms. Treatment type did not have a significant effect on reactivity. In the emotion regulation part of the task, corrugator activity was lower during "breath" compared to "label" both pre and post treatment indicating a reduction in negative emotional response when focusing on breath. There was no change in corrugator activity from pre to post treatment within the breath instruction, but corrugator activity within the label instruction was significantly higher before the treatment compared to afterwards. Results have implications on

understanding the mechanisms by which MBIs affect emotional regulatory processes.

## C-11

## BEYOND PAIN IN FIBROMYALGIA: LIMBIC RELATED EEG-NEUROFEEDBACK TRAINING IMPROVES SLEEP AND AFFECT

Noam Goldway - Functional Brain Center, Wohl Institute for Advanced Imaging, Tel-Aviv Sourasky Medical Centre; Jacob Ablin - Sackler School of Medicine, Tel Aviv University. Internal Medicine T Department, Tel Aviv Sourasky Medical Centre. 5Institute of Rheumatology, Tel Aviv Sourasky Medical Centre; Omer Lubin - Functional Brain Center, Wohl Institute for Advanced Imaging, Tel-Aviv Sourasky Medical Centre; Nimrod, J Keyan - Functional Brain Center, Wohl Institute for Advanced Imaging, Tel-Aviv Sourasky Medical Centre. School of Psychological Sciences, Tel Aviv University; Ayelet Or-Borichev - Functional Brain Center, Wohl Institute for Advanced Imaging, Tel-Aviv Sourasky Medical Centre, Wohl Institute for Advanced Imaging, Tel-Aviv Sourasky Medical Centre. Sackler School of Medicine, Tel Aviv University; Ricardo Tarrasch - Sagol school of neuroscience, Tel Aviv University; Marc Cavazza - School of Computing, Teesside University, United Kingdom; Silviu Brill - Institute of pain medicine, Tel Aviv Sourasky Medical Centre; Haggai Sharon -Functional Brain Center, Wohl Institute for Advanced Imaging, Tel-Aviv Sourasky Medical Centre. Sackler School of Medicine, Tel Aviv University. Institute of pain medicine, Tel Aviv Sourasky Medical Centre. Sackler School of Medicine, Tel Aviv University. Institute of pain medicine, Tel Aviv Sourasky Medical Centre, Tel-Aviv, Israel; Talma Hendler - Functional Brain Center, Wohl Institute for Advanced Imaging, Tel-Aviv Sourasky Medical Centre. Sagol school of neuroscience, Tel Aviv University. Sackler School of Medicine, Tel Aviv University. School of Psychological Sciences, Tel Aviv University.

Background: Fibromyalgia (FM) is a chronic pain syndrome where somatic and affective dimensions are entangled. This mind-body interaction manifests, beyond pain, in disordered sleep and emotion dysregulation. It has been argued that FM chronicity stems from abnormal function of limbic areas, such as the amygdala. Yet, it is unclear to what extent limbic abnormality underlies the different dimensions of FM. To address this, we employed a novel fMRI-inspired EEG-neurofeedback (NF) (Amygdala Electrical Finger Print (Amyg-EFP)) in FM patients, targeting deep limbic structures. We expected that successful NF learning will impact affective more than somatic related dimensions.

Methods:34 FM patients (31F; Age 35.6±11.82) underwent 8-10 NF sessions, with nine patients randomly assigned to perform sham NF and used as controls. Self-report of pain, depression, anxiety and sleep quality as well as objective sleep measures were collected before and after the NF course. Results: Subjective measures of depression, anxiety and sleep, but not pain, improved in correlation to NF-learning index, with high learners (n=13/25) displaying remarkably stronger correlation than low learners (depression/anxiety: R=0.673; p=0.016, sleep quality R=0.618, p=0.032). REM latency, a somatic marker for depressive mood, was improved only in the test group (F(1,30) = 4.43 ; p < 0.05), more so in high learners (F(2,29) = 4.46 ; p< 0.05). These results show that Amyg-EFP-NF, may impact homeostatic processes related to sleep and affect in FM. Hence, limbic dysregulation involves in FM chronic manifestations, possibly with long-term impact on pain.

## C-12

# REDUCED MODULARITY OF COGNITIVE CONTROL NETWORK PREDICTS FUTURE DEPRESSION SYMPTOMS IN ADOLESCENCE

# Shannon M Glasgow, Jingwen Jin, Ruofan Ma, Greg Perlman, Jared van Snellenberg, Roman Kotov, Daniel N. Klein, Aprajita Mohanty - Stony Brook University

Depressive disorders (DD) are a leading cause of disability worldwide, and their incidence increases sharply during adolescence, especially in females. Depressive disorders (DD) are associated with deficits in emotion regulation, including sustained negative affect and a strong reduction in positive affect. It remains unclear whether emotion regulation deficits are mediated via altered functioning of neural networks that support general cognitive control, emotional processing or cognitive control of emotion processing. Furthermore, since cognitive control and emotion regulation are implemented via

rich neural connectivity which undergoes significant dynamic changes during adolescence, it is particularly important to examine these neural networks in adolescence. In the present study, we applied graph theory (GT) analyses to resting-state functional magnetic neuroimaging (fMRI) data to examine whether abnormal functional integration of distributed brain regions supporting 1) cognitive control, 2) emotion processing, and 3) cognitive control of emotion processing is related to future depression in a large sample of adolescent females. GT analyses provide concise measures of the integration and segregation of interconnected nodes of different networks. Correlation analyses (controlling for age) revealed a significant association between modularity across nodes in cognitive control network and depression. Furthermore, modularity of subcortical networks supporting emotional processing or cognitive control and subcortical networks supporting emotion regulation did not relate to depression severity. Present findings indicate that disrupted functional segregation of neuronal network for cognitive control predates depression symptoms, presenting risks for more severe future depression.

## C-13

## **REGULATING MORAL EMOTION ACROSS DEVELOPMENT**

Helion Chelsea - Columbia University; Silvers Jennifer – UCLA; Weber Jochen, Ochsner Kevin - Columbia University

Moral situations tend to elicit strong emotions, but when in the life span do they begin to do so, and can those emotions be regulated effectively? To examine this question, we collected both behavioral and neuroimaging data from participants across a wide age-range (n = 116; ages 6-25). Participants completed a cognitive reappraisal task, wherein they were trained on how to use a distancing regulatory strategy to down-regulate negative emotion towards negative moral and non-moral images. We found that younger participants were less able to down-regulate their emotions in negative moral contexts as compared to older participants, but showed no regulatory deficit in negative non-moral contexts. Further, we found that the right dIPFC, a region implicated in exercising cognitive control, tracked moral relevance. We also found that this region showed a positive-to-negative developmental shift in connectivity with the insula (a region implicated in integrating sensory information and affective responding), suggesting that it may be playing a modulatory role in adulthood as compared to childhood. This research indicates that childhood may be a period when individuals are less able to regulate the emotions elicited by moral stimuli, and underscores the importance of emotional reactivity as a key contributor to moral decision-making.

### C-14

DO HAPPY VERSUS SAD STATES INFLUENCE BIO-BEHAVIORAL MARKERS OF INHIBITION? Jordan C Wylie - The Graduate Center, CUNY; Queens College; Samantha Chiu - Queens College; Jennifer Stewart, Justin Storbeck - The Graduate Center, CUNY: Queens College Uncertainty remains about the impact emotional states have on executive functioning and specifically. inhibition. By examining event related potentials (ERP), the present study explored the influence of happiness and sadness on bio-behavioral indices of inhibition during a Go/Nogo paradigm. We hypothesized that sadness (vs. happiness) would: (1) enhance Nogo behavioral inhibition accuracy; (2) reduce Go behavioral reaction time (RT); (3) amplify Nogo N200 ERP amplitude; and (4) reduce Go and Nogo P300 ERP amplitudes. Twenty-eight participants were fitted with a 128-channel Electrical Geodesics cap, randomly assigned to an emotional induction (happy versus sad film clip), and completed the Go/Nogo task. ERP data were filtered at 1.-30Hz, blink-corrected, artifact-rejected, baseline corrected and re-referenced (average reference). Electrodes from three scalp locations (frontotemporal, fronto-central, centro-parietal) were pooled for analysis. Although behavioral results by condition did not emerge for RT or accuracy, ERP results supported hypotheses. Specifically, N200 amplitudes were: (1) higher for Nogo than Go trials (p<.001); (2) stronger over frontal compared to centro-parietal regions (p<.004); (3) higher for sadness than happiness across Nogo trials (p=.022); and

(4) highest for Nogo than Go trials in right (versus left) frontotemporal as opposed to frontocentral regions (p=.025). P300 amplitudes were: (1) higher for Nogo than Go trials (p<.001); and (2) marginally lower across Go and NoGo trials for sadness than happiness (p=.066); and (3) lower for sadness than happiness (p=.015). In sum, the findings suggest that sadness enhances inhibition, which can be beneficial for high-level cognition (complex problem solving) and goal achievement (reducing undesirable behavior).

#### C-15

# REDUCED EMPATHIC RESPONSES FOR SEXUALLY OBJECTIFIED WOMEN: AN FMRI INVESTIGATION.

# Carlotta Cogoni - University of Trento; Andrea Carnaghi - University of Trieste; Giorgia Silani - University of Vienna

Sexual objectification is a widespread phenomenon characterized by a focus on the individual's physical appearance over his/her mental state. This shift in terms of attention has been associated with negative social consequences such as making the observers perceiving the person as less human, less competent, and less moral. Moreover, behavioral responses toward the person change as a function of the degree of the perceived sexual objectification. In particular, empathic reactions can be dramatically different when directed to sexually objectified and non-objectified (personalized) targets. In the present study, feelings of empathy for social pain were elicited in participants by witnessing the exclusion from a ball tossing game based on the original Cyberball task (Williams et al., 2000). We investigated how neural and behavioral representations of other's social pain are modulated by the degree of sexual objectification of the target. Using a within-subject fMRI design, we found reduced empathic feelings for positive (but not negative) emotions toward sexually objectified women as compared to non-objectified (personalized) women when witnessing their participation to the ball-tossing game. At the brain level, empathy for social exclusion of personalized women recruited areas coding the affective component of pain (i.e., anterior insula and cingulate cortex), the somatosensory components of pain (i.e., posterior insula and secondary somatosensory cortex) together with the mentalizing network (i.e., middle frontal cortex) to a greater extent than for the sexually objectified women. This diminished empathy is particularly relevant when considering the gender-based violence that is afflicting modern society.

#### C-16

# THE IMPACT OF PERCEIVED STRESS ON AUTOMATIC APPROACH-AVOIDANCE TO SOCIAL CUES.

#### Danielle V Dellarco, Travis C Evans, Jennifer C Britton - University of Miami

Environmental and laboratory-induced stressors have been shown to negatively impact and bias cognition (Liston et al. 2009; Oei et al. 2012). However, research on stress perception, a concept critical to defining stress, is lacking. To address this issue, we characterized how increased perceived stress impacts automatic approach-avoidance behavior to emotional social cues. A sample of 36 healthy college aged participants (Mage = 19.42, 28 Females) completed the Perceived Stress Scale (PSS) and an implicit Approach-Avoid Task (AAT). According to the background color, participants used successive button presses to increase (Approach Trial) or decrease (Avoid Trial) happy, fearful, and neutral faces images. Reaction times (RTs) to initial click and across button presses were analyzed. Interactions were tested using a 3 x 2 repeated measures ANOVA. Perceived stress differentially influenced automatic approach-avoidance behaviors depending on the emotion of social cues (F (1,34) = 4.33, p < 0.05). Stress-emotion interactions were observed in approach trials (F (1, 34) = 11.67, p =.002), but not avoid trials (p = .29). Perceived stress was associated with faster automatic approach responses to both happy (F(1, 34) = 7.84, p = .008) and fear (F(1, 34) = 4.83, p = .035) cues relative to neutral cues. Greater stress is associated with greater automatic approach behavior to arousing social cues. The behavior was similar for positive and valence, suggesting greater stress may lead to general emotional reactivity. Future studies should examine whether valence may be more relevant in individuals with psychopathology (i.e., more avoidant of fear).

## NEURAL CORRELATES FOR HEALTH BENEFITS OF GIVING SUPPORT

#### Lauren Ross, Tristen Inagaki - University of Pittsburgh

Giving support to others contributes to the connection between social ties and health, though the neural mechanisms are not well understood. We have proposed that neural regions that contribute to parental care in animals (septal area (SA), ventral striatum (VS), amygdala) may lead to the health benefits of giving. Further, giving support to a single individual in need, such as offspring, may lead to the greatest benefits. Two studies investigated the contribution of parental care-related neural regions to giving to a single individual (giving targeted support) and to broader societal causes (giving untargeted support) in humans. In Study 1 (N = 45), participants gave targeted and untargeted support during a donation task then completed an amygdala reactivity task. Study 2 (n = 384) assessed self-reported giving support and amygdala reactivity. Consistent with our theoretical perspective, giving both targeted and untargeted support (vs. self-reward) resulted in greater SA and VS activity. However, in both Study 1 and 2, only giving targeted support was associated with less amygdala activity. Giving untargeted support was not related to amygdala activity in either study. Results highlight the unique benefits of giving targeted support and elucidate neural pathways by which giving may lead to health benefits.

### C-18

## SOCIAL CONTEXT SHAPES SPONTANEOUS THOUGHT

Judith N Mildner, Diana I Tamir - Department of Psychology, Princeton University, Princeton, NJ, USA People's minds can explore a vast landscape of thought. In this landscape, one's thoughts can stay near the present, or they can travel away from the here and now, for example, to reminisce, prospect, or take another's perspective. What determines the content of thought at any given time? Here, we test the impact of the social environment on social thought. We propose that other people play a significant role in shaping thought, in one of two ways: thought might reflect social processing, such that social isolation decreases social thought because there is less social information available; alternatively, thought may reflect social needs, such that isolation increases social thought because the need for social interaction increases. Three studies tested these hypotheses, by measuring social thought after a day of solitude (Study 1; N = 83), during mere social presence (Study 2; N = 85), and after social interaction (Study 3; N = 82), compared to a control condition. Study 1 measured neural activity during a social inferences task; Studies 1-3 measured spontaneous thought content during mind wandering. Results consistently supported the social processing hypothesis. After solitude, people reported fewer social thoughts during mind wandering; after social interaction, people reported more social thoughts. Neural responses mirrored these behavioral findings: after solitude, the mentalizing network showed decreased activation when making social inferences about a relevant social target. Together, these results show that our social environment shapes the content of our spontaneous, internal thoughts as well as our goaldirected social thought.

#### C-19

#### CONFLICT-DRIVEN ADAPTIVE CONTROL IS ENHANCED BY INTEGRAL NEGATIVE EMOTION

*Qian Yang, Gilles Pourtois - Department of Experimental Clinical and Health Psychology, Ghent University, Ghent, Belgium* 

Negative emotion influences cognitive control, and more specifically conflict adaptation. In this study, we broke down negative emotion into integral and incidental components using a modern motivation-based framework, and assessed whether the former could change conflict adaptation. Integral negative emotion was induced by using loss-related feedback contingent on task performance while participants performed a Stroop task where effects of repetition and contingency learning were controlled, and measured at the subjective and physiological levels. 64 channel EEG was recorded concurrently during task execution. Results showed that conflict-driven adaptive control was enhanced when integral

negative emotion was elicited, compared to a control condition without changes in defensive motivation. Preliminary ERP results suggest that the stimulus-locked N2 and feedback-locked FRN components each captures this improvement in cognitive control as a function of integral negative emotion. These new results are interpreted against a standard cognitive control framework assuming that integral negative emotion amplifies specific control signals transiently, and in turn enhance conflict adaptation.

### C-20

# NEURAL CORRELATES OF DEVELOPING THEORY OF MIND COMPETENCE IN EARLY CHILDHOOD

Yaqiong Xiao, Fengji Geng, Tracy Riggins, Gang Chen, Elizabeth Redcay - Department of Psychology, University of Maryland, College Park, MD, USA

Theory of mind (ToM), or the ability to understand others' thoughts and beliefs, encompasses a range of abilities including inferring emotions and representing false beliefs that show different developmental time courses. Each of these abilities undergoes significant development during early childhood, resulting in dramatic changes in ToM. However, little work has examined the neural correlates of ToM during early childhood. In this study, we investigated the neural correlates of ToM in typically developing children aged 4-8 years, using resting-state fMRI. We calculated whole brain functional connectivity with right temporo-parietal junction (RTPJ), a core region involved in ToM, and examined its relation to children's early, basic, and advanced components of ToM assessed by a parent-report measure. We observed that overall ToM and all three ToM components consistently showed a positive correlation with connectivity between RTPJ and precuneus/posterior cingulate cortex. In addition, advanced ToM was also correlated with RTPJ - left TPJ connectivity. Using a Bayesian modeling approach, we did not observe strong evidence of differences between components. Further, all ToM components showed negative correlation with the right inferior/superior parietal lobe. The findings demonstrate that although these three aspects of ToM emerge with different developmental time courses, each relies on similar regions within the ToM network. The negative correlation suggests that greater functional specialization within the RTPJ network is associated with better ToM abilities. Our data provide new insights into the neural correlates of multiple aspects of ToM in early childhood and have implications for both typical and atypical development in ToM.

### C-21

# A NEURAL META-ANALYSIS OF TEMPORAL DISCOUNTING TASK ACTIVITY: IS THERE A LINK TO CONSTRUAL LEVEL THEORY?

Benjamin J. Smith, John R. Monterosso - University of Southern California Psychology Department; Cheryl J. Wakslak - University of Southern California Marshall School of Business; Antoine Bechara, Stephen J. Read - University of Southern California Psychology Department

In temporal discounting experiments, subjects are repeatedly presented with option sets in which they choose between receiving a small amount of money sooner or a larger amount of money later. Over 50 temporal discounting experiments using fMRI are described in literature, but there has not yet been a meta-analysis identifying regions activated when subjects choose from SmallerSooner and LargerLater alternatives. Evidence from valuation and action planning neuroscience literature suggests a prefrontal cortex 'abstraction hierarchy', from concrete processing in posterior regions to abstract planning in more anterior regions. We aimed to test for evidence for this hypothesis in the temporal discounting literature. Because abstraction has been linked with making LargerLater choices, we hypothesized an association between LargerLater choices and more anterior prefrontal cortex activation, and an association between SmallerSooner choices and more posterior activation. We examined SmallerSooner and LargerLater contrasts from 436 subjects across thirteen fMRI temporal discounting studies. Using SDM, we identified areas significantly related to a SmallerSooner contrast across all of the studies, within two target areas: (1) a ventral prefrontal cortex mask and (2) a broader

prefrontal cortex mask. We observed LargerLater activity anterior of SmallerSooner activity, both in the left inferior frontal gyrus pars triangularis. This was consistent with our pre-registered hypothesis that

LargerLater choices are associated with more anterior PFC activation while SmallerSooner choices are associated with relatively posterior PFC activity. We call for further work linking temporal discounting and hierarchical processing of abstract and concrete information in the prefrontal cortex.

## C-22

#### THE ROLE OF CONTIGUITY FOR THE PROSOCIAL CONSEQUENCES OF MIMICRY

Alexandra L Georgescu, UK, Banika Ahuja, Antonia Hamilton - Institute of Cognitive Neuroscience UCL, London, UK

The positive social consequences that have often been associated with behavioural mimicry have been inconsistently replicated in the past. In the current study, we investigated whether the timing modulates mimicry effects. To this end we used a paradigm that combines virtual reality and functional nearinfrared spectroscopy (fNIRS) and tested 39 typical adult volunteers, of which we considered 19 for the fNIRS analysis. Participants interacted with two virtual partners in a picture description task while making hand-opening movements which were mimicked by their virtual partners at delays of either 0-1.5s (fast mimicry) or 2.5-3s (slow mimicry). Dependent variables involved participants

making explicit ratings of perceived trustworthiness and affiliation of their partners, the number of times participants ask for advice from their partners in a virtual maze task and the oxyhaemoglobin signal data from the fNIRS measurement. Results show that timing does modulate responses to mimicry, in particular the explicit social judgements: Fast mimicry partners were rated as less trustworthy. On a neural level, for "fast mimicry" compared to "slow mimicry", differential activations in the inferior parietal lobe were found, a region typically associated with differentiating self from other. we propose the idea that the self-other distinction implicated for the increased AG and SMg activations during fast mimicry may lead to feelings of being "mocked", hence leading to averseness.

#### C-23

# ACTIVATION OF COMMON PREFRONTAL REGIONS DURING REGULATION OF CRAVING AND NEGATIVE EMOTIONS IN ALCOHOL USE DISORDER.

Shosuke Suzuki, Maggie Mae Mell, John H Krystal, Stephanie S O'Malley, Alan Anticevic, Hedy Kober -Yale University, New Haven, United States

Alcohol use disorder (AUD) is a chronic-relapsing condition, characterized by craving for alcohol and loss of control over its consumption. AUD affects 5.6% of the population and responsible for over 90.000 deaths per year. Using functional magnetic resonance imaging (fMRI), we previously showed that cognitive strategies can reduce craving for drugs. In cigarette smokers, we also showed that such regulation depends on recruitment of prefrontal regions, and reduces activation in reward-related regions (e.g., ventral striatum; VS). Here, we investigated the neural mechanisms that underlie regulation of craving in AUD, and tested whether prefrontal recruitment is domain-specific or whether it represents general regulatory function. Participants with AUD completed the Regulation of Craving task (ROC; N=17) and the Emotion Regulation task (ER; N=15). In each trial of the ROC task, participants were presented with images of alcohol or food, and instructed to focus on either (1) the immediate effects of consumption (NOW) or (2) the negative long-term effects (LATER) and rate their craving. In the ER task, participants were shown negative or neutral images, and instructed to either (1) simply look at the image (LOOK) or (2) re-interpret the image (REAPPRAISE). Cognitive strategies reduced self-reported craving, which co-varied positively with VS activation and negatively with a lateral prefrontal region, replicating results in smokers. Further, we observed common activation of the ventrolateral prefrontal cortex during regulation in ROC and ER (LATER>NOW & REAPPRAISE>LOOK). This suggests that a common regulatory system may underlie regulation of craving and negative emotions in AUD.

# IT TAKES TWO TO TANGO: TWO-PERSON PSYCHOPHYSIOLOGY FOR CAPTURING THE EMERGENCE OF INTERPERSONAL DYNAMICS IN SOCIAL INTERACTION

Dimitris Bolis, Juha Lahnakoski, Leonhard Schilbach - Independent Max Planck Research Group for Social Neuroscience & International Max Planck Research School for Translational Psychiatry, MPI of Psychiatry, Munich, Germany

Due to conceptual and methodological constraints, neuropsychiatric research has so far largely focused on the individual. Here, we present a two-person-psychophysiology study for demonstrating ways of investigating both intra- and interpersonal processes in social interaction. On the conceptual side, we put forward the 'dialectical misattunement hypothesis' (Bolis et al., 2017), which considers the (a-)typical self not merely as (dis-)ordered function within single brains, but also as (mis-)attuned communication between people, emphasizing the need for a second-person perspective in neuroscience (Schilbach et al., 2013). In this line, participants in our study (30 dyads of neurotypical persons) sit opposite each other, working on perceptual tasks individually, while being able to interact via gaze through a microcamera communication system; either in real-time or offline, that is 'interacting' with a recording of the other. Quantitative analysis of interpersonal gaze behavior demonstrated differences between real-time and offline interaction. More concretely, in contrast to static metrics (mutual gaze probability), dynamic measures (recurrence rate for gaze state, i.e. reciprocal dynamics of attention between the perceptual stimuli and the other person) found to be significantly higher in real-time social interaction, indicating higher interpersonal coupling. Interestingly, qualitative results demonstrated that participants were not able to consciously distinguish between real-time and offline gaze-based interaction. Taken together, our results suggest that two-person-psychophysiology can provide a formal characterization and quantification of not only subject-specific, but also interpersonal processes beyond individual awareness. By doing so, two-person-psychophysiology allows to go beyond the individual as the unit of analysis in neuropsychiatric research.

#### C-25

# FAMILY AGGRESSION AND COMMUNITY VIOLENCE EXPOSURE IN EARLY ADOLESCENCE: LONGITUDINAL ASSOCIATIONS WITH BRAIN STRUCTURE AND FUNCTION

Darby Saxbe, Hannah Khoddam - University of Southern California; Larissa Del Piero - VA Puget Sound Health Care System; Gayla Margolin, Jonas Kaplan, Sarah Stoycos, Matthew Sachs, Sarah Gimbel -University of Southern California

A diverse sample of 22 urban-dwelling youth reported on two forms of violence exposure - family aggression and community violence - in early adolescence, and underwent structural and functional neuroimaging approximately four later. Youth rated their parents' emotions while viewing naturalistic video clips in the scanner. The amygdala and hippocampi were manually traced and used as seed regions for resting state analyses. Family aggression predicted larger right amygdala volumes, stronger amygdala-frontolimbic connectivity, and weaker amygdala-posterior cingulate connectivity. Externalizing behavior in mid-adolescence mediated associations between family aggression in early adolescence and multiple patterns of resting state connectivity. Family aggression also predicted dampened activation to parent videos in regions associated with salience and socioemotional processing, including the insula and limbic structures. Community violence exposure in early adolescence predicted smaller manually traced left and right hippocampal and amygdala volumes, even after controlling for age, gender, and concurrent community violence exposure. Community violence continued to predict hippocampus (but not amygdala) volumes after controlling for family aggression. Community violence exposure also predicted stronger resting state connectivity between the right hippocampus and frontolimbic regions. To our knowledge, this is the first MRI study to examine two forms of violence exposure (family aggression and community violence) within the same longitudinal sample. Family aggression and community violence both predicted amygdala volumes, but in opposite directions. We suggest that different forms of adversity (e.g., attachment-related, interpersonal stressors vs. other threats) may have distinct structural and functional correlates in the brain.

# EMPATHY AND DEPRESSIVE SYMPTOMS DURING CHILDHOOD; AN INVESTIGATION OF NEURAL MECHANISMS USING RESTING STATE FUNCTIONAL CONNECTIVITY

Katherine O Bray - University of Melbourne, Melbourne, Australia; Christos Pantelis - The University of Melbourne and Melbourne Health, Melbourne, Australia; Vicki A Anderson - The University of Melbourne and Murdoch Childrens Research Institute, Melbourne, Australia; Sarah L Whittle - The University of Melbourne and Melbourne Health, Melbourne, Australia

Empathy refers to the understanding and sharing of others' emotions, and comprises cognitive and affective components. High levels of affective empathy and low levels of cognitive empathy have been associated with depression in adults. In addition, functional connectivity within the brain's default mode (DMN) and salience networks (SN), involved in cognitive and affective empathy respectively, has been found to be disrupted in depression. The relationship between empathy and depression, and the potentially mediating role of brain connectivity, has not been examined in childhood, a period of life where understanding risk processes is most critical. In a sample of 112 community-dwelling 9-10 year olds, we found (for the first time in children) that affective empathy was positively related to depressive symptoms, while cognitive empathy was negatively related to symptoms. However, analyses investigating associations between cognitive and affective empathy and DMN and SN resting state connectivity (using hubs of the DMN and SN as seeds) revealed no significant relationships. Due to bias in reporting positive findings, it is important to share these results, which may imply that individual differences in empathy are not associated with DMN and SN functional connectivity in children of this age. However, given that seeds were based on an adult meta-analysis, our future work will continue to explore associations between empathy, depression and resting state functional connectivity using complementary whole-brain analysis techniques.

### C-27

## INTERACTIVE EFFECTS OF PARENTING AND ADRENARCHEAL TIMING ON FUNCTIONAL BRAIN DEVELOPMENT AND MENTAL HEALTH - A LONGITUDINAL STUDY

Carolina Barbosa, Julian Simmons - The University of Melbourne; Nandita Vijayakumar - University of Oregon; George Patton, Lisa Mundy - The University of Melbourne & the Murdoch Children's Research Institute; Nick Allen - University of Oregon; Paul Dudgeon - The University of Melbourne; Sarah Whittle - The University of Melbourne

Pubertal timing, parenting, and the interaction between these factors, have been associated with increased risk for psychopathology symptoms during childhood and adolescence. However, little is known about neural mechanisms underlying these associations. The current study examined the moderating role of the timing of adrenarche on associations between parenting and changes in affective brain function from late childhood to early adolescence, and whether these changes are associated with symptom development. Participants were 66 (34 females) children, with 34 classified as relatively early and 32 as late in adrenarcheal timing based upon adrenal hormone levels in late childhood. At two timepoints participants completed an affective face fMRI task. Their parents reported on five dimensions of parenting, and on child symptomatology. Poor parental monitoring and supervision at age 9 was associated with changes in brain activation to happy and angry faces in the right ventrolateral prefrontal cortex and frontal pole (rFP), respectively, and adrenarcheal timing and sex moderated these relationships. Change in rFP activation to angry faces was in turn positively associated with internalizing symptoms at age 12 for relatively 'late' developing boys. Furthermore, positive parenting (PPar) at age 9 was associated with changes in activation to angry faces in the left ventrolateral PFC and adrenarcheal timing and sex moderated this relationship. The current findings suggest that adrenarcheal timing and parenting behaviors interact to predict developmental change in affective brain function from childhood to early adolescence, and this may be an important mechanism for the emergence of psychopathology symptoms during this period.

### EMOTIONAL SUPPORT SERVES AS A BUFFER AGAINST REJECTION SENSITIVITY IN NEGATIVE EMOTIONAL SITUATIONS, PARTICULARLY AMONG THOSE WITH ROBUST NEURAL SIGNATURES OF NEGATIVE APPRAISAL

Richard B. Lopez, Anoushka D. Shahane, Bryan T. Denny - Rice University, Houston, US Previous research has shown that rejection sensitivity-the extent to which individuals anticipate and perceive rejection from others-negatively impacts close relationships and is associated with rumination, a known risk factor for depression. In the current study, we tested for the effects of emotional support and patterns of brain activity associated with negative emotion on perceived interpersonal rejection (PIR). Specifically, in a large sample (N=364) of unrelated, healthy young adults from the Human Connectome Project, we first estimated the extent to which each participant showed correspondence with a validated whole-brain signature of negative affect (i.e., the Picture-Induced Negative Emotion Signature, or PINES) during exposure to negatively valenced social stimuli (i.e., angry or fearful faces). Next, we ran a multiple regression model in which we regressed emotional support, PINES engagement, and their interaction on PIR (controlling for age and gender). In general, participants reporting higher emotional support also reported lower PIR, b = -0.53, t = -12.93, p < .001. There was also a significant interaction effect whereby emotional support was associated with lower PIR at higher levels of PINES engagement, b = -0.58, t = -2.46, p = .01. Taken together, these findings highlight the positive role of emotional support in rejection sensitivity-even, and especially, for individuals who more readily show a brain-based signature of negative emotion when viewing threatening social stimuli. Future work may probe the mechanisms through which emotional support may buffer against rejection sensitivity in other contexts and populations, including among depressed individuals.

### C-29

#### THE EFFECT OF AN ALTERNATIVE EXPERIENCE ON THE UNDERSTANDING OF HEMIPLEGIC MOVEMENTS: A FUNCTIONAL MAGNETIC RESONANCE IMAGING STUDY USING PHYSICAL THERAPISTS AS SUBJECTS

### Rui Watanabe, Narumi Katsuyama, Nobuo Usui, Masato Taira - Tokyo Medical and Dental University, 塁 渡邊

The activity of the action observation network (AON) may be modulated by an observer's motor familiarity with observed movements, based on their physical experience of the movements. However, people sometimes attempt to understand another individual's bodily state that they are unable to experience. For example, physical therapists (PTs) routinely observe and try to understand the movements of hemiplegic individuals by using related clinical experience such as careful touching and observing hemiplegic bodies. Such experiences may provide PTs an understanding of hemiplegic movements through an alternative experience. To investigate the effect of an alternative experience of hemiplegia, we measured the cortical activity of 19 PTs and 19 novice participants (NPs) by using functional magnetic resonance imaging (fMRI). Both groups watched movies of hemiplegic individuals opening and closing their hemiplegic hand or nonhemiplegic hand. Immediately after undergoing fMRI, the participants again watched all movies. Then, they answered questionnaires regarding the filmed individuals' feelings toward their own hemiplegic movements. The fMRI measurements revealed the AON was more activated in PTs than in NPs while observing the hemiplegic movements. The anterior/middle cinculate cortex (aMCC), which is involved in the appraisal of negative feelings, was also more activated, and its functional connectivity to the AON was increased. Furthermore, a behavioral test indicated that, compared to the NPs, the PTs more accurately assessed movement sensations associated with hemiplegia. These findings suggest that, similar to the actual experience, an alternative experience modulates AON activity and aids better understanding of the observed movements.

### **CONVERGENCE OF EMOTIONS AND OPINIONS IN SHARED EXPERIENCES**

Jin Hvun Cheong, Zainab Molani, Sushmita Sadhukha, Luke, J Chang - Dartmouth College People frequently choose to share experiences with others, such as eating a meal, watching a movie, or attending a concert or sporting event together. However, it is currently unknown how these social contexts can impact our individual emotional experiences and cognitive interpretation of events. To investigate this guestion, we recruited participants (N=86) to watch four episodes of a 45-minute TV show (Friday Night Lights) alone or with another participant and recorded their facial behaviors while watching the show. After each episode, participants provided impressions of 13 characters on seven dimensions (e.g., liking, annoying, attractiveness). We compared group differences in the average pairwise inter-subject synchrony of facial expressions and intersubject similarity of character impressions across all 4 episodes. Average inter-subject facial expression synchrony in the shared viewing group (mean r=.14) was greater than the average of the alone viewing group (mean r=.06, t(6998)=15.76, p<.001, Cohen's d=.53), and average inter-subject impression similarity was also greater in the shared viewing group (mean r=.50) than in the alone group (mean r=.43, t(6998) =7.9, p<.001, d=.3). Increased synchrony in facial expressions between subjects also predicted greater similarity in character impressions (b=.16, t(6993)=5.81, p<.001) suggesting that emoting patterns can be indicative of how impressions are formed. Overall, these results provide a unique account of how shared experiences in social contexts promote a convergence of opinions and impressions about events through increased synchrony in expressions of emotion.

## C-31

#### A LINK BETWEEN CHILDHOOD ADVERSITY AND TRAIT ANGER REFLECTS RELATIVE ACTIVITY OF THE AMYGDALA AND DORSOLATERAL PREFRONTAL CORTEX

*M. Justin Kim, Matthew A. Scult, Annchen R. Knodt, Spenser R. Radtke, Tracy C. d'Arbeloff, Bartholomew D. Brigidi, Ahmad R. Hariri - Duke University, Durham, NC USA* Trait anger or the dispositional tendency to experience a wide range of situations as annoying or frustrating is associated with negative mental and physical health outcomes. The experience of adversity in childhood is one risk factor for the later emergence of trait anger. Here, using functional magnetic resonance imaging data from two sets of experiments (emotional face-matching task and working memory task) collected from 220 healthy participants, we report that the association between childhood adversity and trait anger is attenuated in young adults who have both low threat-related amygdala activity and high executive control-related dorsolateral prefrontal cortex (dIPFC) activity (significant three-way interaction between amygdala and dIPFC activity, and childhood adversity in predicting trait anger; b = 1.6, 95% CI = [0.81, 2.39],  $\Delta R2 = .05$ , p < .001). This interaction was robust to the effects of age, sex, trait anxiety, and task performance. These patterns suggest a combination of low threatrelated amygdala and high executive control-related dIPFC activity buffers against the adverse effects of child maltreatment on the development of trait anger, and that it may be a useful target in strategies designed to mitigate the negative mental health consequences of childhood adversity.

#### C-32

# REAL-WORLD EXPLORATION IS ASSOCIATED WITH GREATER POSITIVE AFFECT IN ADOLESCENTS AND ADULTS

Natalie M. Saragosa-Harris - New York University, New York City, USA; Travis R. Reneau, William J. Villano - University of Miami, Miami, USA; Alexandra O. Cohen - New York University, New York City, USA; Aaron S. Heller - University of Miami, Miami, USA; Catherine A. Hartley - New York University, New York City, USA

Research across species suggests that the novel stimuli and environments encountered during exploration can have sustained benefits for affective functioning. Greater physical exploration in laboratory settings has been linked to lower levels of anxiety and depressive symptoms in rodent and
human samples. However, few studies have examined human exploratory behavior in natural settings and the relationship between physical exploration and affect in our everyday lives remains unclear. GPS tracking can provide an index of exploratory behavior in humans by capturing variability in large-scale daily movement patterns, or "roaming entropy". In this study, we asked whether roaming entropy differs as a function of age, how roaming entropy might relate to affective state, and whether roaming entropy is associated with the variability of an individual's social communications. We derived roaming entropy measures in 23 adolescents and 30 adults via GPS tracking over a three-month period. During this tracking period, we used ecological momentary assessment (EMA) methods to evaluate levels of positive and negative affect. Our results indicate that, on average, adults display higher levels of daily roaming entropy than adolescents. In both age groups, participants reported higher positive affect on higher entropy days. Individuals with higher average roaming entropy also reported larger social networks, suggesting a relationship between exploratory behavior and social connectivity. Consistent with laboratory findings demonstrating that novelty engages reward processes, these data suggest that greater variability in our real-world day-to-day activities may promote positive affect.

### C-33

### NEURAL REPRESENTATIONS OF PEOPLE AND MENTAL STATES REFLECT PREDICTIVE CODING OF FUTURE STATES

Mark A. Thornton - Princeton University, Princeton, USA; Miriam E. Weaverdyck - University of California Los Angeles, Los Angeles, USA; Diana I. Tamir - Princeton University, Princeton, USA Navigating the social world requires foresight: people must anticipate the thoughts and feelings of others to interact with them successfully. How does the brain make such social predictions? The theory of predictive coding suggests that the brain represents the world not as percepts, but as predictions. Thus, when we see a ball in flight, we perceive not just its visual features, but also automatically predict and encode its trajectory. When we observe another person, do we likewise reflexively predict their affective trajectory? Here we test whether predictive coding can explain how people anticipate others' future mental states in two functional neuroimaging studies. In Study 1, people consider others' current mental states. In Study 2, people consider individuals with known identities and personality traits. Using representational similarity analysis, we examine whether neural representations of other people's current mental states and identities encode information about those people's likely future mental states. The results of both studies support a predictive coding account of social cognition: neural representations of current states resemble activity patterns of predicted subsequent states, and neural representations of an individual's identity resemble activity patterns of states those individuals were likely to habitually experience. Moreover, a parsimonious set of psychological dimensions from existing theories serve as a scaffolding for these predictions.

#### **C-34**

### A PREREGISTERED STUDY ON THE MISATTRIBUTION OF EMOTIONS AND THE ERROR-RELATED NEGATIVITY

### Nathaniel W Elkins-Brown - University of Toronto; Blair Saunders - University of Dundee; Michael Inzlicht - University of Toronto

Recent work in social and affective neuroscience suggests that emotions play an instrumental role in error monitoring processes, rather than only a moderating one. However, high-powered replications of studies that support this idea are lacking. Here, we attempted to replicate one of the first findings to provide evidence for the functional role of emotions in error monitoring: that a neural signal of error monitoring—the error-related negativity (ERN)—is reduced when participants undergo a misattribution of arousal procedure (Inzlicht & Al-Khindi, 2012). In this procedure, participants misattribute their self-related anxiety to a benign and external source, which ostensibly reduces its magnitude. Importantly, this reduction occurs without changes in behavioral performance or performance expectations. Thus, if misattribution reduces the ERN, this suggests that the neural signal cannot be dissociated from negative emotions. To test this idea with high power, we created a within-subjects version of the original protocol

with a novel "supplement test" procedure to reduce skepticism about the placebo. All hypotheses, methods, and statistical analyses were preregistered in the journal Cortex through their Registered Reports article format. Preliminary findings suggest that while nearly all participants believed in the effects of the placebo, the ERN was not reduced by misattribution. However, misattribution also did not reduce self-reported anxiety, so the relationship between anxiety and the ERN remains unclear. Along with the results of more comprehensive analyses, these findings will be discussed in the context of contemporary literature on emotions and error monitoring, and the recent "replication crisis" in psychology.

### C-35

# NEURAL SUBSTRATES OF VICARIOUS LEARNING ABOUT OTHERS' PROPENSITIES TO COOPERATE

Jin Tao, Zhang Shen, Liu Chao - 1 State Key Laboratory of Cognitive Neuroscience and Learning& IDG/McGovern Institution for Brain Research, Beijing Normal University, Beijing, 100875, China 2 Center for Collaboration and Innovation in Brain and Learning Science, Beijing Normal University, Beijing, 100875, China 3 Beijing Key Laboratory of Brain Imaging and Connectomics, Beijing Normal University, 100875, Beijing, China

Choosing the right person to cooperate or work together is essential in social and economic activities. We not only choose partners for ourselves, but also choose partners for other as a friend, a consultant or a HR. Here, we investigated differences between personal and vicarious learning about others' propensities to cooperate using both behavioral and neural measurement. Thirty-two participants learned to choose partners for themselves (self condition) or a stranger (other condition) among several alternatives who showed different propensities to cooperate. Behavioral data show that compared to self condition, participants had a more explorative inclination in other condition. They switched more after choosing a cooperator rather than a defector. The inverse temperature parameter in the computational modelling is significantly higher in other conditions than in self condition. The fMRI data revealed significantly stronger social prediction-error BOLD signal in the ventral striatum (VS) in self condition than other condition, and such difference is significantly correlated with the difference of inverse temperature parameter between two conditions. Furthermore, MVPA analysis partially support these findings with patterns in striatum, middle cingulate cortex could differentiate the processing of outcomes between self and other conditions. Additionally, the left temporal-parietal junction (TPJ) had greater activities in other condition. The PPI analysis showed that it has stronger functional connectivity with left inferior parietal cortex (IPL) and dorsal lateral prefrontal cortex (dIPFC) when making choice in other condition. Our study provides evidences for the dissociable computational and neural mechanisms underlying vicarious and personal learning.

### C-36

### COMBINING COMPUTATIONAL MODELING AND BRAIN IMAGING REVEALS DISTINCT PROCESSING OF DIFFERENT MOVEMENT QUALITIES

Vaessen Maarten, Abassi Etienne - Maastricht University; Mancini Maurizio, Camurri Antonio -University of Torino; de Gelder Beatrice - Maastricht University

Humans spend considerable time observing one another whether it is to gather information about their actions or their emotions. Given the importance of the information obtained from bodies we still know surprisingly little about the neural mechanism of body perception. The purpose of the current study is to bridge this gap by investigating the relationship between brain activity of humans perceiving different categories of dance movements and computational and behavioral features of kinematics. For this purpose, we designed an fMRI study to investigate brain activation of participants passively viewing two types of novel dance choreographies videos. Subjects viewed 120, 10 second video clips and we investigated where in the brain activity codes for quantitative features of the dance choreographies using representational similarity analysis (RSA). We observed that model features at different levels of the model hierarchy map to areas at different level of the brain's visual hierarchy.

Features were related to brain patterns in early visual and generic higher level motion sensitive regions, while those features that explicitly relate to dynamic aspects of posture were encoded in OCT, pSTS and SPL. Our results show that precepts of body movement differentially activate brain regions based on the kinematic and behavioural ratings of the stimuli and thus, that these aspects might be encoded in these regions. Our approach goes beyond classical methods of categorically mapping cognitive constructs to brain activation/deactivation and instead attempts to find a basis for feature encoding in affective body and action perception.

### C-37

### TRACKING THE MOTIVATIONAL CONTROL OF BEHAVIOR OVER TRAINING

Ahmet O. Ceceli - Rutgers University, Newark, NJ, USA; Eva R. Pool, Mladena Aleksic, John P. O'Doherty - California Institute of Technology, Pasadena, CA, USA; Elizabeth Tricomi - Rutgers University, Newark, NJ, USA

The repeated performance of outcome-sensitive, goal-directed actions, regulated by a caudateprefrontal cortex network, may eventually facilitate the formation of cue-driven habits, regulated by a putamen-thalamic-motor cortex network. The time-course of this shift in motivational control remains elusive. Using variable-interval reinforcement (adapted from fMRI study by Tricomi et al., 2009), we trained 119 neurotypicals outside of the scanner on cue-action-outcome contingencies for varying durations. Responses to fractal cues were rewarded with M&M or Goldfish outcomes, and participants underwent this training phase for either 16 or 48 minutes in one day, 64 or 96 minutes across two days, or 96 minutes across three days. Participants then consumed one of the snacks until it became unpleasant, diminishing its value. A subsequent extinction phase tested the degree to which participants maintained goal-directed performance (i.e., response rates towards devalued snack diminished relative to valued snack). We found that training duration did not significantly predict outcome-insensitivity in this dataset; however, pooled analyses with a dataset collected in a separate laboratory yielded a trend toward significance between minimally- and maximally-trained groups (n=109; p=0.06). Furthermore, because participants in Tricomi et al., 2009 received training while undergoing MRI, we analyzed preliminary behavioral data from 13 participants who performed the task in a scanner. Consistent with previous reports, scanned participants displayed no change in response rate based on outcome value (p=0.54), suggesting that the context of the scanning environment may be conducive to habit formation. Salient contextual cues characteristic of the MRI scanner may contribute to the development of habits.

### C-38

### APPRAISAL OF THREAT IN OTHERS' FACES AND RELATED STIGMA: A CLINICAL HIGH-RISK COHORT STUDY

Emmett M Larsen, Zarina Bilgrami - Mount Sinai School of Medicine; Francesca Crump, Jenny Shen -Columbia University; Amelia Abbott-Frey - Mount Sinai School of Medicine; Lawrence Yang - Columbia University; Cheryl Corcoran - Mount Sinai School of Medicine

Introduction: Face emotion recognition (FER) deficits and stigma characterize schizophrenia, including prodromal stages. Baseline FER deficits predict psychosis onset in clinical high risk (CHR) youths, specifically in fear/anger processing (Corcoran 2015). As stigma depends on perceived appraisal by others, we hypothesized it would be associated with FER deficits in CHR youths. Methods: In cross-section, we studied FER and stigma in 28 CHR youths, who also had measures of prodromal symptom severity. FER was assessed using the Penn Emotion Recognition Task (ER-40; Kohler 2005). Link's measures of shame and discrimination in schizophrenia, adapted for CHR, were used to assess stigma (Link 1989; Yang 2015). Results: A negative correlation was found between reported shame and accuracy in fear recognition (r = -0.41; p = .029), even controlling for prodromal symptom severity. When stratified by shame, the "high shame" cohort had worse fear recognition than the "low shame" group (p = .014). There was also a correlation between stigma emotions and misperception of fear in non-fearful faces (r = .37, p = .050). Discussion: The association between fear perception and reported shame in

CHR youths has implications for prevention. Causal direction can be clarified in longitudinal study, and also by interventions that target each, such as cognitive remediation or oxytocin for FER deficits (Wolwer 2005; Fischer-Shofty 2013), or stigma reduction strategies (Yang 2014). Potential mechanisms for their association include disturbance in amygdala function for FER (Atkinson and Adolphs, 2011) and for stigma (Raij, 2014).

### C-39

### THE VALUE OF PERCEIVED CONTROL IS REPRESENTED IN CORTICOSTRIATAL CIRCUITRY

Kainan S. Wang, Mauricio R. Delgado - RUTGERS UNIVERSITY, NEWARK NJ USA The ability to perceive and exercise control over an outcome is desirable and beneficial to our wellbeing. Previous studies have shown that animals and humans show behavioral bias towards seeking control and that such bias is related to neural activation of regions such as the ventromedial prefrontal cortex (vmPFC) and striatum. Yet, it is unclear how the subjective value of control can be quantified. In this experiment, we aim to characterize the neural and behavioral bias towards seeking control. Participants were asked to make a series of binary choices between a Control and No-Control option to maximize potential monetary reward. We manipulated the expected value (EV) of each pair of options and predicted a reference choice behavior where participants were equally likely to choose either option when both were equated in EV. Any deviation from this reference was inferred as the subjective value of the options. We found that participants (N = 27) were equally likely to choose either option when No-Control was worth 30% more in EV than Control option, highlighting the greater subjective value assigned to perceiving control. Notably, participants' selection of the Control over No-Control option recruited the vmPFC, suggesting its potential role in encoding the subjective value of perceiving control. Further, the inter-subject difference in this subjective value was tracked by the striatum, bolstering the notion that perceiving control carries motivational and affective properties. Elucidating how the subjective value of control is represented neurally may provide new insights into the links between perceived control and behavior.

### C-40

### BRAIN MORPHOMETRY 'CHANGES' FOLLOWING MINDFULNESS MEDITATION TRAINING INDISTINGUISHABLE FROM ACTIVE AND PASSIVE CONTROL GROUPS IN A RANDOMIZED CONTROLLED TRIAL

Kaley E. Ellis, Tammi R.A. Kral, Martina Ly, Cole Korponay, Lawrence Tello, Robin Goldman, Melissa A. Rosenkranz, Antoine Lutz, Richard J. Davidson - University of Wisconsin-Madison, Madison, WI, USA Previous research has found brain morphometry changes following mindfulness meditation training (Fox et al., 2014). We aimed to replicate these findings in a rigorously-designed randomized controlled trial with an active control intervention. Meditation-naive participants (n=105, average age 48.18 years, 38% male) completed two structural MRI scans (T1 and T2). After T1 participants were randomly assigned to either wait-list control (WL, n=36) or one of two 8-week interventions: Mindfulness Based Stress Reduction (MBSR, n=33) or the previously validated Health Enhancement Program (HEP, n=36) active control (MacCoon et al., 2012). Images were processed using FreeSurfer's longitudinal pipeline (version 5.3.0), segmented and normalized to Montreal Neurological Institute (MNI)-152 space with 8 mm smoothing. Five regions of interest (ROI) were defined using the Wake Forest University (WFU) Pick Atlas, from which we extracted grey matter volume and cortical thickness estimates. All analyses controlled for age and sex. No significant group differences were found for change (T2-T1 in any structural measures, including: gray matter volume of bilateral amygdala (Cohen's f = 0.1199), cortical thickness of right insula (Cohen's f = 0.0143), right superior frontal gyrus (Cohen's f = 0.0174), left posterior cingulate gyrus (Cohen's f = 0.0304), or left middle temporal gyrus (Cohen's f = 0.0556). There were no significant differences between groups in whole-brain analyses of cortical thickness and gray matter volumetric change. These results fail to replicate prior findings that short-term mindfulness

meditation training was associated with brain morphometry changes when compared to a well-matched, active control intervention in a randomized controlled trial.

### C-41

# PHYSICAL PRESENCE OF THE HARM-DOER MODULATES ANGER EXPRESSION AND PHYSIOLOGICAL AROUSAL: THE ROLE OF INTERDEPENDENT SELF-CONSTRUAL

Urielle Beyens - Center for Brain and Cognitive Sciences and Department of Psychology, Peking University, Beijing 100871, China; Hongbo Yu - Department of Experimental Psychology, University of Oxford, Oxford, UK; Xiaolin Zhou - Center for Brain and Cognitive Sciences and Department of Psychology, Peking University, Beijing 100871, China

How does the physical presence of the offender during interpersonal harm influence the victim's reactive aggression? This question becomes greatly relevant in a world where physical presence is no longer a prerequisite for social interactions. The purpose of this study is to explore the effect of mere physical presence (without visibility) of the harm-doer on anger expression and physiological arousal. We predict that the impact of physical presence would be modulated by interdependent self-construal. Participants rated their trial-by-trial level of anger while they were passively harmed (an aversive noise and money deduction) by a confederate sitting in the same room (present condition) or in another room (absent condition). No significant main effect of physical presence was observed, however there was a significant interaction between interdependent self-construal and physical presence. Specifically, physical presence of the offender, relative to absence, led to lower anger ratings and lower skin conductance responses only in participants with high interdependent self-construal. The low interdependent self-construal group showed the opposite trends for both anger ratings and skin conductance. Drawing on the concepts of psychological distance and embodied cognition, we suggest that the physical presence of the harm-doer induces greater concreteness of the social context, motivating those with the disposition to value social connectedness to reduce their reactive aggression; while the absence of the harm-doer elicits a more abstract representation of the relationship with the offender. Our findings highlight the essential regulatory function of physical presence on human emotions during interpersonal harm.

### C-42

### NEURAL CORRELATES OF SOCIAL INFLUENCE ACROSS DEVELOPMENT

Christopher N. Cascio - University of Wisconsin; Rui Pei, Emily B. Falk - University of Pennsylvania Social influence is present throughout life and can influence our preferences and behaviors. Despite the fact that both adolescents and adults are susceptible to social influence, adolescents tend to conform at higher rates than adults, which may be attributed to maturational differences in the brain and differences in sensitivity to social cues. However, it is currently unknown whether neural processes associated with social influence differ between adolescents and adults performing comparable tasks. Therefore, the aim of the current study (N=169) was to examine whether development (adolescents versus young adults) moderates neural correlates associated with social influence. Results demonstrate that neural systems associated with conflict detection (dACC), mentalizing (DMPFC), and memory retrieval (inferior and superior parietal lobules) are involved in processing divergent social feedback and conformity among voung adults compared to adolescents. By contrast, adolescents did not show any significant neural activity when processing divergent social feedback (compared to convergent and no social feedback) and conformity (compared to maintaining initial preferences). Follow-up analyses suggest that this may be related to more diffuse patterns of brain activity between teens in how they process social feedback compared to young adults. In sum, we report that adults recruited focal brain responses in regions related to conflict detection, mentalizing, and memory retrieval during social influence, whereas teens showed more variable patterns of response.

#### C-43

### NEUROANATOMICAL CHANGES INDUCED BY PREGNANCY: A COMPARATIVE ANALYSIS WITH A FEMALE ADOLESCENT SAMPLE

Magdalena Martínez García - a) Centro de Investigación Biomédica en Red de Salud Mental, Spain. b) Laboratorio de Imagen Médica, Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Madrid, Spain., María del Carmen Paternina Die - Universitat de Barcelona (UB). Barcelona. Spain. Erika Barba-Müller - Unitat de Recerca en Neurociència Cognitiva. Departament de Psiquiatria i Medicina Legal, Universitat Autònoma de Barcelona, Barcelona, Spain., David García-García - a) Laboratorio de Imagen Médica, Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Madrid, Spain. b) Centro de Investigación Biomédica en Red de Salud Mental, Spain. c) Departamento de Bioingeniería e Ingeniería Aeroespacial, Universidad Carlos III, Madrid, Spain, Marisol Picado - Unitat de Recerca en Neurociència Cognitiva, Departament de Psiquiatria i Medicina Legal, Universitat Autònoma de Barcelona, Barcelona, Spain., Eveline A Crone - a) Brain and Development Laboratory, Leiden University, Leiden, the Netherlands. b) Leiden Institute for Brain and Cognition (LIBC), Leiden University, Leiden, the Netherlands., Elseline Hoekzema - a) Unitat de Recerca en Neurociència Cognitiva, Departament de Psiguiatria i Medicina Legal, Universitat Autònoma de Barcelona, Barcelona, Spain. b) Brain and Development Laboratory, Leiden University, Leiden, the Netherlands, c) Leiden Institute for Brain and Cognition (LIBC), Leiden University, Leiden, the Netherlands., Manuel Desco - a) Laboratorio de Imagen Médica, Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Madrid, Spain. b) Centro de Investigación Biomédica en Red de Salud Mental, Spain. c) Departamento de Bioingeniería e Ingeniería Aeroespacial, Universidad Carlos III, Madrid, Spain. d) Fundación Centro Nacional de Investigaciones Cardiovasculares Carlos III, Spain., Óscar Vilarroya - a) Unitat de Recerca en Neurociència Cognitiva, Departament de Psiguiatria i Medicina Legal, Universitat Autònoma de Barcelona, Barcelona, Spain. b) Fundació IMIM, Barcelona, Spain., Susanna Carmona Cañabate - a) Laboratorio de Imagen Médica, Unidad de Medicina y Cirugía Experimental, Hospital General Universitario Gregorio Marañón, Madrid, Spain. b) Centro de Investigación Biomédica en Red de Salud Mental, Spain. c) Departamento de Bioingeniería e Ingeniería Aeroespacial, Universidad Carlos III, Madrid. Spain

Throughout life, women experience substantial cognitive adaptations serving the transition into challenging periods. Motherhood and adolescence are known to be two critical periods where the interplay between hormonal fluctuations and peripheral stimulation mediates plasticity in the brain. In fact, recent investigations of this group have demonstrated that human pregnancy involves long-lasting volumetric changes in the woman's brain, primarily located in regions responding to social processes. However, the specific profile of neuroanatomical changes and the brain regions subserving these alterations still remain to be resolved. In the current study, we aimed to better understand how the brain is reorganized during pregnancy and the role of this remodeling in aspects of the maternal behavior. We used prospective (pre and post pregnancy) data involving structural magnetic resonance imaging (sMRI) of 25 first-time mothers. We quantified change over time in a detailed set of brain metrics that together provide a full characterization of the cerebral cortex's architecture. We found that during pregnancy the surface of the women's brain shrinks and flattens, mirroring the changes observed in the brain of the adolescents' sample. Interestingly, those areas most affected coincided with regions related to social cognition processing. Finally, whereas the neuroanatomical alterations in the female group mostly concerned surface area and cortical thickness measures, the fathers' group exhibited alterations mainly in cortical thickness. These findings suggest that neural changes associated to pregnancy and adolescence might be produced by similar endocrine-driven neurobiological processes, which entail a further specialization of neural networks involved in social cognition.

### **C-44**

### WHITE MATTER AND SOCIAL COGNITION

#### Yin Wang, Athanasia Metoki, Ingrid Olson - Temple University

There is a growing consensus that social cognition and behavior emerge from interactions across distributed regions of the "social brain." Researchers have traditionally focused their attention on functional response properties of these gray matter networks and neglected the vital role of white-matter connections in establishing such networks and their functions. In this study we conducted a comprehensive review of prior research on structural connectivity in social neuroscience to clarify structural connectivity underlying social cognition. We paid particular attention to three key social processes: face processing, embodied cognition, and theory of mind, and their respective underlying neural networks. Next, we implemented probabilistic tractography on a large sample of diffusion-weighted imaging data (i.e. Human Connectome Project 900 subjects) to define the particular tracts involved in each social process, as well as to examine overlap. Together, these findings provide us with an unprecedented, well-defined landscape of large white matter pathways underlying major social brain networks.

### C-45

### THE EFFECTS OF AMBIVALENCE AND EMOTION REPORTING ON EXECUTIVE ATTENTION

#### Catherine Norris, Rares Mosneanu, Amanda Elam - Swarthmore College

Ambivalence, feeling good and bad at the same time, is thought to be both an uncomfortable emotional state and physiologically arousing. We have also previously shown that ambivalence may distract from a subsequent task, as individuals who watched an ambivalent film clip later showed impaired performance on a color Stroop Task. Importantly, Stroop interference was decreased when ambivalent participants were allowed to report their mixed emotions. In the current study, we sought to examine the effects of ambivalence and emotion reporting on executive attention. Participants were randomly assigned to (a) watch an ambivalent or univalent film clip and (b) report or not report their emotions before completing the Attention Network Task (ANT; Fan et al., 2002) while event-related brain potentials (ERP) were recorded. Results showed that participants who did not report on their emotions after watching the ambivalent film clip were less accurate on incongruent ANT trials. Participants in the ambivalent condition showed larger N2 amplitudes and smaller P3 amplitudes when allowed to report their emotions before the ANT. In sum, ambivalence leads to impaired executive attention as evidenced by participants' accuracy and response times; this impairment is alleviated when participants are allowed to report their mixed emotions. Moreover, ambivalence and emotion reporting affect both early and late attentional processes: larger N2s in ambivalent participants who reported their emotions suggests improved attentional control, while smaller P3s suggest more efficient attention allocation to relevant stimuli.

#### **C-46**

### ARE YOU REALLY LOOKING AT ME? DIRECT GAZE MODULATES ACTION CONTROL BY RECRUITING NETWORKS RELEVANT FOR SELF-AWARENESS

Imme C Zillekens - (1) Independent Max Planck Research Group for Social Neuroscience, Max Planck Institute of Psychiatry, Munich, Germany; (2) International Max Planck Research School for Translational Psychiatry (IMPRS-TP), Munich, Germany; Marie-Luise Brandi - (1) Independent Max Planck Research Group for Social Neuroscience, Max Planck Institute of Psychiatry, Munich, Germany; Lena M Schliephake - (1)Research Group Neural Mechanisms of Human Communication, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; (2) International Max Planck Research School on Neuroscience of Communication: Function, Structure, and Plasticity, Leipzig, Germany; Leonhard Schilbach - (1) Max Planck Institute of Psychiatry, Munich, Germany; (2) Department of Psychiatry, Ludwig-Maximilians-Universität, Munich, Germany Eye contact is a constitutive element of social interactions and serves important communicative purposes. While previous research has demonstrated that gaze cues do not only affect how we perceive a person, but also how we control our actions, the impact of direct gaze on motor control and its neural correlates remain unclear. To address this, we conducted an fMRI study, in which 28 healthy participants completed a reaction time task by performing a spatially congruent or incongruent button press in response to a gaze shift of an anthropomorphic virtual character, which initially showed direct gaze or averted gaze. Behavioral results demonstrate that direct gaze was associated with slower reactions irrespective of response type as well as a trend towards a larger performance difference between congruent and incongruent trials. At the neural level, we observed that direct gaze leads to a differential increase of neural activity in ventromedial prefrontal cortex as well as the bilateral insula. In addition, we found that reaction time differences between the congruent and incongruent condition for direct gaze were correlated with neural activity in anterior cingulate cortex and inferior frontal gyrus. Taken together, our results demonstrate that direct gaze, indeed, has a modulatory impact on how participants perform simple actions by recruiting neural networks that have been associated with self-awareness and action monitoring.

### C-47

# TMS AND TORTURE: THE RIGHT TEMPOROPARIETAL JUNCTION (RTPJ) IN A SIMULATED ADVANCED INTERROGATION SCENARIO CAUSES PARTICIPANTS TO INFLICT LESS PSYCHOLOGICAL HARM

### Celia Guillard, Lasana Harris - UCL, London, UK

The aim of this study was to examine the causal role of the right temporoparietal junction (rTPJ) during intentional harm. The rTPJ is part of the social cognition network and has been associated with moral judgments (Young & Saxe, 2009), mentalizing (Saxe & Kanwisher, 2003), and intentional harm (Young et al., 2010). However, the majority of research investigating intentional harm is conducted from a 3rd person perspective with the participant as a distant observer, either endorsing harm or not. Here, we situate the participant as 1st person or perpetrator of harm. We explore 1st person harm in the context of politically motivated abuse using a novel torture paradigm that is ethical and causes minimal distress to participants. Forty-six participants consider sequentially a variety of physical and psychological torture techniques, and determine an intensity level for each that elicits cooperation from a fictional terrorism suspect. Our results contradict the longstanding theory that social cognition must be reduced (the victim must be dehumanized); rTMS that inhibits the rTPJ and disrupts social cognition causes individuals to inflict less psychological harm than the sham TMS condition. These findings suggest that social cognition may be engaged during morally motivated human rights abuses and that victims might be humanized, rather than dehumanized.

### C-48

### NEURAL MESSAGE ENGAGEMENT PREDICTS REAL-WORLD SUSCEPTIBILITY TO CONVERSATIONAL INFLUENCE ON DRINKING BEHAVIOR

*Christin Scholz, Bruce P. Doré, Nicole Cooper, Emily B. Falk - University of Pennsylvania* Effects of interpersonal conversations and mass media messages on attitude and behavior change interact frequently. The mechanisms facilitating this interplay are unclear, partially because it is unknown who is most susceptible to conversational influence and how these individual differences relate to message processing. We collected daily, text message-based ecological momentary assessments (EMA) of drinking behavior and alcohol-related conversations in 60 college students. Multi-level modeling results show bi-directional lagged effects so that more positive conversations lead to more future drinking (conversational influence), and increased alcohol consumption leads to more negative conversations in the future (hangover effect). On average, daily conversations were positive towards alcohol consumption. Before the EMA period, we used fMRI to assess information processing while participants were instructed to either engage positively with anti-drinking PSAs (by considering their persuasiveness or enhancing their emotional response) or to look at them naturally. We focused on differences in neural activity between these conditions within a functionally defined valuation ROI to operationalize the capacity for positive engagement with anti-drinking messages. This measure was significantly related to self-reported perceived message effectiveness. We then used a multi-level model to link this neural measure to real-world susceptibility to conversational influence on drinking behavior. Pro-drinking conversations affected drinking behavior less strongly among those who showed greater neural engagement with anti-drinking advertisements at baseline. These findings suggest a potential mechanism for interactions between media effects and interpersonal communication. Increased value assigned to anti-drinking PSAs may act as a buffer against the negative influence of pro-alcohol conversations.

### C-49

# BRAIN REGIONS ASSOCIATED WITH "THEORY OF MIND" ENCODE FIRST-ORDER BELIEFS DURING ALTRUISTIC CHOICE

Ian D Roberts - University of Toronto; Anita Tusche - California Institute of Technology; Cendri Hutcherson - University of Toronto

Brain regions from the "Theory of Mind" network (e.g., TPJ, precuneus) have recently been demonstrated to encode the value of another's payoffs during altruistic decision-making (Hutcherson et al., 2015). However, because these brain areas have been previously implicated in both the representation of other's mental states and moral reasoning, it is not yet clear which of these processes is reflected by their involvement in altruistic choice. To investigate this question, participants completed a dictator game while in an MRI scanner in which they decided whether to accept or reject possible monetary divisions between themselves and a partner. During the task, participants were alternately instructed to think about their partner, think about the ethical implications of their choices, or respond naturally. Following completion of the scanner task, participants rated the same monetary decisions for how their partner would feel about the outcome and how ethical it would be to accept. Focusing on the partner while deciding increased overall activity in the TPJ and precuneus relative to ethics. Moreover, parametric analyses revealed that regions of TPJ and precuneus tracked anticipated partner feelings when making decisions naturally. These findings suggest that the "Theory of Mind" network represents first-order beliefs about a partner's subjective outcomes during altruistic choice rather than more abstract ethical rules.

### C-50

# ON THE SAME WAWELENGTH: AN EEG HYPERSCANNING STUDY DURING SOCIAL INTERACTION

Gayannee Kedia, Shane Fresnoza - University of Graz, Austria; Clemens Hutzinger - Private University Schloss Seeburg, Austria; Emanuel Jauk, Anja Ischebeck, Austria, Katja Corcoran - University of Graz, Austria

"Being on the same wavelength" may be more than a figure of speech. Recent research in social neuroscience suggests that people's brains can rhythmically oscillate with each other. In the present study, we investigated whether two persons who meet for the first time get into neural synchrony as they interact with each other. We ran an hyperscanning EEG study: We measured the similarity in brain oscillations of dyads of participants who had never met before and were asked to discuss moral dilemmas. Results indicated increasing phase-to-phase coherence in the theta range (EEG oscillations between 4-7 Hz) between the dyad members over the time of the interaction. Moreover, we found that this increase predicted the extent to which the two participants influenced each other in their attitudes towards the moral dilemmas. These results suggest that people's brain naturally couple during social interaction and that this process facilitates social influence.

### C-51 \*SANS Poster Award winner\*

# FALSE PERCEPT OF THREAT EMERGES FROM EXCESSIVE ACTIVITY IN THE V1 SUPERFICIAL LAYERS

Ai Koizumi - Center for Information and Neural Networks (CiNet), National Institute of Information and Communications Technology (NICT), Japan; Minye Zhan - Cognitive Neuroscience, Maastricht University, Netherlands; Hiroshi Ban - Center for Information and Neural Networks (CiNet), National Institute of Information and Communications Technology (NICT), Japan; Federico de Martino - Cognitive Neuroscience, Maastricht University, Netherlands, Ikuhiro Kida - Center for Information and Neural Networks (CiNet), National Institute of Information and Communications Technology (NICT), Japan; Maarten Vaessen, Beatrice de Gelder - Cognitive Neuroscience, Maastricht University, Netherlands; Kaoru Amano - Center for Information and Neural Networks (CiNet), National Institute of Information and Communications Technology (NICT), Japan

When detecting a possible threat in the environment, people tend to make relatively more false alarm responses (Koizumi, Mobbs, & Lau, 2016). We here address how such false percept emerges from intrinsic neural activity, which may differ from how correct percept (i.e., hit response) emerges from the feedforward processing of threatening sensory signals. We particularly focused on the roles of primary visual cortex (V1) because its activity reflects not only feedforward sensory signals but also feedback signals, and it is known to reflect subjective percept including false percept (Ress & Heeger, 2003). As V1 consists of six cortical layers involved in distinctive types of feedforward and feedback processing (Shipp, 2007), we hypothesized that false alarms may depend on the processing in specific cortical layers of V1. To test this hypothesis, we used 7-Tesla fMRI to measure layer specific activity of V1 while participants performed a task to detect a fearful face as well as a control task to detect a happy face. Our results showed that activity in the V1 superficial layers was relatively enhanced on the false alarm trials of a fearful face detection task. Further analyses suggested that such enhanced activity in V1 was led by pulvinar, a thalamic area which sends direct feedback input to the V1 superficial layers (Shipp, 2007). These results were absent in a control task to detect a happy face. Thus, exaggerated feedback from pulvinar to V1 may help generate false percept of a threatening stimulus even in the absence of sensory input.

### C-52

### ECOLOGICALLY VALID NEURAL AND BEHAVIORAL PREDICTORS OF THE CONTINUATION OF SOCIAL ANXIETY SYMPTOMS IN YOUTHS

Tessa Clarkson, Nicholas R. Eaton - Department of Psychology, Stony Brook University; Eric E. Nelson - Center for Biobehavioral Health, Nationwide Children's Hospital, Columbus, Ohio & Department of Pediatrics, Ohio State University; Nathan A. Fox, Ellen Leibenluft, Pine S. Daniel, Adina Heckelman - Department of Human Development and Quantitative Methodology, University of Maryland; Stefanie L. Sequeria - Dietrich School of Arts & Sciences, University of Pittsburgh; Johanna M. Jarcho - Department of Psychology, Stony Brook University

We demonstrated that while anticipating unpredictable-vs-predictable positive social evaluation, early adolescents with childhood social-reticence exhibited heightened engagement in brain regions implicated in salience and distress processing, including dorsal anterior cingulate (dACC) and insula (Jarcho et al., 2016). Although social-reticence and early social anxiety symptoms are associated with increased risk for more severe symptoms in later adolescence, these relations are not observed for all youth. Alterations in brain function may help explain this discontinuity. We tested the extent to which brain function, social anxiety symptoms, and their interaction during early adolescence predicted expression of social anxiety symptoms 3-years later. At age 11, participants (N=53) completed an fMRI Virtual School paradigm. Brain function was measured as participants anticipated and then received social evaluation from purported peers with reputations for being nice (100% positive evaluations), mean (100% negative evaluations), or unpredictable (50% positive 50% negative evaluations). While there were no main effects (p's>0.133), dACC activation while anticipating unpredictable-vs-predictable positive social evaluation moderated the extent to which social anxiety symptoms at age 11 predicted social anxiety symptoms at age 14 (B=11.854, p=0.007). Specifically, for participants with higher levels

of dACC activation, more severe anxiety symptoms at age 11 predicted greater symptom severity at age 14. This relation was not observed in participants with lower levels of dACC activation. Thus, the convergence of neural and self-reported risk factors predict continuity in social anxiety symptoms, whereas the presence of only neural or self-reported risk factors for social anxiety symptoms may predict discontinuity in symptoms over time.

C-53

# USING NEURAL-REINFORCEMENT TO DEVELOP AN UNCONSCIOUS THERAPY FOR COMMON FEARS

Vincent Taschereau-Dumouchel, Hakwan Lau - University of California, Los Angeles, Los Angeles, USA Can 'hardwired' fear responses, e.g. for spiders and snakes, be reprogramed unconsciously in the human brain? Currently, exposure therapy is amongst the most effective treatments for anxiety disorders, but this intervention is subjectively aversive to patients, and rates of premature attrition have been reported to be as high as 70% (Zayfert et al., 2005). We developed an unconscious method to bypass the unpleasantness in conscious exposure using functional magnetic resonance imaging (fMRI) neurofeedback. Using this Neural-Reinforcement method, participants learn to generate brain patterns increasingly similar to a specific multivariate brain pattern (i.e. decoder). To target naturally occurring animal fears without presenting participants with the feared animals, we utilized Hyperalignment (Haxby et al., 2011) to construct accurate animal decoders (~ 83%) for a target participant using the multivoxel patterns of a group of 29 'surrogate' participants. We demonstrate in a double-blind placebo-controlled experiment that training participants to activate the hyperalignment decoder of an animal they fear can lead to reliable reductions in physiological fear responses measured by skin conductance as well as amygdala reactivity. Furthermore, the results of an information transmission analysis indicate that the animal representation induced during Neural-Reinforcement was relatively localized in the ventral temporal region and disconnected from the rest of the fear-related circuitry. This might explain why our intervention could be carried out without any aversive reaction. Combining our method with in-scanner virtual reality may eventually extend our approach to psychopathologies such as post-traumatic stress disorders, which still present considerable therapeutic challenges.

### **C-54**

### TIME-FREQUENCY CORRELATES OF ACTION CHOICE UNDER SOCIAL THREAT

Rocco Mennella, Emma Vilarem, Julie Grèzes - Laboratoire de neurosciences cognitives, École normale supérieure, Paris, France

Emotional expressions signal crucial social information (e.g., safety, possibility to mate, threat), to which the receiver's behavioral responses have adapted throughout evolution. Recently, we revealed a differential impact of threat-signaling displays (anger and fear) on recipients' action decisions (freely choosing a sit in a room): anger favored avoidance behaviors while fear prompted equal probability of approach and avoidance (Vilarem et al., under review). Here, we investigated the neural signatures of such influence, by recording EEG (n=27) during the abovementioned free choice task. We hypothesized that 1) the selection of the "preferred" response (e.g., avoiding anger) should be associated with higher motor activation, as indicated by greater EEG beta desynchronization over central electrodes; 2) cognitive conflict should emerge when choosing the "non-preferred" option (e.g., approaching anger), as reflected by greater fronto-central theta power. Behaviorally, the results confirmed that anger expressions augmented the probability of sitting away from threat compared to fear. Contrary to our hypotheses, EEG results showed no differences in beta desynchronization over motor areas. Furthermore, fronto-central theta power was greater for away vs. toward responses for anger displays, and vice-versa for fear. Importantly, theta power significantly predicted behavioral choices. Altogether, while confirming that anger and fear have a differential impact on the recipient's action choices, our data suggest that such influence does not stem from the motor system. Finally, higher theta power (possibly

generated by medial prefrontal areas) may reflect the motivational value associated with the selection of the most adaptive social response.

### C-55

# COMBINING DEEP REINFORCEMENT LEARNING WITH FMRI TO PROBE THE ENCODING OF STATE-SPACE REPRESENTATIONS IN THE HUMAN BRAIN

Logan Cross, Jeff Cockburn, Yisong Yue, John O'Doherty - California Institute of Technology, Pasadena, USA

Models of reinforcement learning detail a computational framework for how humans should learn to take actions in an environment to maximize cumulative reward. Numerous studies have found implementations of components of reinforcement learning algorithms in the brain. However, it is unknown how computational principles like state space representation scale up to high-dimensional environments of real-world complexity. Researchers in computer science began to tackle this problem by developing artificial neural networks, such as the deep Q network, that can learn to play Atari 2600 video games with human level performance. These networks are loosely based on biological nervous systems and combine the hierarchical sensory processing of convolutional networks with reinforcement learning algorithms. Thus, similar computational strategies for extracting visual features relevant to reward and action may occur in the brain during video game play. Here, we have human subjects freely play three Atari video games during fMRI scanning. Using an encoding model analysis, we map representations in visual, motor, and parietal cortices to representations in the last hidden layer of the deep Q network. These neural network representations have filtered out irrelevant visual information and can be interpreted as a state space for the network. Non-primary sensory areas, such as the precuneus, posterior cinqulate cortex, and lateral parietal cortex were found to show correspondence with these models of state space across multiple games. These results provide evidence that these regions play a role in encoding state-space features that are subsequently utilized for the computation of action-values in high dimensional decision-making environments.

### C-56

### MEASURING TEMPORALLY EXTENDED AFFECTIVE STATES IN RHESUS MACAQUES

Kristen D Esannason, C Octavia Martin, Frederic M Stoll - Icahn School of Medicine at Mount Sinai; Elisabeth A Murray - National Institute of Mental Health; Peter H Rudebeck - Icahn School of Medicine at Mount Sinai

Measures of the autonomic nervous system are often used to infer mood or temporally extended affective states in humans, yet little is known about this relationship in nonhuman primates. Studies in nonhuman primates have predominantly assessed instantaneous and short-lived behavioral and neural responses to either brief aversive or positive stimuli. No studies in this animal model have probed the relationship between autonomic activity and temporally extended affective states that extend over minutes or hours, durations typical of mood states in humans. To address this issue, we analyzed EKG signals recorded from three rhesus macaques while they performed a two-alternative forced-choice task for fluid reward. On each trial, monkeys chose between images that led to the delivery of different amounts of fluid. Because the amount of reward available on each trial was randomly selected, the reward rate varied within each session. This meant that subjects experienced periods of high and low reward intake, which we predict would modulate their affective state. To test this possibility, we examined the relationship between changes in reward rate over the course each session and the subject's heart rate over different time scales. For all three subjects, there was a consistent negative correlation between heart rate and reward rate. This effect was not driven by changes in breathing as a result of reward consumption, satiation, and was statistically significant in a high proportion of sessions (p<0.01). Thus, our data suggest that changes in heart rate may signal changes in temporally extended affective states in nonhuman primates.

### C-57

# A BEHAVIORAL PLS ANALYSIS OF HOW MOTIVATION SHAPES BRAIN NETWORKS DURING EVALUATIONS OF TARGETS VARYING IN BOTH RACE AND STATUS

Bradley D. Mattan, Jennifer T. Kubota, Tianyi Li, Tzipporah P. Dang, Jasmin Cloutier - University of Chicago

Previous behavioral and neuroimaging work indicates that individuals who are externally motivated to respond without racial prejudice (EMS) tend not to spontaneously regulate their prejudice and will prefer to focus on non-racial attributes when evaluating others. This fMRI analysis used Partial Least Squares (PLS) to examine the distributed brain networks differentially recruited when perceiving faces varying in both race and socioeconomic status (SES) as a function of the perceiver's EMS. Sixty-one White male participants privately formed impressions of Black and White male faces ascribed with high or low SES. Across all conditions, greater EMS was associated with reduced co-activation of a network of regions previously found to support emotion regulation (rostral cingulate cortex) and social cognition (temporal pole, medial prefrontal cortex). In summary, participants who reported greater EMS showed less spontaneous coordination between networks supporting emotion regulation and social cognition. The reduction in coordination between these regions may contribute to the tendency for high-EMS individuals to be less effective at regulating their prejudice and navigating interracial interactions.

### C-58

### PURPOSE IN LIFE AND NEURAL RESPONSES TO HEALTH MESSAGES

Yoona Kang - University of Pennsylvania; Victor J. Strecher - University of Michigan; Emily B. Falk - University of Pennsylvania

Having a strong sense of purpose in life is associated with health: however, mechanisms through which purpose leads to health is unclear. The current study tested whether individuals with high sense of purpose experience less conflict when making positive health decisions and are more open to the idea of changing health behavior. Health information that encourages behavior change can present a conflict of motivations. On one hand, self-improvement motives may lead to openness to helpful information. On the other, self-enhancement motives may lead to defensiveness and rejection of the message, because acknowledging one's unhealthy behavior can threaten positive self-views. Individuals with a strong sense of what is important in life may experience less of such conflict and hence show greater endorsement of the helpful information. To test this idea, 220 sedentary adults who are likely to feel defensive in response to health messages were presented with health advice that highlighted reasons not to be sedentary in an fMRI scanner. While participants considered the self-relevance of the messages, conflict-related processes were monitored within a meta-analytically defined map of conflictrelated neural regions. Individuals high in purpose showed less activity within these conflict-related regions and were more likely to endorse the self-relevance of the health messages. These results suggest that individuals with strong sense of purpose are more receptive to potentially threatening, yet beneficial health messages. One possibility is that the link between purpose and health might be a function of reduced conflict-related regulatory burden in the process of making adaptive health decisions.

### C-59

### LEARNING FROM FAILURE: HOW WRITING ABOUT PAST FAILURES AFFECTS BRAIN PROCESSING DURING LEARNING

### Brynne C. DiMenichi, Elizabeth Tricomi - Rutgers University, Newark

Expressive writing about stressful events has been shown to improve physical health, decrease anxiety, depression, and rumination, and improve cognitive functioning. Previously, our lab found that writing about a past failure improves attention and decreases the body's physiological stress response to a new stressor. However, it remains elusive what brain processes are responsible for expressive writing's effect on cognitive processing. In our study, participants were randomly assigned to write about a difficult

time in which they did not succeed or a trivial topic, and then complete a word association learning task during fMRI data acquisition, with feedback and no feedback conditions. Across groups, participants showed typical positive feedback > negative feedback activation in the striatum at time of feedback. At time of viewing words, participants who were assigned to write about past failures showed significantly greater activation in the mid-cingulate cortex (MCC) compared to control participants, who showed decreased activation in the MCC. Furthermore, within a mediation model we conducted, failure writing participants' ratings of their failure's severity predicted MCC deactivation, which predicted better later memory for words learned in a no feedback setting. As this region has been associated with processing negative emotion and physical pain, suppression of activation in this area may support optimal performance. Our results support the social psychological theory that greater disclosure about past negative events like a past failure may paradoxically result in greater benefits, such as improvements to cognitive performance.

### **C-60**

### COMPUTATIONAL INSIGHTS INTO MORAL TEMPTATION IN TABOO TRADEOFFS

Hause Lin, Dharini Ilangomaran, Krupal Bhagat, Cendri A Hutcherson - University of Toronto Many of our most significant decisions and conflicts are driven by culturally-bound sacred values. People treat these values as moral imperatives and claim that trading them off against secular values is a taboo, no matter how great the benefit or how small the violation (e.g., "you can't put a price on human life"). When rejecting moral compromise, do people consider offsetting benefits or do sacred values render people immune to temptations? To answer these questions, we combined novel behavioral and computational analyses to study taboo tradeoffs. Across three studies, participants with religious (halal) food restrictions decided whether to eat non-taboo or taboo foods (e.g., bacon) in exchange for cash payments (\$1 to \$50). Although participants always rejected taboo foods, they were sensitive to the monetary offers: Reaction times (RTs) increased subtly as more money was offered, and the effect was stronger for participants who reported less religious commitment. Drift diffusion models also indicated that participants were tempted by monetary offers even on taboo trials. To probe these effects, we examined RTs for non-taboo trials that participants consistently rejected for lower amounts of money. We observed similar slowing effects of money on RTs, and the size of these effects predicted acceptance rates when more money was offered. Interestingly, simulations suggested that people might accept taboo tradeoffs when benefits are sufficiently high, prompting new questions about how people resist the temptation to compromise sacred values. We are currently designing a neuroimaging study to address these questions.

### **Poster Session D**

Saturday, May 5, 10:15 - 11:45 AM

#### D-1

### SAFETY SIGNAL LEARNING: A NOVEL METHOD OF FEAR REDUCTION IN CHILDREN AND ADOLESCENTS

Paola Odriozola, Luise Pruessner, Jason T Haberman, Emily M Cohodes, Jeffrey D Mandell, Dylan G Gee - Yale University

Despite dynamic changes in fear extinction and related frontoamygdala circuitry during adolescence, interventions for anxious youth are primarily based on principles studied in adulthood (Lee et al., 2014). Here we investigated the efficacy of safety signal learning, which has been shown to effectively reduce anxiety-like behavior in animal models (Christianson et al., 2012), in youth and adults. Skin conductance response (SCR) was collected from 23 subjects (ages 9-30) during a developmentally-adapted conditioned inhibition task. Conditioned stimuli (CS) consisted of geometric shapes, and the unconditioned stimulus (US) was an aversive noise (50% reinforcement rate). The task included a block testing a compound stimulus that paired the safety signal, a geometric shape never paired with the US, with the CS, as well as an extinction block, a standard method of fear reduction. A repeated measures ANOVA revealed a significant condition by age group interaction, such that children and adolescents, but not adults, showed reduced SCR to the compound stimulus compared to the CS alone, F(1,21) =5.71, p = .026. Moreover, the compound stimulus was more effective at reducing SCR than extinction in children and adolescents, whereas adults displayed the opposite effect, F(1,21) = 4.31, p = .050. Initial fMRI results showed hippocampal engagement in youth with anxiety disorders (p<.05, corrected). suggesting a potential neural mechanism underlying safety signal learning. These findings provide initial evidence that safety signal learning may reduce fear in youth and highlight the potential for novel interventions that target the biological state of the developing brain.

#### D-2

### THE COUPLED BRAINS OF CAPTIVATED AUDIENCES: HOW SUSPENSE IN A MOVIE MODULATES COLLECTIVE BRAIN DYNAMICS

### Clare Grall, Ralf Schmaelzle - Michigan State University

Entertainment media skillfully engage the core human tendency to empathize with others, which fosters complex emotional experiences in audiences such as suspense. Suspense not only creates a strong attentional focus within individuals, but it does so reliably across viewers who are collectively engaged with the story and care intensely about the characters. Despite its prevalence in media psychology. limited work has examined suspense from a social, cognitive, and affective neuroscience perspective. Here we examined continuous brain responses of 600 viewers watching a suspenseful movie. To create a time-resolved measure of audience engagement, we computed dynamic inter-subject correlations (ISC) of brain responses among all viewers using sliding-window analysis. In parallel, we captured the in-the-moment-experience of suspense in an independent sample with continuous response measurements (CRM). We find that dynamic ISC over the course of the movie tracks with the experienced suspense in the CRM sample. The spatial distribution of this dynamic ISC suggests two primary clusters of collective brain dynamics: engagement in the visual, auditory, and dorsal attention systems, and the seemingly distinguishable, time-varying engagement in the so-called default-modenetwork. This second finding bridges two large but disparate literatures on DMN function, particularly resting-state studies of functional connectivity and social neuroscience investigations of task-based activations. The finding that audience responses via fMRI can predict subjective experiences necessitates future research that forecasts behavioral outcomes in large audiences. This approach will

promote insights into the brain basis of suspense as well as the broader set of processes that are so skillfully engaged by media.

### D-3

### WHEN HIGH STAKES HELP: DEVELOPMENTAL SHIFTS IN REINFORCEMENT LEARNING FROM GAINS AND LOSSES

### Catherine Insel, Mia Charifson, Mahalia Prater Fahey, Gina Falcone, Leah H. Somerville - Harvard University

Reinforcement learning comprises incrementally updating value representations based on the receipt of feedback. This incremental form of learning continues to develop throughout adolescence to guide optimal goal directed behavior. However, it remains unknown how stakes, the value of a prospective goal, influence the developmental emergence of reinforcement learning. To test this guestion, 84 adolescents and young adults aged 13 to 20 completed a probabilistic reinforcement learning task while undergoing fMRI. In this task, participants repeatedly selected between fractals in a pair and received probabilistic monetary outcomes based on their choices. There were four fractal pairings that represented different monetary stakes: high gain (+50c/+0c), low gain (+25c/+0c), high loss (-50c/-0c). and low loss (-25¢/-0¢). Performance analyses revealed that for optimal choice accuracy, there was an age by stakes (high/low) by valence (gain/loss) interaction. Whereas younger adolescents learned better from high stakes losses, older adolescents learned better from high stakes gains. These developmental findings could not be explained by differences in subjective value. Following the learning task, participants completed a go/no-go task in which the no-go targets comprised the previously learned fractal images, however incentives were no longer at stake. This task measured whether learned valueassociations persisted beyond the immediate learning environment to influence subsequent cognitive control. For no-go accuracy, there was an age by stakes by valence interaction. With age, there was an emerging improvement of no-go accuracy for high-stakes relative to low-stakes cues, but not for loss cues. Together, these data suggest that motivational stakes asymmetrically shape performance across adolescence.

### D-4

### SHARED NEURAL ARCHITECTURE FOR NAVIGATING SPACE AND SOCIAL HIERARCHIES

Mena Du, Ruby Basyouni, Carolyn Parkinson - University of California, Los Angeles Much of everyday mental life involves representing and reasoning about information we cannot perceive directly. For example, effectively navigating human social groups requires tracking, encoding and reasoning about the bonds, rivalries and hierarchies that comprise them. Yet, the mechanisms supporting abstract social cognition remain poorly understood. Converging theories from neuroscience, psychology and linguistics suggest that recently acquired cognitive capacities in evolution, such as encoding and reasoning about complex social structures, might co-opt neural circuitry with evolutionarily older functions, such as encoding and navigating space. Here, we used multi-voxel pattern analysis of fMRI data to test if common neural mechanisms support analogous operations on spatial and social contents. Participants first learned, through trial and error, the relative positions of 9 individuals in a fictive social hierarchy. During scanning, participants performed a social "navigation" task that required determining who was a particular number of steps more or less powerful than a reference person in the learned hierarchy. In separate fMRI runs, participants performed an ostensibly unrelated task that allowed us to characterize patterns of activity associated with spatial shifts of attention (i.e., eye movements). In brain regions with a well-established role in directing spatial attention (e.g., the superior parietal lobule), multi-voxel response patterns when mentally navigating "up" and "down" the social hierarchy resembled those evoked when shifting spatial attention upward and downward, respectively. Thus, shifting attention in external space and in internal representations of social relations appears to rely on at least partially shared neural mechanisms.

# WHICH FEAR? DECODING THE NEURAL RESPONSE PATTERNS INVOLVED DURING THE INTERPRETATION OF CONTEXTUAL FEARFUL EXPRESSIONS IN YOUTHS WITH CALLOUS-UNEMOTIONAL TRAITS

Shawn A. Rhoads, Katherine O'Connell - Georgetown University, Washington D.C., USA; Elise M. Cardinale - National Institutes of Health, Washington D.C.; USA, Amy L. Palmer - N/A; Abigail A. Marsh - Georgetown University, Washington D.C., USA

Individuals with high levels of callous-unemotional (CU) traits are characterized by deficits in recognizing fearful faces. While fearful faces signal that the expresser has identified a threat, they are ambiguous with respect to the nature of that threat. In the present fMRI paradigm, 21 adolescents (12 CU; 9 healthy controls, HC; mean age=14.2) viewed fearful facial expressions accompanied by a written cue specifying 1 of 3 possible contexts (i.e., the pictured person was "afraid for themselves," "afraid for you," or "afraid of you"). Average accuracies for discriminating between each context based on neural response patterns were computed using a whole-brain searchlight approach with leave-one-run-out cross-validation. To compare decoding accuracy, a repeated-measures analysis of variance was conducted using a 2 (group) x 3 (context comparison) factorial design. A main effect of group revealed greater accuracy for HCs in left superior temporal sulcus (STS), F(1,19)=49.7, right STS, F(1,19)=27.5, and right rostral prefrontal cortex, F(1,19)=26.3, p<.001. Context-by-group interaction effect revealed better accuracy in the right superior temporal gyrus for HCs, F(1,19)=11.1, p<.001. Main effect of context comparison was non-significant. This study reveals how machine learning can effectively dissociate among neural responses implicated in socioemotional processing between HC and CU youths viewing disambiguated fearful expressions. Furthermore, these results provide a preliminary understanding of the neural representations associated with divergent interpretations of fear.

### **D-6**

### BRAIN BASES OF ADAPTIVE SOCIAL FUNCTIONING: LINKING PERCEPTIVE AND PREDICTIVE PROCESSES

Erica J. Ho, Jenna Reinen, David C. Gruskin - Yale University, New Haven, CT, USA; Hyojung Seo, Ifat Levy - Yale School of Medicine, New Haven, CT, USA; Avram J. Holmes - Yale University, New Haven, CT, USA

The ability to predict the outcomes of interpersonal exchanges is critical for successful navigation through our complex social world. This adaptive feature of social functioning relies on the dynamic coordination of a range of abilities, from perceiving socially-relevant stimuli to learning social contingencies, and involves the integrated function of overlapping brain systems encompassing the medial prefrontal cortex (mPFC) and striatum. The present ongoing study employs a pair of novel tasks aimed to investigate the interaction of social perception and prediction. In the first task, participants rate the valence (negative to positive) of face photographs morphed to depict varying degrees of anger and happiness. Next, while undergoing fMRI scanning, participants complete a reinforcement learning task in which they have repeated encounters with two targets (faces) who offer "deals" while the valence and intensity of their expressed emotion varies from calm through happy or angry. On each trial, participants work to learn the target's intention, indicate whether they accept or reject the ostensible offer, and receive probabilistically determined feedback. Preliminary results suggest that individual differences in emotion perception accuracy predict variation in self-reported affect (i.e., subthreshold depressive symptoms), as well as successful learning behavior. Ongoing analyses aim to identify the extent to which emotion perception ability is related to observed prediction errors in mPFC and striatum during social contingency learning. Precise characterization of the interactions linking perceptive and predictive aspects of social functions may provide crucial insights into not only typical behavior, but also neuropsychiatric disorders marked by social and hedonic abnormalitie

# VMPFC-RVLPFC COACTIVATION MEDIATES THE RELATIONS BETWEEN DEPRESSION SEVERITY AND EFFORTLESS EMOTION REGULATION PERFORMANCE

Itamar Jalon, Alon Erdman, Noam Goldway - Tel Aviv University, Tel Aviv, Israel; Maya Bleich, Moran Artzi, Yoav Domani, Hagai Sharon - Sourasky Medical Center, Tel-Aviv, Israel; Eiran Harel - Beer Yaakov Mental Health Center, Israel; Rany Abend - National Institute of Mental Health, Bethesda, MD, USA; Talma Hendler - Tel Aviv University, Tel Aviv, Israel

It was recently suggested ER implementation relies on ongoing value tracking (on a good-for-me/badfor-me axis; known to involve vmPFC) by default, while higher order ER processes can override the default function (involving regions in lateral-PFC). As impaired ER and valuation link to core symptoms of depression, we tested a simple, effortless ER process and its utilization of a value-sensitive region in vmPFC in MDD. To examine this matter, we used the emotional-stroop task to probe for Emotional Conflict Adaptation (ECA; the effortless adaptation to consecutive incongruent emotional stimuli), known to involve vmPFC. Treatment-resistant MDD patients (n=40) and healthy controls (n=63) completed the task while undergoing fMRI. A separate monetary reward task was used as localizer for a valuesensitive region in vmPFC. We hypothesized that ECA performance will rely on vmPFC recruitment, will involve reduced connectivity with high-order ER regions (IPFC), and that both will be related to depression severity. Across the entire sample (n=103), ECA index positively correlated with vmPFC activation. ECA index negatively correlated with vmPFC-rvIFG functional connectivity during ECA trials. These results suggest this ER process relies on vmPFC activation, and that involvement of a higherorder ER region co-occurs with decreased ER. Lastly, ECA index significantly accounted for depression severity, and this association was mediated by vmPFC-rIFG task connectivity. Our results depict a link between ER, activation in a value-sensitive region in vmPFC and high/low-order ER regions connectivity. Most importantly, the variance in behavior accounted for by this connectivity pattern, emerged as explanatory of depression symptoms.

### D-8

# SPATIAL, TEMPORAL, AND SOCIAL VARIANTS OF DISTANCING YIELD A CONSISTENT PATTERN OF BRAIN ACTIVATION

### John P Powers, Kevin S LaBar - Duke University, Durham, USA

Distancing is a type of reappraisal that involves simulating a new perspective to alter the psychological distance and emotional impact of a stimulus. Meta-analysis of fMRI studies has demonstrated that distancing is associated with activation in regions of the default mode and frontoparietal control networks. However, psychological distance encompasses several domains, including spatial, temporal, and social distance, which are not equally represented across studies of distancing. Thus, it is unclear whether the neural basis of distancing involves domain-specific variations. To answer this question, we trained healthy young adults to decrease emotional responses to aversive pictures using spatial (imagine stimulus far away), temporal (imagine stimulus in the past), and objective (social; imagine stimulus from a neutral observer perspective) distancing techniques. We used an event-related design to collect fMRI data while participants performed each of these techniques and responded naturally to aversive pictures (view). Conjunction analysis of spatial - view, temporal - view, and objective - view revealed extensive overlap in distributions of activation including bilateral superior temporal sulcus, left inferior parietal lobe, left ventrolateral prefrontal cortex, left dorsal frontal cortex, pre-supplementary motor area, posterior cingulate cortex, and precuneus. Contrasts of each distancing technique against the remaining techniques vielded no significant results. These results support a distribution of brain activation associated with distancing that is consistent across domains, and may help to explain findings of comparable regulation performance across distancing techniques of different domains. Additionally, they provide preliminary neuroscientific support for the coherence of psychological distance domains described by construal level theory.

### NEURAL ACTIVATION OF SOCIAL AFFECT AND THE ROLE OF OXYTOCIN AND OXTR IN HIGH-FUNCTIONING AUTISM

Annalina V. Mayer - Department of Psychiatry and Psychotherapy, Lübeck University, Lübeck, Germany; Anne-Kathrin Wermter, Sanna Stroth, Michael Haberhausen, Thomas Stehr, Inge Kamp-Becker - Department of Child and Adolescent Psychiatry, Psychosomatics and Psychotherapy, Philipps University of Marburg, Marburg, Germany; Frieder M. Paulus, Sören Krach - Department of Psychiatry and Psychotherapy, Lübeck University, Lübeck, Germany

Individuals diagnosed with Autism Spectrum Disorders (ASD) often show a reduced ability to intuitively represent their own and others' mental and affective states. Recent evidence suggests that intranasal application of the neuropeptide oxytocin (OXT) facilitates various social processes that are linked to symptoms in ASD, such as empathy, Theory of Mind and emotion recognition. OXT is therefore considered as potentially beneficial in ASD treatment. However, the individual response to OXT is influenced by genetic factors, such as variation in the oxytocin-receptor-gene (OXTR). It is yet unclear how this might interact with OXT effects in ASD patients and whether it might modulate the neural processes underlying social affect. To address these questions, we examined male participants with a diagnosis of high-functioning ASD using a double-blind, cross-over, placebo controlled fMRI protocol. We employed three experiments to investigate distinct levels of social affect: basic emotion recognition, empathy for physical pain and empathy for other's embarrassing moments as a form of social pain. On the behavioral level, OXT slightly moderated ratings of social affect across all experiments. The fMRI results revealed that brain areas associated with processing of arousal as well as mentalizing regions were differentially engaged after OXT application, depending on the variant in the OXTR. Our findings offer new perspectives on neural mechanisms underlying the effect of OXT on social affect in ASD. Considering genetic variation in the OXTR might be helpful when assessing the effectiveness of OXT treatment in certain individuals.

### D-10

### DEVELOPING THE ABILITY TO REMEMBER INFORMATION WITH HIGH FUTURE REWARD

Kate Nussenbaum, Catherine A. Hartley - New York University, New York, NY, USA Previous work has revealed that individuals demonstrate enhanced memory for information associated with explicit reward signals at the time of learning. However, in the real world, such explicit reward signals are often absent. Instead, the reward value of information depends on the structure of the environment. In this experiment, we examined whether individuals could infer the value of remembering information based on the statistics of their environments. Specifically, we collected data from children, adolescents, and adults as they completed three different tasks - a task in which they learned the frequency with which information would be probed and the total reward they could earn by remembering it, a task in which they learned the information itself, and a final test of memory for the information presented. Our analyses examined whether participants could use the statistics of their environment to prioritize encoding resources toward information that would be more rewarding to remember. Though almost all subjects demonstrated evidence of learning the frequency with which information would be probed and reported recognizing that selectively remembering more frequent information would be a useful strategy to maximize reward, participants' ability to implement this strategy varied widely. Preliminary results revealed interacting effects of age and general cognitive ability on participants' ability to selectively remember more rewarding information.

# THE INFLUENCE OF PARENTING STYLE ON THE NEURAL CORRELATES OF EMOTION PROCESSING AND ITS RELATION WITH INTERNALIZING SYMPTOMS IN CHILDREN

Elena Pozzi - Melbourne Neuropsychiatry Centre (MNC), Department of Psychiatry, The University of Melbourne & Melbourne Health, Melbourne, Australia; Julian G. Simmons - Melbourne School of Psychological Sciences, University of Melbourne, Melbourne, Australia; Chad A. Bousman -Departments of Medical Genetics, Psychiatry, and Physiology & Pharmacology, The University of Calgary, Calgary, Canada; Orli Schwartz - Melbourne School of Psychological Sciences, University of Melbourne, Melbourne, Australia; Lisa Sheeber - Oregon Research Institute, Eugene, USA; Michelle Byrne, Nicholas B. Allen - Department of Psychology, University of Oregon, Eugene, USA; Sarah L. Whittle - Melbourne Neuropsychiatry Centre (MNC), Department of Psychiatry, The University of Melbourne & Melbourne Health, Melbourne, Australia

Objective The importance of parenting in influencing mental health outcomes, particularly depression, during childhood and adolescence is well known. However, the neurobiological mechanisms are still unclear. Emotion processing impairments are thought to be fundamental to depression. As such, investigating the effect of parenting behavior on the neural underpinnings of emotion processing in children may provide fundamental clues as to the link between parenting and depression. Method 94 children (49 females) who were part of a larger longitudinal study (the Families and Childhood Transition Study) participated. Observational measures of parenting style were collected from mothers at baseline. Functional magnetic resonance (fMRI) during an implicit emotion-processing task was performed at follow-up (mean age=9.9 years) and measures of internalizing symptoms were collected. Results Higher maternal aggressive behavior and higher maternal positive behavior were associated with decreased and increased activity in the lingual gyrus, respectively, during implicit processing of negative (angry and fearful) emotional stimuli (i.e., faces). Maternal communication was associated with increased activity in the amygdala and middle orbitofrontal cortex (mOFC) in the whole sample, and in temporal pole, somatosensory cortex and amygdala in girls. Activation in the latter two regions was in turn related to lower parent-reported depression/anxiety symptoms. Further, positive maternal behavior was associated with amygdala connectivity with the middle temporal gyrus. Conclusions The brain regions implicated suggest that maternal behavior may influence the identification, and attribution of meaning and intention to affective stimuli. Implications for depression require further investigation.

### D-12

### MATCHING RISK PREFERENCES TO BEAT A SOCIAL OPPONENT

### R. McKell, Carter - University of Colorado Boulder

In an interactive, multiplayer, risk game, in which behavior correlated with drug use, players deviated from solitary risk preferences to beat an opponent in a pattern that correlated with fMRI activation at the convergence of numeric and social processing in the brain. Public health concerns over risk taking have been shown to be closely tied to social factors. Social influences on risk taking have been demonstrated in tasks from psychology but these tasks utilize artificial social pressures and require additional constraints to understand the neural mechanisms of social influence. We designed an interactive, incentive-compatible, multiplayer, social, risk game in which a participant recruited for fMRI played against multiple co-recruited behavioral participants providing both a substantial imaging population (n=29) as well as a large behavioral sample (n=159). Risk preferences during solitary play correlated with self-reported drug use. Players deviated from solitary risk preferences to beat opponents in the game, taking on more risk to win when opponents were risky but also foregoing risk to guarantee a win. Compared to a non-interactive social baseline, risk behaviors in the social game correlated with fMRI activation at the convergence of numeric and social processing in the temporal parietal junction. This finding is consistent with a model in which risk estimation in a social setting does not occur by simple modulation of risk perception but instead requires construction of a social context for decision making.

# AMYGDALA FUNCTIONAL CONNECTIVITY PREDICTS DEPRESSIVE SYMPTOMS IN THE TRANSITION FROM CHILDHOOD TO ADOLESCENCE: A PROSPECTIVE STUDY

Marjolein E.A. Barendse, Julian G. Simmons, Australia, Sarah Whittle - University of Melbourne, Carlton, VIC, Australia

The transition from childhood to adolescence is a vulnerable period for the development of depression. Neuroimaging studies to date have indicated an important role of the connections between limbic areas and the prefrontal cortex (PFC) in the aetiology of depression. However, very little research has examined this in a longitudinal or prospective way during this vulnerable period. Therefore, the current study aimed to investigate whether functional connectivity of the amygdala while processing fearful facial expressions during late childhood, can predict depressive symptoms 3 years later in early adolescence. Method: Participants were 68 children (M age 9.51 years at time 1 and 12.22 years at time who completed the Children's Depression Inventory (CDI) and Positive and Negative Affect Scale (PANAS) at both time points. They also viewed fearful and calm facial expressions while undergoing functional MRI at time 1. Psychophysiological interaction (PPI) analyses were performed to examine amygdala connectivity and its relation to later (time 2) symptoms, controlling for baseline (time 1) symptoms. Results: More positive connectivity of the right amygdala with the left inferior parietal cortex and dorsolateral PFC was associated with lower CDI total score and lower PANAS negative affect at time 2. Additionally, in girls, more positive connectivity of right amygdala with the anterior cingulate cortex was associated with lower PANAS negative affect at time 2, whereas the opposite was true for boys. Conclusion: Results suggest that functional connectivity between the amygdala and prefrontal and parietal areas may be relevant to the development of depressive symptoms.

### D-14

### HERITABILITY OF AGGRESSION FOLLOWING SOCIAL EVALUATION IN MIDDLE CHILDHOOD: AN FMRI STUDY

Michelle Achterberg, Anna C.K. van Duijvenvoorde, Mara van der Meulen, Marian J. Bakermans Kranenburg, Eveline A. Crone - Leiden University, the Netherlands

Middle childhood marks an important phase for developing and maintaining social relations. At the same time this phase is marked by a gap in our knowledge of the genetic and environmental influences on brain responses to social feedback and their relation to behavioral aggression. In a large developmental twin sample (509 7-9-year-olds) the heritability and neural underpinnings of behavioral aggression following social evaluation were investigated, using the Social Network Aggression Task (SNAT). Participants viewed pictures of peers that gave positive, neutral or negative feedback to the participant's profile. Next, participants could blast a loud noise towards the peer as an index of aggression. Genetic modeling revealed that aggression following negative feedback was best explained by shared and unique environmental influences. On a neural level, the anterior insula and anterior cingulate cortex gyrus (ACCg) responded to both positive and negative feedback, suggesting they signal for social salience cues. The medial prefrontal cortex (mPFC) and inferior frontal gyrus (IFG) were specifically activated after negative feedback, whereas positive feedback resulted in increased activation in caudate, supplementary motor cortex (SMA) and dorsolateral prefrontal cortex (DLPFC). Increased SMA and DLPFC activation after positive feedback was associated with more aggressive behavior after negative feedback. Moreover, genetic modeling showed that 17% of the variance in dorsolateral PFC activity was explained by genetics. Our results suggest that the processing of social feedback is partly explained by genetic factors, whereas shared environmental influences play a role in behavioral aggression following feedback.

### D-15 \*SANS Poster Award winner\*

# SOCIAL INFLUENCES ON HEALTH BEHAVIOR: PHYSICAL ACTIVITY ACROSS SOCIAL NETWORK INFLUENCES NEURAL RESPONSES TO HEALTH MESSAGES AND BEHAVIOR CHANGE

#### Prateekshit Pandey, Yoona Kang, Nicole Cooper, Christin Scholz, Matthew Brook O'Donnell, Emily B Falk – University of Pennsylvania

Brain activity in the medial prefrontal cortex in response to persuasive messages can predict later behavior change. Further, individuals are strongly influenced strong the behavior of others in their social network. Yet, little is known about how the social group surrounding the individual might affect neural receptivity to persuasive messaging. We propose that neural processing of persuasive messages can change based on group-based social network norms. To test this, sedentary adults (n = 177) provided information about the physical activity levels of their social network members (i.e. group-based social network norms) and viewed health messages promoting physical activity in an fMRI scanner. In particular, activity within the ventromedial prefrontal cortex (vmPFC), previously associated with behavior change following exposure to persuasive messages, was monitored. We also followed the participants for a month, objectively logging physical activity using wrist-worn accelerometers. We found that the average perceived levels of physical activity within a participant's social network was significantly related to activation within a functionally defined map of the VMPFC. Further, we found a marginally significant indirect effect, via vmPFC activation, of physical activity levels of participants' social networks on increased physical activity and decreased sedentary behavior. These results provide new links between social network characteristics and individuals' neural receptivity to messaging and subsequent behavior change. Specifically, having physically active members in one's social network can make people become more receptive to health messages and positively change subsequent health behavior.

### D-16 INFANT BRAIN RESPONSE TO MOTHER'S VOICE PREDICTS SOCIOEMOTIONAL DEVELOPMENT

### Andrew Erhart, Pilyoung Kim - University of Denver, Denver, USA

Evidence shows that infants respond preferentially to their mother's voice, both behaviorally and neurally. In 10-year-old children, the specificity of brain response to mother's voice predicted social communication scores, however it is unknown whether the developmental influences of brain response to mother's voice can be observed earlier than 10 years old. The current study used fMRI to investigate the extent to which activation in brain areas that are preferentially responsive for mother's voice are associated with socioemotional outcomes in infancy. During natural sleep, sixteen infants (M=15.79 months, SD = 4.13) listened to angry, sad, happy and neutral tones of voice by their mother and an unfamiliar woman. Infant functional data was registered to their own anatomical image and warped onto a standard 1-year old infant template. A whole-brain linear mixed effects model was conducted with emotion (angry, sad, happy, neutral) and actor (mother, control) as within-subject's factors and infant's age as a covariate. Following a planned comparison of Mother > Control, the clusters with significantly (p < .005 corrected) more activation for mother's voice over control voice were extracted. Clusters significantly preferential to mother's voice were found in left fusiform gyrus, right fusiform gyrus, left inferior temporal gyrus, and right superior temporal pole including insula. Activation in the right fusiform gyrus to mother's voice was significantly associated with children's socioemotional development as assessed using the Bayley-III, r(15) = .586, p = .017. This finding demonstrates developmental consequences of brain response to mother's voice even in infancy.

### DISCOVERING SOCIAL GROUPS VIA LATENT STRUCTURE LEARNING

Tatiana Lau, Thomas Pouncy, Samuel J Gershman, Mina Cikara - Harvard University, Cambridge, USA Little is known about how we learn social group boundaries. We show that a domain-general, computational model of latent structure learning predicts social preferences better than models using explicit category labels and similarity. Participants state their own political stances and learn the stances of 3 agents (A, B, and C). A and B each agree with the participant 50% of the time; we manipulate the agreement level of C to either cause or not cause the participant to form a latent group consisting of themselves, B, and C. When asked whose political stance (A's or B's) they would adopt, participants are more likely to choose B only when a latent group is formed. This contradicts similarity frameworks, which predict equal rates of choosing A and B and that C's presence should not matter. We find the predicted latent structure effect (Experiment 1); that it persists even when B's preferences exhibit low coherence (Experiment 2); that it leads subjects to rate B as more likeable, competent, and moral (Experiment 3); and persists despite explicit, countervailing labels of team memberships. Even when B is labelled as an out-group member and A is labelled as an in-group member, participants side with B (Experiment 4). Social groups drive many decisions, from the quotidian (who do I approach at this party?) to the consequential (who do we target with missile strikes?). Understanding how we infer such groups and the flexibility of these inferences is a crucial first step to identifying how to diminish intergroup bias.

### D-18

### THE JOINT CONTRIBUTION OF PLACENTAL HSD11B2 AND NR3C1 GENE EXPRESSION FOR EMOTION DYSREGULATION IN YOUNG CHILDREN

Wei Zhang - CUNY Queens College, NYC, US; Jessica Buthmann - CUNY Graduate Center, NYC, US; Duke A. Shereen - CUNY Advanced Science Research Center, NYC, US; Yoko Nomura - CUNY Queens College, NYC, US

Evidence is accumulating that placental genes involved in the stress response can influence offspring development. 11-beta hydroxysteroid dehydrogenase (HSD11B2) and glucocorticoid receptor (NR3C1) are two placental genes that modulate glucocorticoid levels in-utero. Alterations in their expression lead to suboptimal neurodevelopment in young children. However, little is known about the effects of these genes on the development of emotion regulation. Furthermore, although these two genes regulate the same biological pathway, their potential combined contribution has not vet been characterized. The current study examined the independent and joint effects of placental HSD11B2 and NR3C1 genes on the development of emotion regulation in 103 1 to 5-year-old children. Placenta samples were collected at the time of delivery, and the mRNA level of gene expression was assessed. Emotion regulation was measured by respiratory sinus arrhythmia (RSA) activity during a rest condition and a startle task during the postnatal visit. Our results showed that the interaction between HSD11B2 and NR3C1 genes predicted RSA reactivity during the startle task. Specifically, lower HSD11B2 in combination with lower NR3C1 expression was associated with greater blunted RSA reactivity. Blunted RSA reactivity reflects emotion dysregulation and is often associated with child behavioral problems. No main effect was observed for the independent effects of each gene and rest RSA was not predicted by levels of gene expression. To sum up, alterations in placental gene expression across the biological pathway for glucocorticoid modulation contribute to emotion dysregulation in young children. This study provides new insights into the prenatal basis for child psychopathology.

### NEURAL SYNCHRONY RELATES TO PERCEIVED AUTHENTICITY IN RETELLING STORIES

*Kristin V Shumaker, Matthew B. O'Donnell - University of Pennsylvania; Ralf Schmälzle - Michigan State University; Matthew D. Lieberman – UCLA; Emily B. Falk – University of Pennsylvania* Sharing personal stories - telling our own stories and retelling the stories of others - is a ubiquitous social behavior with potentially powerful consequences. Synchronous, correlated brain activity has been found within groups of listeners exposed to the same story, but the outcomes of this on future retellings of the story are unknown. In this functional near-infrared spectroscopy (fNIRS) study, we investigate the role of neural synchrony between a listener and a larger group in successful story retelling, where success is measured as the perceived authenticity of the retold version of the story. After asking each listener in the study (n=39, female) to listen to a story and then retell it as though the experience happened to them, those retold stories were rated by an independent group of participants (n=1,097, female) on three dimensions of authenticity. Our results show that the more correlated the brain activity of one individual is to the group average, the more their story retelling is perceived as authentic by subsequent listeners. These results suggest that being perceived as authentic when retelling a story to a new audience may in part reflect normative patterns of response to stories.

### D-20

# AGE OF AVATAR MODULATES THE ALTERCENTRIC BIAS IN A VISUAL PERSPECTIVE-TAKING TASK: AN ERP STUDY

Victoria, E A Brunsdon - University of Kent, Elisabeth, EF Bradford - University of Kent, Heather, J Ferguson - University of Kent

Visual perspective-taking involves being able to see the world from another person's point of view. Healthy adults are able to rapidly and accurately compute what someone else can see, yet they experience difficulties ignoring the irrelevant perspective when there is a conflict between their own and another person's perspective, experiencing egocentric and altercentric interference. We investigated how the characteristics of the other person might influence perspective-taking ability by changing the age of the other person (a child or an adult). We predicted that the altercentric interference effect (i.e., interference from the other person's perspective) would be reduced or absent when the other person present was a child as compared to an adult. Participants completed a visual perspective-taking task, in which they had to verify the number of discs seen from either their own or another person's perspective (either a child or an adult). The age of the avatar (child or adult) was manipulated between (Experiment 1) or within (Experiment 2) participants, and interference was assessed using behavioral (Experiments 1 and 2) and ERP (Experiment 1) measures. Results revealed that altercentric interference is reduced or eliminated when a child avatar was present, suggesting that adults do not automatically compute a child avatar's perspective. This effect is attributed to an own-age bias, which could be due to enhanced visual processing of the own-age perspective or because adults assume a reduced mental capacity for younger children.

### D-21

# SOCIAL TOUCH OBSERVATION IN ADULTS WITH AUTISM: INTACT COGNITIVE UNDERSTANDING BUT LACK OF EMBODIED RESONANCE

Haemy Lee, Stien Van De Plas, Michelle HA Hendriks - Department of Brain and Cognition, KU Leuven, Leuven, Belgium; Steffie Amelynck, Bart Boets - Department of Neuroscience, Center for Developmental Psychiatry, KU Leuven, Leuven, Belgium; Hans Op de Beeck - Department of Brain and Cognition, KU Leuven, Leuven, Belgium

Individuals with autism spectrum disorder (ASD) exhibit impairments in the use of nonverbal communication such as social and reciprocal touch. The current ongoing study aims to characterize affective responses to observed social touch in individuals with ASD and its underlying neural mechanisms. Individuals with ASD (N=21) and neurotypical (NT) adults (N=17) evaluated valence and

arousal of 39 videos displaying social touch interactions, from which we extracted each group's affective similarity matrix. Subsequently, participants underwent fMRI scans while watching the same videos. By means of multivoxel pattern analysis we calculated neural similarity matrices in two predefined regions that are relevant to social cognition and vicarious touch processing, i.e. the temporoparietal junction (TPJ) and somatosensory area BA2, respectively, and we modeled the relationship between the neural matrix and the affective similarity matrix. Results suggest that individuals with ASD and NT adults perceive the valence and arousal of touch similarly. Also at the brain level, the affective meaning of touch is equally well represented in TPJ region in both groups (both p < 0.001) and the quality of these representations does not differ between groups (p=0.41). Conversely, unlike the NT group (p < 0.001), the ASD group does not show affective representations in BA2 (p=0.5) resulting in a significant group difference in the quality of affective representations in this somatosensory area (p=0.04). Our findings imply intact affective representations in theory of mind regions but lacking vicarious somatosensory representations when adults with high-functioning ASD observe other's social touch communications.

### D-22

### ASSOCIATIONS BETWEEN SELF-REGULATION ISSUES AND NEURAL CORRELATES OF SOCIAL AND NON-SOCIAL REWARD

Adaeze C. Egwuatu, Hannah Wisniewski, Jennifer M. McDermott - University of Massachusetts, Amherst

Reward processing has traditionally been examined using object-based rewards (e.g., money). However, a growing body research suggests that positive social cues (e.g., happy faces) activate similar brain areas associated with approach-motivation and reward processing. However, few studies have examined differences in neural reactivity to distinct social and non-social reward contexts on neural activity in children and how it relates to behavior. The current study aimed to address this guestion. Forty-one children (20 females; Mage=8.46 years) viewed and rated 150 images. Images consisted of 4 categories: interpersonal reward (e.g., social interaction), intrapersonal reward (e.g., faces), object reward (e.g., food), and neutral images. Two event-related potentials (ERPs), the N400 and late-positive potential (LPP), were compared to examine differences in motivation salience. Parent report of child's behavior was also examined. Results revealed that the N400 was largest to object-based rewards at frontal regions (p's < .05). Males also showed larger N400s to object-based rewards, while females elicited larger N400s to interpersonal reward (p<.01). For the LPP, there was a category by gender interaction with males exhibiting larger LPPS to object-based rewards compared to females (p<.01). Partial correlations revealed that attenuated N400s and enhanced LPPs to social reward images (i.e., interpersonal and intrapersonal) was related to self-regulation issues, but there was no association with ERPs and object-based rewards. Findings highlight neural differences between social and non-social reward contexts in children and across gender. Also, associations between behavioral measures and ERPs to social rewards indicate timing of neural processes should be examined.

### D-23

### TRAVELING TOGETHER THROUGH TOPIC SPACE PREDICTS ENJOYMENT OF CONVERSATION

*Emma M. Templeton, Luke Chang, Thalia Wheatley - Dartmouth College, Hanover, USA* What makes conversation good? Conventional wisdom suggests that what we talk about matters (e.g., stick to sports, avoid politics). Here, we explore a different hypothesis: It isn't the topic that matters per se, but rather how we move from one topic to another. We used topic modeling – a natural language processing technique – to explore how people move between topics during unstructured, naturalistic conversation. We recorded dyads as they talked to each other for 10 minutes and used transcripts of those conversations to train our topic model. We then fit this model to each speech turn, allowing us to represent each turn as one point in a hyperdimensional "topic space." To quantity movement within this space, we first computed the Euclidean distance between each speech turn for each participant in each conversation. We then summed these values to yield a metric of total distance travelled, capturing how far each participant moved through topic space. Participants who travelled further reported more enjoyable conversation. Moreover, it was not simply distance travelled that predicted enjoyment but whether two conversation partners traveled far together. By correlating the time series of cosine similarity values between each speech turn for each participant with that of their partner, we quantified the alignment between their conversational trajectories. Participants with greater topic synchrony reported enjoying their conversations more. This study demonstrates how natural language processing can be harnessed to quantify mental coupling during real world conversation, allowing us to better understand how conversation facilitates social bonds.

### **D-24**

### NEURAL RESPONSES TO ONE'S OWN NAME UNDER MORTALITY THREAT

#### Shihui Han - Peking University, Xiaoyue Fan

Recent behavioral research has shown evidence for greater inclination to avoid symbolic cues of mortality threats in nonbelievers than Christians. However, the neurocognitive mechanisms underlying religious influences on behavioral tendency to avoid mortality threats remain unknown. We tested the hypothesis of distinct arousal/attention-related brain responses to self-related information under mortality in in nonbelievers and Christians. We recorded event-related brain potentials (ERPs) from Christians and nonbelievers while they viewed their own names and a stranger's name (i.e., Zuma) that flashed around a cue word (i.e., death, pain or life) located at the center of a screen. While own name vs. a stranger's name induced faster responses and larger P3 amplitudes, the P3 amplitudes to own name showed distinct patterns of modulations by the cue words in nonbelievers and Christians. Specifically, own name elicited larger P3 amplitudes in the death than pain/life cue conditions in nonbelievers but not in Christians. Moreover, the differential P3 amplitude to own names in the death vs. life cue conditions predicted greater inclination to avoid mortality threats in nonbelievers but not in Christians. Moreover, the differential P3 amplitude to own names in the death vs. life cue conditions predicted greater inclination to avoid mortality threats in nonbelievers but not in Christians. Our findings provide a neurocognitive account of increased behavioral tendency to avoid mortality threats in nonbelievers than in Christians.

### D-25

### THE CO-ACTIVATION AND COMPETITION OF SOCIAL CATEGORIES

#### Ryan M. Stolier, Jonathan B. Freeman – New York University

Humans readily sort one another into social categories. This is accomplished despite the fact that diverse category members may often display cues visually related to their opposing categories (e.g., a feminine male). Recent computational models propose this process involves initial partial co-activation of the multiple cued social categories simultaneously (e.g., co-activation of male and female). Mousetracking paradigms have suggested this process through findings that participants' hand movements are attracted simultaneously to two competing response options during social categorization (e.g., 'Male' and 'Female'). We hypothesized such social-category co-activation to be reflected in neural representations in the fusiform gyrus (FG), a region central to face perception and representation of social categories. Furthermore, we hypothesized regions involved in cognitive-monitoring to respond to category competition (e.g., dorsal anterior cingulate, dACC) to help resolve such competition. We collected mouse-tracking data concurrently with fMRI (n = 16) during gender and race categorization tasks. We found that the extent to which the hand was simultaneously attracted to the opposite gender or race category response option corresponded to increased neural-pattern similarity with the average pattern associated with that category, which in turn associated with stronger dACC engagement. The findings point to a model of social categorization in which occasionally conflicting facial features are resolved through competition between co-activated FG representations with the assistance of conflictmonitoring regions. More broadly, the results offer a promising multimodal paradigm to investigate the neural basis of "covert" temporarily-active representations in the service of a broad range of processes in social and affective neuroscience.

### SOCIAL CLOSENESS MODULATES REPRESENTATIONAL SIMILARITY BETWEEN THE SELF AND OTHERS IN MEDIAL PREFRONTAL CORTEX

### Andrea L Courtney, Meghan L Meyer - Dartmouth College

Some have proposed that self and other identities merge with increasing social closeness, giving rise to overlapping mental representations (Aron et al., 1991). The present study sought to determine whether, consistent with merging representations, social closeness modulated the representational similarity of self and others, as measured by multivariate brain activation patterns. During an fMRI scan, participants made personality trait judgments for sixteen targets: the self, five nominated close others, five nominated acquaintances, and five celebrities. Outside of the scanner, participants provided social closeness ratings for each of these targets. These ratings were then compared with the neural representational similarity of each of the targets to the self. A whole-brain searchlight representational similarity analysis (RSA) revealed a region of the MPFC whose activation patterns during trait judgments reflected the social closeness of the targets to the participant. Neural activation in MPFC has previously been associated with reflecting on the self and close others (Kelley et al., 2002; Moran et al., 2011; Northoff & Bermpohl, 2004), but whether this activation reflected shared mental representations was unknown. Our results suggest that self-other overlap in the MPFC may be more nuanced and graded than previously demonstrated, and may reflect patterns consistent with the merging of self and other identities.

### D-27

# COMMON NEURAL PATHWAYS FOR EMOTIONAL AND ATTENTIVE TRAITS IN YOUNG CHILDREN

### Christiane S Rohr, Amy Webber, Dennis Dimond, Deborah M Dewey, Signe L Bray - The University of Calgary

Emotion and attention play ubiquitous roles in perception, cognition and social interactions, jointly underlying performance on numerous tasks in daily life. As skills in these domains develop rapidly, and perhaps jointly, in young children, we assessed the neural basis of overlap in these traits using functional connectivity (FC) analyses in 58 children aged 4-7 years. Children watched a TV show while fMRI data was acquired and regional timecourses were correlated to estimate FC. Emotional traits were assessed with the Emotion Regulation Checklist, which provided scores for emotion regulation and emotional lability. Inattentive and hyperaractive traits were assessed with the Swanson, Nolan and Pelham IV (SNAP-IV) Parent Questionnaire. To identify shared and distinct neural pathways, we used data-driven connectome-based predictive modelling to develop models of inattention, hyperactivity and emotional lability from the connectivity data. Behaviourally, emotional lability correlated with both inattention (r=.68, p<0.001) and hyperactivity (r=.8, p<0.001). Brain functional connections associated with all three measures revolved around pathways between midbrain-thalamus and the default mode network. In addition, emotional lability and inattention exclusively shared pathways within the dorsal attention network and its connections to hippocampus and dorsolateral prefrontal cortex; emotional lability and hyperactivity exclusively shared thalamostriatal connections, as well as connections between hippocampus and sensory areas. Our findings demonstrate the utility of dimensional (continuous) scores and predictive modeling to interrogate brain-behavior relationships in young children, and suggest that multiple brain pathways underlie the link between emotional lability and attentive traits in early childhood.

# BUFFERING EFFECT OF POSITIVE EMOTION ON SKIN CONDUCTANCE RESPONDING AND AMYGDALA ACTIVATION: A FEAR EXTINCTION STUDY

Olivia L Strauser, Amber D Swaim, Daniel S Lumian, Detre A Godinez - University of Denver; Christian E Waugh - Wake Forest University; Kateri McRae - University of Denver

Fear conditioning is a long-standing paradigm widely used to study the process of fear learning. However, not as much is known about the emotional contexts which best support successful fear extinction. Specifically, experiencing positive emotions during extinction may act as a safety signal to increase the success of extinction. Two studies were conducted to test this hypothesis, one measuring skin conductance response (SCR) in Study 1, and amygdala activation as measured by fMRI in Study 2. It was predicted that there would be an interaction between emotional context (positive vs. neutral) and conditioning (CS+ vs. CS-) on these two measures. Both studies utilized a standard fear conditioning procedure with a manipulation of emotional context during extinction. There was intentional oversampling due to the prerequisite of SCR or amygdala learning during acquisition for inclusion in extinction analysis. In Study 1, 42% of participants (N=36; 72.2% female, mean age=19.5) were defined as learners based on SCR. For Study 2, 47% of participants (N=20; 85.0% female, mean age=24.0) were identified as learners based on amygdala activation. Extinction analyses for Study 1 demonstrate a main effect of emotional context on SCR, such that SCR is significantly reduced under the positive emotion condition, but no significant interaction between emotional context and conditioning. Our research indicates there may be a broad suppressive effect of positive emotion during fear extinction.

### D-29

### NEURAL MECHANISMS OF COORDINATING MULTIPLE GOALS BASED ON CHANGING NEEDS

Thalia H. Vrantsidis, William A. Cunningham - University of Toronto

People often must coordinate multiple goals, where some depend on changing needs - e.g. driving to another city also requires getting food or gas as needed. We investigated the neural mechanisms underlying these abilities. While undergoing fMRI scanning, participants played a game where they had to maximize points without running out of in-game 'food' or 'water', which changed in value based on ingame 'hunger' and 'thirst'. On each turn, participants had to choose one of two items (food, water, or points). They then received either the chosen item (75% chance) or unchosen item (25% chance), which allowed for distinguishing option, choice and outcome related value signals. Value regions including ventromedial prefrontal cortex showed responses consistent with needsensitive evaluations of food and water. Pursuit of points additionally activated the ventral striatum. These results may indicate partly distinct processes for the flexible evaluation of need-dependant goals, and the more stable evaluation of goals that do not depend on needs. Need-sensitive responses also changed depending on the two options available. When selecting between competing need-dependent options (food vs water), these areas tracked only to the chosen item's need. When only one option depended on needs (food/water vs points), they tracked need for the need-dependant option regardless of choice. This suggests that competing need-dependent goals may be compared directly in flexible valuation areas like VMPFC. However, when more stable, needindependent, values must be compared with needdependant ones, this comparison may occur elsewhere.

### D-30

# SOCIOSEXUALITY AND BEHAVIORAL INHIBITION: ELECTROPHYSIOLOGICAL EVIDENCE OF INHIBITORY CONTROL DEFICITS TO SEXUAL STIMULI

*Erin N Palmwood, Robert F Simons - University of Delaware, Newark, DE, USA* Sociosexuality has been consistently associated with an increased likelihood of engaging in acts of infidelity. In light of emerging work suggesting a link between inhibitory control deficits and perpetration of cheating behaviors, the present study sought to clarify the association between sociosexuality and infidelity by examining neural correlates of behavioral inhibition to sexual stimuli among individuals with varying attitudes, desires, and behaviors surrounding casual sexual encounters. Participants completed a modified version of the stop-signal reaction time (SSRT) task while behavioral and electroencephalography (EEG) data were recorded. Results indicated that individuals with more unrestricted sociosexuality needed to recruit more cognitive resources in order to successfully inhibit behavioral responses to sexual, but not neutral, stimuli. These findings highlight deficits in inhibitory control to sexual stimuli as a potential mechanism by which sociosexuality confers increased risk for engaging in acts of infidelity in romantic relationships, which may be used to inform individual and couple interventions for cheating behaviors.

### D-31

# EFFECTS OF EVALUATIVE GOALS ON CONSCIOUS PERCEPTION OF EMOTIONAL FACES: A BINOCULAR RIVALRY STUDY

Dustin T Weilbach, Daniel S Lumian, Timothy D Sweeny, Kateri McRae – University of Denver Binocular rivalry (BR) presents different images to each eye at the same time and was used here with emotional faces to explore the effects of top-down manipulation on emotional perception. BR allows for the measurement of predominance (the first percept to reach conscious awareness) and dominance (the percept reported in awareness most often), and is primarily driven by bottom-up processes. We manipulated two factors to examine whether top-down instructions could influence conscious perception of cross-valence pairs of emotional expressions. The first factor, evaluative condition, consisted of positive focus, negative focus, and no focus. The second factor, emotional expression pair, consisted of three cross-valence pairs: happy vs sad, happy vs disgust, and happy vs fear. Participants were 28 college students who identified as majority female (n=17, 61%) with a mean age of 19.86 years (SD=2.59). We hypothesized congruency effects between top-down focus and perception in predominance and dominance, such that more positive (negative) would be reported more often in the positive (negative) condition. We observed a main effect of evaluative condition on both predominance F(2,54) =5.76, p<.01, =.18, and dominance F(2,54) =3.60, p<.05, =.12. These effects were driven by greater happy predominance and dominance in the positive condition compared to negative and no focus conditions. Additionally, a main effect of valence (a positivity bias), was observed across all conditions regardless of focus, consistent with previous BR studies of emotion expression. Results suggest directed attention has a significant effect on predominance and dominance of happy faces paired with multiple negative faces.

### D-32

# USING A BIOLOGICALLY BASED COMPUTATIONAL MODEL (PVLV) TO INTERPRET BOLD SIGNALS IN THE DOPAMINE SYSTEM

Jessica A. Mollick - University of Colorado Boulder, Yale University; Thomas E. Hazy - eCortex, Inc.; Kai A. Krueger - eCortex, Inc; Randall C. O'Reilly

While many fMRI studies focus on understanding which brain areas encode reward prediction errors (RPEs), interpretations do not always account for widespread modulatory projections of dopamine neurons, which also encode these signals. Using conditioned inhibition, where participants learn about an inhibitor that cancels the expected reward, reduces these effects of dopamine, as dopamine neurons respond with a inhibition or dopamine dip, to an inhibitor. A brain region called the lateral habenula drives these dip signals. In the fMRI study, we found that the habenula responds to an inhibitor, and replicated prior studies showing substantia nigra (SN) activity for reward predictors. Next, using a biological model of the dopamine system, the PVLV model, with different pathways for CS and US dopamine, and positive and negative valence, we test hypotheses about the sources of BOLD fMRI. The PVLV model makes precise temporal predictions for excitatory and inhibitory inputs to dopamine neurons, adding further predictors for interpreting BOLD beyond commonly used temporal-differences models. In the fMRI task we found the model's predicted absolute value of dopamine, which converts an expected inhibition of dopamine neurons to an increase in BOLD, fit BOLD in SN and the accumbens. The absolute value of predicted dopamine from the model in a pain learning task also correlated with

BOLD in the SN, amygdala and accumbens. This approach adds to our understanding of RPE encoding in these regions, motivates using biologically based dopamine models, and translates between electrophysiological data modeled by the PVLV model and human fMRI data.

### D-33

### THE ROLE OF ANXIETY IN EXPLORE-EXPLOIT DECISIONS

Danelly Rodriguez - Hunter College: Jennifer K Lenow, Elizabeth A Phelps – New York University In psychopharmacological research, exploratory tests (e.g. EPM maze) are used to test anxiolytic drug efficacy in rodents. In humans, high anxiety levels are associated with avoidance of uncertainty and decreased exploration. Humans use two strategies when exploring: Directed and Random exploration. Given that anxiety and exploration are both related to uncertainty, the present study tests for a causal relationship between anxiety and decreased exploration in humans. It is hypothesized that acute anxiety will predict a decrease in directed and random exploration. Thirteen subjects (77% female) completed an explore-exploit decision-making task (Horizon task) that measures exploration. Subjects chose between certain and uncertain choices in short (5 trials) and long (10 trials) horizon games. There were 8 safe and 8 threat alternating blocks within subjects. We used a well-validated threat-of-shock manipulation to induce acute anxiety within threat blocks. We estimated a logistic regression model to measure changes in exploration as a function of anxiety. Predictor variables included differences in expected reward ( $\beta = 0.17$ , p < 0.05), horizon condition (long/short) ( $\beta = 0.73$ , p < 0.05), and block type (safe/threat) ( $\beta = 0.12$ , p < 0.05). We analyzed interaction effects between block type and horizon condition ( $\beta = -0.25$ , p < 0.05), and a 3-way interaction among all predictor variables ( $\beta = 0.03$ , p < 0.05). Preliminary results a decrease in random and directed exploration in threat blocks. Continuing this study will elucidate the relationship between emotion, anxiety disorders, and decision-making in humans.

### D-34

### REDUCED NEURAL REWARD BIAS IN MAJOR DEPRESSION DISORDER USING A FMRI PROBABILISTIC REINFORCEMENT LEARNING TASK

Alexandra Antonesei, Kou Murayama, Ciara McCabe - University of Reading Introduction: Major depression is characterized by a dopaminergic imbalance in response to reward processing. This study aims to adjust a reinforcement learning behavioural task to the scanner environment; and to test the effects of different reinforcement ratios of primary rewards at neural level in MDD vs HC. Methods: 26 MDD participants and 33 HC participants took part in a three-block eventrelated learning task during which they had to distinguish between two highly similar stimuli, while trying to maximize the intake of taste reward. Unknown to the participants, reward was delivered four times more for one stimulus (target) compared to the other one (non-target). Reward bias refers to the participants' tendency to define an ambiguous stimulus as target. Results: Whole brain analyses showed less BOLD activation in MDD vs. HC participants in the left caudate (p<.05, FWE for multiple comparisons) in response to the target vs. non-target contrasts, and in the anterior cingulate cortex (p<.05, FWE for multiple comparisons) in response to the target vs. missing the target contrasts. However, MDD vs. HC participants showed increased BOLD activation in the OFC/insula (p<.05, FWE for multiple comparisons) in response to the target vs the bias contrasts. Conclusions: In line with previous research, MDD participants showed reduced neural responses to rewarding stimuli. However, relative to HC participants, the MDD participants were better at differentiating between a rewarding and an ambiguous stimulus, while showing a conservative response in defining other stimuli as rewards.

### LOWER AUTONOMIC AROUSAL IS ASSOCIATED WITH HIGH AUTISTIC TRAITS IN NON-CLINICAL YOUNG ADULTS DURING EMOTION PROCESSING

Helio C. Cuve, Yu Gao - Brooklyn College – CUNY; Shawn Fagan - Graduate Center CUNY; Akiko Fuse - Brooklyn College - CUNY

Emotion Recognition Deficits (ERD) has been extensively studied in Autism Spectrum Disorders (ASD) but the underlying mechanisms are not yet well understood. We tested the eye avoidance and hypoarousal hypotheses for ERD in ASD using a non-clinical sample of young adults. One hundred and one undergraduates (71% female M age = 20.1224, SD=1.95) judged emotions displayed on the computer screen while their eve movements and skin conductance responses [SCRs] were being recorded. The task had two blocks: free gaze (block 1) and cued gaze: eyes vs. mouth (block 2). High vs. low autistic traits group were obtained using a top-bottom 20% AQ score criteria, matched for gender. Correlations and a partially repeated between subjects ANOVAs were performed. In general, autistic traits were significantly negatively associated with SCRs in all conditions. We found significant main effects of group on SCRs for sad, neutral and fearful faces, with high autistic traits displaying consistently lower SCRs across conditions. A condition\*group interaction was found for accuracy of sad faces, with higher autistic traits group being less accurate in the mouth condition. No significant effect of autistic traits on eye gaze patterns was found. Findings provide partial support to the hypoarousal hypothesis of autism, and are in line with findings on clinical populations. Mixed findings in the literature may be partly due to heterogeneity of methodologies and autism phenotype. This is the first study to link hypoarousal to high autistic traits in nonclinical sample during emotion processing. Keywords: autistic traits, hypoarousal; eye-tracking

#### D-36

# EFFECTS OF MINDFULNESS TRAINING ON EMOTION PROCESSING IN SELF-RELEVANT CONTEXTS: EVIDENCE FROM THE LATE POSITIVE POTENTIAL

Lianne Cho, Kristina Eichel, Willoughby, B Britton - Brown University

Previous research suggests that mindfulness improves emotion regulation as a possible mechanism for clinical outcomes, and that self-relevant stimuli induce greater emotional responses than non selfrelevant stimuli. Using the late positive potential (LPP), the present study investigates the neural correlates of emotion processing and self-referential activity. It is expected that LPP amplitude will be smaller for the control than self condition, and that the signal for both conditions will decrease after the intervention. 104 participants completed a cognitive task before and after an 8-week mindfulness-based intervention. The task involved categorizing positive and negative adjectives in self-relevant (self) and non self-relevant paradigms (control). LPPs were compared before and after the intervention, between conditions, and between opposite word valences. The intervention-induced LPP differences were correlated with participants' change scores of subjective or interview-based measures of affect, emotion regulation and depression. Contrary to the hypotheses, the LPP was greater in the control than self condition (p < .001, d = 1.2), as well as after compared to before the intervention in both conditions (p < .001, d = 1.2), as well as after compared to before the intervention in both conditions (p < .001, d = 1.2), as well as after compared to before the intervention in both conditions (p < .001, d = 1.2), as well as after compared to before the intervention in both conditions (p < .001, d = 1.2), as well as after compared to before the intervention in both conditions (p < .001, d = 1.2). .001, d = 2.4). There was no significant LPP difference between word valences, and no significant correlations between the LPP and self-report measures of emotion-related variables. The results suggest that 8 weeks of mindfulness meditation is associated with greater emotion processing of stimuli regardless of self-relevance. Meditation-related sensitization has been demonstrated by other studies, and may represent an underreported phenomenon. Consequently, further research is needed to determine the relevance of affective brain activity with respect to clinical outcomes.

# GREATER ACTIVATION OF AN EMOTION REGULATION NETWORK DURING REAPPRAISAL IS ASSOCIATED WITH BETTERY DIETARY SELF-CONTROL

#### Silvia U Maier, Todd A Hare - University of Zurich

Longitudinal studies have associated self-regulation with desirable life outcomes such as health, wealth and social connectedness. However, we do not yet know if and how regulatory abilities transfer across domains. Therefore, we combined emotion reappraisal and dietary choice tasks with fMRI to investigate links between regulatory success across domains.

### D-38 \*SANS Poster Award winner\* WHAT ARE THE BRAIN NETWORK PROPERTIES ASSOCIATED WITH FLOW EXPERIENCES? APPLYING NETWORK NEUROSCIENCE ANALYSES TO A NATURALISTIC BEHAVIORAL TASK

Richard Huskey, Shelby Wilcox - School of Communication, The Ohio State University; Rene Weber -Department of Communication, University of California Santa Barbara

Flow experiences are characterized by a high level of intrinsic reward that emerges as a result of a balance between high-task difficulty and high-individual ability at the task (Csikszentmihalyi, 1990). The synchronization theory of flow offers an explanation for the neural basis of this psychological process (Weber et al., 2009). It predicts an energetically optimized brain network organization between cognitive control and reward regions under conditions of a balance between task difficulty and individual ability. While initial results provide support for the structural predictions (Klasen et al., 2012; Ulrich et al., 2016, 2013), the connectivity and energetic optimality hypothesis remain untested. Our study addresses this gap. Subjects (n=18) played an open-source, naturalistic, and high experimental control video game while undergoing functional magnetic resonance imaging. Following a procedure that has been empirically validated in four different studies (Huskey et al., under review), we experimentally manipulated the balance between task difficulty and individual ability. Using graph theoretic analyses, we show that the balanced-difficulty condition (compared to low- or high-difficulty conditions) was associated with highest average network degree in fronto-parietal control, ventral attention, and memory networks. We also show that this condition was characterized by the highest level of global efficiency. These results provide a first ever test of synchronization theory's core predictions and suggest important insights in the way in which task-related intrinsic reward shapes brain-network organization. Moreover, these results demonstrate the utility of using naturalistic behavioral paradigms for testing core questions in cognitive neuroscience (Krakauer, et al., 2017).

### D-39

### RACIAL BIAS INFLUENCES ON EMPATHIC INFORMATION PROCESSING - AN EEG STUDY

Sarah Fabi, Hartmut Leuthold - Department of Psychology, University of Tübingen, Germany Even though the chronometry of empathic information processing, from stimulus encoding, over categorization to motor processing stages, is quite well investigated, it remains unclear which processing stages are influenced by the racial background of the target. Thus, in order to identify the racial bias in empathic processing, we presented white participants pictures of fair- and dark-colored hands in painful and neutral situations and asked them to judge the painfulness or the skin color, while recording EEG. Event-related brain potentials indicated an automatic empathic influence on stimulus encoding and later controlled influences on the categorization stages, as reflected by the early posterior negativity (EPN) and the late posterior positivity (P3), respectively. P1 amplitudes (90-130 ms) over midline electrodes were smaller in the painful than the neutral condition for fair- but not dark-colored hands, speaking for an early influence of racial bias. Furthermore, we found a positive correlation between the implicit racial ingroup preference of participants and P3 amplitude differences between fairand dark-colored hands to painful stimuli only, indicating that racial bias influences the late categorization stage. Concerning the motor processing stages, EEG oscillations suggested larger facilitation of sensorimotor activity for painful than neutral stimuli before the response and larger inhibition after the response, but independent of skin color. In sum, the present study advances our understanding of the locus of the racial bias in empathy processing by demonstrating that both the early encoding stage and, depending on participants' implicit ingroup preferences, the late categorization stage are influenced by racial bias.

### **D-40**

### EXAMINING INTRINSIC FUNCTIONAL CONNECTIVITY OF THE AMYGDALA WITH CORTICAL NETWORKS IN REAL-WORLD ALTRUISTS

Kruti M. Vekaria, Charles J. Lynch - Georgetown University, Washington, DC, USA; Kristin M. Brethel-Haurwitz - University of Pennsylvania, Philadelphia, PA, USA; Elise M. Cardinale - National Institute of Mental Health, Bethesda, MD, USA; Abigail A. Marsh - Georgetown University, Washington, DC, USA Dominant evolutionary theories of altruism cannot easily explain costly altruism, during which an individual undergoes significant risks or costs to help another person. Prior research has demonstrated that extraordinary altruists, such as altruistic kidney donors, behaviorally show decreased social discounting and additionally exhibit greater amygdala volume and sensitivity to distress cues, in line with the amygdala's extensive connectivity to brain regions associated with affective and executive processing. Research utilizing resting state functional connectivity (rsFC) approaches finds that prosocial (versus individualistic) tendencies can be predicted by neural connectivity and global efficiency of the cingulo-opercular network in the brain. We extended these results by examining amygdala connectivity to canonical intrinsic networks in a sample of extraordinary altruists. We collected 7 minutes of resting state fMRI data in altruistic kidney donors and matched controls. Following preprocessing, cortical surfaces were generated in Freesurfer and the denoised fMRI time-series data was mapped onto the midthickness surface. We selected an independent parcellation of the brain as our regions-ofinterest and computed the temporal correlation between each parcel, resulting in parcel-by-parcel functional connectivity matrices across a range of thresholds (.90-.99). When examining the number of edges from the left/right amygdala nodes with the cortical networks, results of a nonparametric comparison find that altruists have significantly greater bilateral amygdala degree (sum of edges) with dorsal attention and visual networks, and trending greater degree with cingulo-opercular and default mode networks, suggesting a greater influence of the amygdala on the activity of these networks in prosocial individuals.

### D-41

# NEURO-CHEMICAL MEDIATORS OF THE SOCIAL REGULATION OF NEURAL THREAT RESPONDING WITH MARITAL PARTNERS

Sara E. Medina-DeVilliers - University of Virginia; Lane A. Beckes - Bradley University; James A. Coan - University of Virginia

There is considerable evidence that positive social contact–especially physical touch–unconditionally increases opioid activation in both humans and other social mammals. The present study investigated whether endogenous opioids mediate the social regulation of neural responses to threat. Sixty participants and their partners were recruited for a double-blind control study in which they received 50 mg of Naltrexone, an opioid antagonist, or a placebo. Participants underwent functional magnetic resonance imaging (fMRI) while alone, or while holding a partner's or stranger's hand. During the scan, randomized threat (20% chance of shock) and safety cues were displayed to the participant. We observed an interaction between handholding condition (alone, stranger, partner) and drug (naltrexone, placebo). Decomposition of the interaction effect suggested the commonly observed regulatory effects of supportive handholding manifested in the naltrexone group, but not in the placebo group. Specifically, in the naltrexone group, we saw significantly less activity during partner handholding than both stranger handholding and the alone condition, in the left amygdala, anterior insula, inferior frontal gyrus, orbital frontal gyrus, and portions of the dorsal striatum. No such differences across handholding conditions were found under placebo. Results indicate at the very least that endogenous opioid activity is not necessary for the direct effects of supportive handholding on neural threat responding. Future research

should examine the atypical pattern founds in the placebo condition such as whether a long wait time (2 hours in this study) attenuates later threat responses through habituation, and whether this habituation may have been blocked by naltrexone.

### D-42

# WOULD YOU DO YOUR BEST TO BENEFIT THE OTHER? NEURAL CORRELATES AND DEVELOPMENT OF PROSOCIAL LEARNING ACROSS ADOLESCENCE

Bianca Westhoff, Neetje E. Blankenstein, Elisabeth Schreuders, Eveline A. Crone, Anna C.K. Van Duijvenvoorde - Leiden University; Leiden; The Netherlands

Prosocial behavior is defined as voluntary social behaviors intended to benefit others (e.g., helping, sharing, and cooperating), and is important for social bonding and being liked by others. To behave prosocially, we must learn the consequences that our actions have for other people. Although adolescence is known to be an important period for the development of (pro)social behavior, the development and underlying mechanisms of prosocial learning across adolescence are yet unknown. In this functional neuroimaging study we assessed prosocial learning and its neural correlates across adolescence (age 9-21; N=74; 52.7% female). Participants performed a two-choice probabilistic reinforcement learning task in which one stimulus was associated with a higher probability of reward. Outcomes resulted in monetary consequences for themselves ('self' condition), for an unknown other participant in the experiment who could not reciprocate ('other' condition), or for no one (control condition). Preliminary results show that participants from all ages are able to learn in all conditions, but learn better when they can benefit themselves than when they can benefit an unknown other. Reinforcement learning models show that sensitivity to gains and losses decreases with age, but only when learning for self and others. These results highlight that general social learning tendencies are present in early adolescence. However, outcome sensitivity is subject to age-related change and depends on the social context of learning. Next steps focus on unraveling the neural correlates of prosocial learning. Together, these results will provide new insights on the salience of others on adolescents' learning.

### D-43

### AVOIDING A STRANGER'S LOSS: MODELING THE INFLUENCE OF AFFECT ON SOCIALLY-RELEVANT BEHAVIOR

Katherine O'Connell, Brandon Padgett, Abigail Marsh - Georgetown University, Washington DC, USA Disturbances in affect are often reported in individuals who persistently engage in antisocial behaviors. However, inconsistencies in the exact nature of these disturbances indicates that measuring affective responses, per se, is only one step towards understanding a complex social behavioral trait. The current work tested the feasibility of measuring the influence of affect on behavior using a reinforcement learning framework. A sample of 19 undergraduate students (13 females), completed a go/no-go learning task (Guitart-Masip et al., 2011), in which action requirement (vigor/inhibition) was crossed with valence (reward/punishment). During the task, subjects learned to win money or avoid losing money for themselves, a stranger study partner, or no one. We observed a three-way interaction effect on task accuracy such that there was a significant action by valence interaction, which differed between contexts. These results indicated that subjects showed worse performance when action and valence were incongruently mapped (i.e. when inhibition is required to obtain a reward; when vigor is required to avoid a punishment), and that this incongruency effect was greatest for when monetary outcomes impacted the subject. Furthermore, individuals with high psychopathic traits, as indexed by the total score on the Psychopathic Personality Inventory-Short Form, showed reduced affective influence on behavior when their partners were at risk of losing money relative to the no one condition. These data indicate that behavioral biases in response to perceiving another individual's affective experience can be used to identify individual differences in social-behavioral traits.

### HOW POSITIVE AND NEGATIVE ROLE MODELS DRIVE PLASTICITY IN MORAL PREFERENCES

Honabo Yu, Jennifer Siegel - University of Oxford: Molly Crockett - Yale University Moral preferences are plastic: behavior is susceptible to influence from both positive and negative role models. However, it remains unknown whether positive and negative moral influence operate via similar or different cognitive mechanisms. We addressed these questions by using a drift-diffusion model (DDM) of moral preferences, which allowed us to decompose the extent to which moral decisions are guided by benefits to oneself vs. harm to others. We hypothesized that positive role models would influence moral preferences by increasing sensitivity to harming others, while negative role models would exert influence by increasing sensitivity to selfish benefits. We tested this in a multi-stage moral decision-making study. In an initial stage, participants made choices where they traded off profits for themselves against pain for a stranger. Next, participants were randomly assigned to predict either a positive or negative role model's choices on the same task, where the positive role model made substantially more altruistic choices than the negative role model. In a final stage, participants again traded off profits for themselves against pain for others. Across time, participants' decisions became more similar to the role models whose choices they had predicted. DDM analysis showed that observing a positive role model increased the sensitivity of choices to harm, while observing a negative role model increased the sensitivity of choices to profit. Our results suggest that moral plasticity induced by positive versus negative role models is driven by different cognitive mechanisms.

### D-45

### SPONTANEOUS RECRUITMENT OF COGNITIVE CONTROL BRAIN REGIONS SERVES AS A BUFFER BETWEEN RISK FOR DEPRESSION AND A NEURAL SIGNATURE OF NEGATIVE EMOTION

### Anoushka D. Shahane, Richard B. Lopez, Bryan T. Denny - Rice University

Neuroimaging research of explicit emotion regulation (ER) has demonstrated that cognitive reappraisal, a strategy involving changing one's cognitive construal of an emotionally evocative stimulus to alter its emotional impact, engages cognitive control regions such as the dorsomedial prefrontal cortex (PFC), bilateral dorsolateral PFC, ventrolateral PFC, and posterior parietal cortex. Whether there is reappraisalrelated engagement during implicit ER (i.e., in the absence of explicit instructions to regulate one's emotional responses) is largely unknown. And although researchers have identified reliable whole-brain signatures that characterize affective responses, namely the Picture Induced Negative Emotion Signature (PINES), a key question is whether these neural signatures are associated with clinicallyrelevant health outcomes, such as risk for depression. In this study, we explored whether risk for depression is associated with greater correspondence with the PINES, and whether recruitment of cognitive reappraisal regions attenuates this effect. One-hundred eighty-three participants from the Human Connectome Project performed a simple matching task in which they matched either shapes or negatively-valenced (angry or fearful) faces. Results from a moderated regression analysis indicated that as individuals showed higher reappraisal-related activity (when matching negative face stimuli), there was a reduced association between PINES engagement and risk for depression. In conclusion, patterns of spontaneous, reappraisal-related brain activity-potentially indexing implicit ER-served as a buffer between depression risk and a brain-based signature of negative emotion. Overall, these results elucidate neural mechanisms underlying negative emotional experience and may have implications for the design of effective implicit ER interventions.

### THE BRAIN MECHANISMS BEHIND IN-GROUP AND OUT-GROUP DYNAMICS: A STUDY IN MULTICULTURAL SINGAPORE

Amos Tan, Atiqah Azhari - Division of Psychology, School of Social Sciences, Nanyang Technological University, Singapore; Gianluca Esposito - Division of Psychology, School of Social Sciences, Nanyang Technological University, Singapore; Department of Psychology and Cognitive Science, University of Trento, Rovereto, TN, Italy

Multiculturalism is a pertinent social challenge faced by modern globalized societies. Singapore is a prime example of a nation which is racially diverse, striving to attain a shared cultural identity while maintaining individual ethnic roots. Therefore, it is of interest to investigate how shared cultural contexts may influence the neurophysiological mechanisms behind the perception of ingroup and outgroup distinctions in a multi-ethnically integrated society such as Singapore. The current study utilized Nearinfrared Spectroscopy (NIRS) to study prefrontal cortical (PFC) responses of Singaporean Chinese females (majority ethnic group in Singapore) to ethnic ingroup faces (IF) and outgroup faces (OF) when visually primed with either: Culture-related context (CC), e.g. Singapore landmarks; or Ethnicity-related context (EC), e.g. Indian temple. We hypothesize that CC, as compared to EC, will result in reduced PFC activation towards OF faces. Indeed, results showed that CC priming exhibited a lower activation in the left intermediate frontal area than EC priming for exposure to OF. Interestingly, exposure to OF (as compared to IF) showed a reduced activation in the left dorsolateral prefrontal cortex (DLPFC) and left intermediate frontal area when participants were primed with CC. However, upon priming with EC, exposure to OF (as compared to IF) showed higher activation in the left middle and intermediate frontal areas. Results suggest that shared cultural contexts reduce PFC activity associated with perception of outgroup faces, potentially minimizing the distinction between ingroups and outgroups. Findings highlight the importance of incorporating shared cultural contexts in governmental policies aimed at fostering social cohesion.

#### D-47

### WHO AFRAID TO COGNITIVE DISSONANCE? THE INTERPLAY BETWEEN SOCIAL DECISIONS AND BELIEFS ABOUT OTHERS IN CHILDREN

Hernando Santamaría García - Pontificia Universidad Javeriana, José Santamaría García - Universidad de los Andes: María González Gadea - Universidad Torcuato di Tella, Agustín Ibanez - Instituto de Neurociencia cognitiva y Traslacional INCyT; Sigman Mariano - Universidad Torcuato di Tella Previous studies in adults demonstrated that beliefs and sharing decisions in social scenarios are closely related. However, to date, little is known about the development of this relationship in children. By using a modified dictator game, we assessed sharing behavior and beliefs about others in children between three and 12 years-old. We performed four studies (n= 376) aimed to assess: i) whether decisions were related to beliefs (study 1 and 2), and ii) whether information about recipient's forced sharing behavior would shape decisions and beliefs (study 3 and 4). Results of studies 1 and 2 showed that beliefs about others' generosity were related to children's sharing behavior. In studies 3 and 4, we found that only children older than nine years-old shared more pieces of candy when they knew the recipient would be forced to share (cooperative context) than when they knew the recipient would be forced not to share (non-cooperative context). Besides, children older than six years-old did not modify their beliefs about others' generosity according to these social contexts. These results suggest that normative or preconceived beliefs about the functioning of the social world may guide social behavior in children.
### D-48

# REDUCED ANXIETY AND AMYGDALA – SGACC RESTING STATE FUNCTIONAL CONNECTIVITY FOLLOWING MBSR

Tammi RA Kral, Ted Imhoff-Smith, Dan Grupe, Richard J Davidson - University of Wisconsin-Madison Functional connectivity between the amygdala and subgenual anterior cingulate cortex (sgACC), as assessed with resting state functional magnetic resonance imaging (rs-fMRI), has been associated with perceived stress, and a brief, intensive mindfulness intervention reduced connectivity of this network in a highly stressed population (Taren et al., 2015). We assessed the impact of an 8-week mindfulness based stress reduction (MBSR) intervention on rs-fMRI connectivity between the amygdala and medial prefrontal cortex (MPFC) in healthy adults. Following a baseline scan, participants were randomized to either MBSR (N=27, mean age(SD)= 38.8(13.4) years) or an active control intervention (N=30, mean age(SD)= 42.8(12.6) years). We utilized an amygdala central nucleus seed from Oler et al. (2013) and focused on the right amygdala, as significant effects of mindfulness training in prior work was limited to the right side (Kral et al., under review; Taren et al. 2015). We assessed right amygdala rs-fMRI voxelwise within a MPFC mask (Grupe et al. 2016), and by extracting connectivity weights from a sqACC region defined based on coordinates from Taren et al. (2015). MBSR reduced right amygdala-sgACC rsfMRI connectivity relative to the control intervention both in the ROI (p=0.03) and voxel-wise analyses (p<0.05, corrected). There were no baseline differences between groups in either measure. Participants in the MBSR group also had reduced selfreported anxiety following the intervention (p=0.01). These results provide a conceptual replication of prior work, and evidence for improvements in anxiety and functional changes in brain networks of healthy adults as a result of training in MBSR.

## D-49

### TRAUMA AFFECTS OXYTOCIN RECEPTOR GENE EXPRESSION IN THE PLACENTA

Pehme M Patricia, Kosuri Mahathi - The Graduate Center, CUNY; Queens College, CUNY; Belzie Alissa - Queens College: Nomura Yoko - The Graduate Center, CUNY: Queens College, CUNY Biopsychobehavioral changes associated with post traumatic stress disorder (PTSD), such as hormonal dysregulation, may have enduring effects and adverse consequences for perinatal health and child development. Capitalizing on an ongoing longitudinal study, data from 350 mother-child dyads were analyzed to evaluate differences in the expression of oxytocin receptor (OXTR) gene in the placenta by maternal PTSD diagnostic outcome, ascertained by the Posttraumatic Diagnostic Scale (PDS). OXTR gene expression was dichotomized at the limit of detection (i.e. expressed vs. not expressed) and differences in 14 domains of child temperament at 6 months, measured by Infant Behavior Questionnaire-revised (IBQ-R), were examined. Fisher's exact test revealed that mothers with PTSD did not express OXTR gene (p = 0.050). Independent sample t-tests revealed that children with placental OXTR expression had lower Smile and Laughter domain scores (p = .01). Trauma experience and PTSD symptoms could affect oxytocin gene receptor expression in the placenta, and that in turn could influence the child's temperament at 6 months of age. Oxytocin is known to promote the quality of bonding between a mother and a young child. While preliminary, findings from the current study show diminished placental OXTR gene expression in mothers with a PTSD diagnosis, uncovering a possible biological mechanism of the guality of mother-infant bonding. Further, the findings contribute to the understanding of transmission of transgenerational trauma and emphasize the importance of maternal and child mental health intervention.

### D-50

# PUPIL AREA CHANGE AS A PHYSIOLOGICAL MARKER OF ADULT ROMANTIC ATTACHMENT FORMATION.

#### Sarah Merrill, Cindy Hazan - Cornell University

Recent work has begun to distinguish the reward biology of the transition from infatuation to attachment, with the dominance of the appetitive and consummatory reward systems, respectively, in each stage.

Dopamine, which drives the appetitive reward system, causes pupil dilation, and mu-opiates, which drives the consummatory reward system, cause pupil constriction. Using this theoretical framework, we measured pupil area changes of 85 participants in response to self-produced mental representations of the partner. Pupil area was measured while participants were asked to bring their partner to mind for 3 minutes. Pupil area was z-scored with baseline; dilation was indicated by standard deviations above the mean, while constriction was indicated by standard deviations below the mean. As hypothesized, when conjuring the image of their partner, infatuated participants had significant pupil dilation, while attached participants had significant pupil constriction. Participants were also asked to imagine their partner as a source of support and as a source of sexual desire. Regardless of attachment status, there was significant dilation to the representation of a partner as sexual and significant constriction to the representation of a partner as supportive. This indicates that the shift from pupil dilation to constriction may correlate with a shift in the conceptualization of the partner. Finally, pupil area significantly positively correlated with indicators of infatuation such as idealization and mood dependency. These results are promising for a non-invasive, unconscious, biological marker of attachment, as well as providing empirical support in humans for the theorized neurobiological changes associated with attachment formation.

## D-51

## MORE POWER, GREATER EFFICIENCY: THE POWERFUL COMPLETE A WORKING MEMORY TASK WITH LESS COGNITIVE RESOURCES THAN THE POWERLESS

Enru Lin - Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland; Laure Freydefont -University of Zurich, Zurich, Switzerland; Petra C Schmid - Swiss Federal Institute of Technology (ETH Zurich), Zurich, Switzerland

The experience of high power has been associated with increased performance in many cognitive tasks. But what are the processes and mechanisms behind this effect? Do individuals who feel powerful try harder or are they simply more efficient in their use of resources than those who feel powerless? To answer this question, we manipulated participants' psychological power and then used electroencephalography methods to measure cortical activity while participants performed a working memory task (i.e., a 2-back task). Based on findings of previous research, event-related desynchronization (ERD) in the upper alpha band (10.50-12.75 Hz) was used to quantify the use of cognitive resources, with lower ERD values indicating lower cortical activation. In line with our prediction, high-power participants exhibited lower ERD compared to low-power participants across the whole brain, with the difference most pronounced at the parieto-occipital region. When analyzing task performance (i.e., d' and reaction times), no significant effects of power condition emerged. These findings suggest that high-power participants used less cognitive resources than low-power participants to achieve comparable performance, which imply that high-power participants performed the task with greater cognitive efficiency. The present study makes a significant contribution to the literature on power and goal pursuit: while past studies showed that the powerful pursue their goals more effectively (i.e., have a better outcome), our study suggests that power also makes people pursue their goals more efficiently (i.e., have a better goal pursuit process).

### D-52

# HOW RACE AND SEX INFLUENCE PHYSIOLOGICAL AND SUBJECTIVE RESPONSES TO AVERSIVE STIMULATION

Troy C. Dildine - National Institutes of Health, Bethesda, USA & Karolinska Institutet, Stockholm, Sweden; Dominik Mischkowski - Ohio University, Athens, USA; Lauren A. Banker - University of Florida, Gainesville, USA; Esther E. Palacios-Barrios - University of Pittsburgh, Pittsburgh, USA; Andreas Olsson - Karolinska Institutet, Stockholm, Sweden; Lauren Y. Atlas - National Institutes of Health, Bethesda, USA

Women and non-White individuals experience increased incidence and severity of pain in clinical settings. Meta-analyses of both groups suggest similar outcomes to experimental models of acute pain,

with women experiencing lower pain tolerances compared to men (Mogil, 2012) and non-White individuals exhibiting lower pain tolerances compared to White individuals (Kim et al., 2017). However, few studies have formally investigated whether race or sex modulate physiological responses to aversive stimulation. To address this gap, we examined the influence of sex and race on pain and pain-related responses. Seventy-five healthy volunteers (53% female; 37% White) rated pain evoked by 24 acute noxious heat stimuli while we measured skin conductance and pupil dilation. We replicated differences in pain tolerance between racial groups (p = .01) and sexes (p < .01); however, we found no differences in the relationship between pain and temperature across trials between sex or racial groups. Beyond self-report, analyses suggest race and sex do not play a role in the relationship between pain and skin conductance nor pain and pupil dilation response (between sex: stronger relationship in women; p < .001) and mean skin conductance (between race: increased magnitude in White individuals; p = .01). These results suggest pain-related responses are constructed similarly across groups, but indicate a complex relationship between sociocultural factors, pain, and nociception.

## D-53

# MULTI-VOXEL PATTERN ANALYSIS OF AFFECTIVE BODY PERCEPTION WITH QUANTITATIVE POSTURAL AND KINEMATIC FEATURES OF MOVEMENT

Marta Poyo Solanas, Maarten Vaessen, Beatrice de Gelder - Maastricht University, Maastricht, The Netherlands

When we observe someone else performing an (affective) body movement, our brains transform this information into an understanding of the intent and the emotion expressed. However, it is yet not clear how humans discern affect from movement and posture and which mechanisms are underlying this process. Here, we bridge this gap by investigating the relationship between brain activity and postural and kinematic features derived from body movements with searchlight representational similarity analysis (RSA). For this purpose, 11 participants were scanned at 3T while passively viewing 16 videos of whole-body movements expressing either anger, happiness, fear or a non-emotional action. We estimated the actor's joint positions (x, y coordinates) in each frame for every video (OpenPose, see Cao et al., 2017) and subsequently derived quantitative features such as velocity, acceleration, limb contraction, vertical movement and symmetry. RSA results showed between-stimulus similarity of multivoxels patterns in supplementary motor area and cerebellum corresponding to similarities in acceleration. Vertical movement showed significant effects in anterior cingulate cortex. Limb contraction negatively correlated with anterior insula and fusiform gyrus. Finally, emotional category correlated positively with frontal eye fields. Our results show that precepts of body movement differentially activate brain regions based on the postural and kinematic content of the stimuli and thus, that these aspects might be encoded in these regions. Our approach goes beyond classical methods of categorically mapping cognitive constructs to brain activation/deactivation and instead attempts to find a basis for feature encoding in affective body and action perception.

### **D-54**

# INSULA-RELATED FUNCTIONAL CONNECTIVITY CHANGES ASSOCIATED WITH MOOD AND FATIGUE SYMPTOM DECREASE FOLLOWING A TAI CHI INTERVENTION FOR MAJOR DEPRESSIVE DISORDER

Anna Xu, Catherine E Kerr, Chloe Zimmerman - Brown University, Providence, RI USA; Albert Yeung -South Cove Community Health Center, Massachusetts General Hospital, Boston, MA USA; Sara W Lazar - Massachusetts General Hospital, Harvard University, Boston, MA, USA

Fatigue (i.e., decreased vitality) is a common yet disruptive symptom in major depressive disorder (MDD). Tai Chi, a contemplative practice combining slow movements and deep breathing, has been shown to be clinically effective in alleviating fatigue and mood symptoms in MDD, but the neural correlates behind its efficacy has been less explored. In this study, we collected self-report scores of

vitality and depressed mood as well as resting-state functional magnetic resonance imaging (rs-fMRI) data on Chinese elderly patients with MDD (N =16) that went through a 10-week Tai Chi intervention. Because the insula has been implicated in studies involving the neural correlates of other contemplative practices and in studies documenting abnormalities involving it in MDD, we used a seed-to-voxel approach to test whether functional connectivity changes associated with the insula are associated with clinical benefits resulting from Tai Chi. Replicating previous findings, we found decreased depressed mood and increased vitality following the Tai Chi intervention. Furthermore, decreases in depressed mood were associated with increased functional connectivity between the right anterior insula (AI) and occipital pole as well as between the left AI and left anterior cingulate cortex (cluster-corrected p < 0.05). However, increased vitality was associated with only increased functional connectivity between the right posterior insula and regions associated with sensorimotor processes (cluster-corrected p < 0.05). These results suggest that the neural correlates involved with fatigue changes from Tai Chi can be differentiated from mood changes from Tai Chi by examining different areas in the insular cortex.

## D-55

## EVENT-RELATED REPETITIVE TMS TO RIGHT POSTERIOR STS (BUT NOT OCCIPITAL FACE AREA) IN HEALTHY VOLUNTEERS (HV) BRIEFLY RECAPITULATES FACE EMOTION RECOGNITION (FER) DEFICITS OF SCHIZOPHRENIA (SZ)

Cheryl M Corcoran - Icahn School of Medicine at Mount Sinai; Jack Grinband, Jaimie Gowatsky, Casimir Klim - NYSPI/Columbia; Matthew J Hoptman - Nathan Kline Institute; Daniel C Javitt -Columbia, Nathan Kline Institute

Introduction: Profound FER deficits exist in Sz, causing social disability, though can be partly remediated with computer-based training. Neurostimulation might augment remediation if critical nodes were identified. We aimed to 1) briefly recapitulate FER deficits of Sz in HV using rTMS to rpSTS, 2) identify connectivity patterns of rpSTS regressed by FER, and 3) apply TMS to rpSTS with fMRI as readout. Methods: 1) Nine healthy volunteers had rTMS (10 Hz; 500 msec; 110% RMT) to rpSTS or rOFA (counterbalanced; 10/10 system overlay with standard MRI) concurrent (1/3 trials) with stimuli (http://faces.mpdl.mpg.de/) for emotion or gender identification (button press). 14 Sz patients completed these tasks without TMS. 2) Whole-brain resting-connectivity analyses, seeded by rpSTS, was applied in 27 Sz and 35 HV who also completed the UPenn FER task. 3) BOLD fMRI was obtained in 4 HV preand post-TMS to rpSTS (1 Hz; 20 minutes). Results: 1) In HV, rTMS to rpSTS only (not OFA) significantly slowed reaction time for FER only (not gender identification): overall F test for logRT (p=.001) with post-hoc rpSTS vs.OFA (p=.005) and rpSTS vs. non-stim trials (p=.004). rpSTS recapitulated slowed RT ad lower FER accuracy of Sz. 2) In both HV and Sz, rpSTS had significant resting connectivity with V1 (p= .00013), positively modulated by FER accuracy. 3) Analyses are ongoing. Conclusions: rpSTS is a critical node in the FER circuit with connectivity to primary visual cortex modulated by FER, whose disruption recapitulates FER deficits, making it a candidate target for remediatory neurostimulation.

## D-56

## EMOTIONAL VARIABILITY IS ASSOCIATED WITH RISK FOR DEPRESSION

William J. Villano, C.E. Chiemeka Ezie, Rod C. Gillis - University of Miami; A. Ross Otto - McGill University; Aaron S. Heller - University of Miami

Gaining a better understanding of the dynamics of emotion is essential to advancing research in psychopathology. While Ecological Momentary Assessment (EMA) has facilitated more granular measurement of day-to-day emotional variability, it is often difficult to gauge when exactly personally relevant events occur relative to normative variations in positive and negative affect. In order to better understand individual differences in affective variability in response to personally relevant events, we measured affect in undergraduate students immediately after receiving exam feedback. Utilizing dense sampling periods following exam feedback, we were able to test whether initial emotional reactions or

emotional variability in response to these personally-relevant events were associated with individual differences in risk for depression. Linear mixed effects analyses indicated that initial reactions were not associated with psychopathology risk, but there was a significant interaction between affect variability, exam grade, initial emotional reaction, and risk for depression: individuals at high risk for depression reported greater emotional variability relative to exam grades than less depressed individuals. Parallel analyses indicate that those same individuals at risk for depression were more pessimistic about their grades when asked to predict the outcome, even though their grades were no worse than individuals at lower risk for depression. Taken together, these results suggest that one's outlook as well as the dynamics of emotional regulation following personally salient events may be a risk factor for depression.

### D-57

### **BRAIN PREDICTORS OF SUCCESSFUL REAPPRAISAL IN AGING**

Sydney M Krueger - Columbia University; Bruce P Doré - University of Pennsylvania; Shane Colombo, Odile Rodrik - Columbia University; Teal Eich - Columbia University Medical Center; Jochen Weber; Yaacov Stern - Columbia University Medical Center; Kevin N Ochsner - Columbia University The structure of the brain changes significantly in later adulthood and the impact of such change on socioemotional processing is not well understood. Older adults display a bias in attention and memory for positive compared to negative and neutral emotional stimuli, which has been localized using fMRI to activity in the Anterior Cingulate Cortex (ACC) (Brassen, Gamer & Buchel, 2011). Here, we investigated the ACC, and specifically its structure, as a predictor of emotion regulation success, hypothesizing an enhanced role in processing of positive emotions in older adults. 30 younger (Mage = 24.7) and 30 older (Mage = 65.3) participants viewed negative images while either responding naturally or implementing a positivizing reappraisal strategy (i.e. finding positive meaning). Contrasting reappraisal trials with respond-naturally trials, older adults performed significantly worse than younger adults at increasing positive emotions. Voxel Based Morphometry was used to assess gray matter concentration across the whole brain. Within the older age group, while also controlling for age, we found that the region of a priori interest, the ACC, tracked positively with increased ability to up-regulate positive emotions (reappraisal success). This suggests that grey matter conservation in the ACC supports successful positivizing reappraisal, which extend on the role of the ACC as a brain region involved in positivity bias in older adults. We conclude that preservation of the ACC may be crucial for maintaining high levels of positive affect in old age.

### D-58

## BRAIN BEFORE BEHAVIOR: TEMPORAL DYNAMICS IN THE TREATMENT OF SOCIAL ANXIETY -NEURAL CHANGES OCCUR EARLY AND PRECEDE CLINICAL IMPROVEMENT

Kristoffer N T Månsson - Stockholm University, Stockholm, Sweden; Karolinska Institutet, Stockholm, Sweden; Uppsala University, Uppsala, Sweden; Tor D. Wager - University of Colorado at Boulder; Nils Isaacson; Örn Kolbeinsson; Andersson Gerhard; Hakan Fischer - Stockholm University, Stockholm, Sweden, Uppsala University, Uppsala, Sweden; Tomas Furmark - Uppsala University, Uppsala, Sweden The brain rapidly responds to affective processing and neural responsivity can separate patients with anxiety disorders from healthy individuals. Psychiatric treatment also alters brain responsiveness however, the brain's temporal dynamics during treatment remain unknown. Here, patients with social anxiety disorder (SAD) were treated with cognitive-behavioral therapy (CBT) and functional magnetic resonance imaging (fMRI) assessments were performed before, during and after intervention. Forty-six SAD patients received a 9-week Internet-delivered CBT and symptoms were assessed weekly using the Liebowitz social anxiety scale (LSAS-SR). MRI was acquired at 4 time-points (2 baselines, mid- and post-treatment). Blood-oxygen level-dependent (BOLDfMRI) was performed while patients viewed negative facial expressions. BOLDfMRI data was reviewed manually by classifying signal from noise. All subjects contributing with complete data. Patients improved slightly from baseline to midtreatment (P<.001, Cohen's d=0.34) on the LSAS-SR, but mainly from mid- to post-treatment (P<.001, d=1.46). Whole-brain neural responsivity decreased from baseline to post-treatment (False Discovery Rate, FDR

P<.005) in the medial prefrontal cortex, precuneus and amygdala/parahippocampus. However, no changes (FDR P>.05) from mid- to post-treatment were found, suggesting that the early alterations accounted for the effect. Furthermore, early response reductions were positively associated with symptom improvement from pre-post treatment (Pearson's r=.50, P<.001). This is, to our knowledge, the first study assessing early and late psychiatric treatment changes in the brain. Interestingly, altered neural responsivity in limbic and default-mode network regions preceded self-reported alleviation of social anxiety. Understanding the brain's temporal dynamics and subsequent modification of behavior may be highly important for future clinical neuroimaging research.

### D-59

# NEURAL PATTERN CHANGE OF MEMORY CONTROL OF PERSONAL STRENGTHS AND WEAKNESSES

# Xinyuan Yan, Yina Ma - State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University

To suppress negative thoughts and retrieve positive thoughts of the self is fundamentally important for individuals to maintain a positive view of self and mental health. Thus people are motivated to maintain and enhance positive self-views but to avoid negative ones. However, it remains unknown whether and how the suppression and retrieval manipulation would influence the neural representation of the positive and negative aspects of the self. To address these issues, the current fMRI study (N = 46) employed the typical think/no-think paradigm (TNT), as well as memory test scanning before and after TNT, to uncover the neural patterns changes induced by suppression and retrieval of personal strengths and weaknesses. First, we found better suppression of personal weakness than strengths. The activity in the hippocampus and fusiform gyrus was also modulated by the valence of personal traits, stronger for retrieval of negative (relative to positive) self. Pattern similarity analysis further reveals that item-based pattern similarity changes were found in the hippocampus and MFG when suppressing either positive or negative aspects of the self. regardless of valence, providing a neural account for the typical memorysuppression effect. Moreover, the memory-retrieval induced pattern similarity change was valencedependent, decreasing representational similarity for negative items in the right hippocampus and MFG, but increasing that for positive items in left hippocampus. These results suggest that memory retrieval allows finer-grained representation of personal strength, whereas blurs the representation of the weakness of the self.