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PRESENTS

NEURAL SYSTEMS OF SOCIAL BEHAVIOR

Hilton Hotel, Austin, Texas
May 11-13, 2007

Conference Organizer: Jennifer Beer
Program Selection Committee: Jennifer Beer, Jason Mitchell, Kevin Ochsner

NEURAL SYSTEMS OF SOCIAL BEHAVIOR
Hilton Hotel, Austin, Texas May 11-13, 2007

The conference takes place in Salon F and Salon G on the 6th floor of the Austin Hilton.

FRIDAY, MAY 11

5:30-8:30PM:	Registration	Salon F Foyer
6:15-7:30PM:	Introductory Remarks	Salon F
	Keynote Address: **John Kihlstrom**	Salon F
7:30-8:30PM:	Welcome Reception	Salon F

SATURDAY, MAY 12

8:45AM-1:30PM:	Registration	Salon F Foyer
9:00-10AM:	Continental Breakfast	Salon F Foyer
9:55-10:55AM:	Paper Session A	Salon F
	(Ermer, Bahnemann, Mitchell)	
11:00AM-12:00PM:	Poster Session A	Salon G
12:00-1:30PM:	*Lunch Break*	
1:30-3:10PM:	Paper Session B	Salon F
	(Borg, Beer, Ochsner, Feldman Barrett)	
3:10-3:50PM:	Coffee Break	Salon F
3:50-5:30PM:	Paper Session C	Salon F
	(Rangel, van't Wout, Lakshminarayanan, Camerer)	
6:00-7:15PM:	Keynote Address: **David Amaral**	Salon F

SUNDAY, MAY 13

8:30-9:30AM:	Continental Breakfast	Salon F Foyer
9:15-10:55AM:	Paper Session D	Salon F
	(Harris, Olsson, Schiller, Phelps)	
11:00AM-12:00PM:	Poster Session B	Salon G
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FRIDAY, MAY 11

6:30PM-7:30PM: Keynote Address: **"The Footprints of Phineas Gage"**
John F. Kihlstrom, University of California, Berkeley

Although once the province of social psychology, the social neuroscience approach now reaches into other social sciences as well, including economics and political science, as well as in the study of ethics. Social neuroscience has its roots more than 150 years ago, in the case of Phineas Gage. The 19th-century debate over the significance of the Gage case forms a backdrop for a consideration of certain issues in current social neuroscience, in particular the question of whether there are distinctive mental modules, and associated brain systems, dedicated to social interaction. I also consider the question of whether, and how, neuroscientific data can inform theory at the psychological and sociocultural levels of analysis.

SATURDAY, MAY 12
9:55AM-10:55AM: PAPER SESSION A

9:55-10:15AM "**Reasoning about Social Exhchange Engages Theory of Mind"**
Elsa Ermer, Scott A. Guerin, Leda Cosmides, John Tooby, & Michael B. Miller, University of California, Santa Barbara,

Baron-Cohen (1995) proposed that the theory of mind (TOM) inference system evolved to promote strategic social interaction. Social exchange—a form of cooperation for mutual benefit—involves strategic social interaction and requires TOM inferences about the contents of other individual's mental states, especially their desires, goals, and intentions. There are behavioral and neuropsychological dissociations between reasoning about social exchange and reasoning about equivalent problems tapping other, more general, content domains. It has therefore been proposed that social exchange behavior is regulated by *social contract algorithms*: a domain-specific inference system that is functionally specialized for reasoning about social exchange. We report an fMRI study using the Wason selection task that provides further support for this hypothesis. Precautionary rules share so many properties with social exchange rules—they are conditional, deontic, and involve subjective utilities—that most reasoning theories claim they are processed by the same neurocomputational machinery. Nevertheless, neuroimaging shows that reasoning about social exchange activates brain areas not activated by reasoning about precautionary rules, and vice versa. As predicted, neural correlates of theory of mind (anterior and posterior temporal cortex) were activated when subjects interpreted social exchange rules, but not precautionary rules (where TOM inferences are unnecessary). We argue that the interaction between TOM and social contract algorithms can be reciprocal: social contract algorithms require TOM inferences, but their functional logic also allows TOM inferences to be made.

SATURDAY, MAY 12

10:15-10:35AM "**Sociotopy of the Superior Temporal Sulcus-Searching for Dissociable Representations for Judgments on Movements, Mental States and Norm-Congruency Behavior"**

Markus Bahnemann, K. Prehn, I. Wolf, & H.R. Heekeren, Max-Planck Institute for Human Development

Numerous studies using diverse paradigms to investigate the neural basis of biological motion perception (BM), theory-of-mind (ToM), and normative judgments (NJ) have found activity in the superior temporal sulcus (STS). Interpretations of this activity range from it being representative of the perception of socially relevant cues (Allison, 2000) up to the generation of a concept of person (Greene, 2002). The goal of the present fMRI study was to elucidate the function of the STS region within the social cognitive network. Based on a meta-analysis of previous imaging studies, we hypothesized that sub-regions within the STS would be differentially, i.e. function-specifically, activated by the three different tasks (BM, ToM, NJ). We developed a new task, in which participants made judgments about an agent's movements, mental states or norm-conformity of behavior represented in animated stimuli. Importantly the material was kept constant and only task instructions were manipulated. Results reproduced whole-brain task-specific networks for each task as reported by previous studies. All three tasks activated the STS-region. The ToM-Task led to the greatest activity encompassing the entire sulcus and including the clusters of activity evoked by the BM- and NJ-Tasks. This considerable overlap suggests that a common process is engaged by all three tasks, yet to a different extent. This process might be an automated inference of intentions, even if not demanded by the task.

10:35-10:55AM **"Activity in right temporo- parietal junction is not selective for theory-of-mind"**

Jason Mitchell, Harvard University

Recent researchers have suggested that a region of right temporo-parietal junction (RTPJ) selectively subserves the attribution of beliefs to other people (Saxe & Kanwisher, 2003; Saxe & Powell, 2006; Saxe & Wexler, 2005). At the same time, a similar RTPJ region has been observed repeatedly in a variety of nonsocial tasks that require participants to redirect attention to task-relevant stimuli (e.g., Corbetta & Shulman, 2002; Serences et al., 2005). However, because these two sets of tasks have never been compared within the same participants, it remains unclear whether these observations refer to the exact same region of RTPJ or may instead involve neighboring regions with distinct functional profiles. To test the claim that there is a region of RTPJ selective for belief attribution, the current study used functional neuroimaging to examine the extent to which cortical loci identified by a "theory-of-mind localizer" also distinguish between trials on a target detection task that varied demands to reorient attention (i.e., a version of the "Posner cueing task"). Results were incompatible with claims of RTPJ selectivity for mental state attribution. Regardless of whether regions were defined from group analyses or were individually tailored for each participant, RTPJ activity was also modulated by the nonsocial attentional task. The overlap between theory-of-mind and attentional reorienting suggests the need for new accounts of RTPJ function that integrate across these disparate task comparisons.

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1:30PM-3:10PM: PAPER SESSION B

1:30-1:50PM ***"An Adaptionist Model of Disgust: Evidence from fMRI and Self -report Data"***

Jana Schaich Borg, Neuroscience Institute at Stanford University;
Debra Lieberman, University of Hawaii, Department of Psychology;
Kent A. Kiehl, Olin Neuropsychiatry Research Center, Institute of Living, Hartford, CT and The Mind Institute, Albuquerque, NM

The emotion of disgust can be partitioned into three distinct functional domains: pathogen disgust, sexual disgust, and moral disgust. Using adaptationist logic, we propose that disgust first evolved to mediate the avoidance of disease-causing agents, and then was co-opted as new selective pressures arose to guide decisions regarding mating behavior and, ultimately, other social interactions. We discuss findings from our fMRI study investigating the possible neural correlates of these proposed domains. Specifically, our study explored whether: (i) pathogen, sexual, and moral disgust activate common neural systems, and (ii) these three domains also entrain separate cognitive and behavioral systems specific to their respective evolved functions. Fifty male participants completed a set of surveys, and afterwards were scanned while performing a memory task that presented neutral statements, statements describing pathogen-related acts (pathogen disgust), statements describing incestuous acts (sexual disgust), and statements describing non-sexual socio-moral transgressions (moral disgust). Conjunction analyses indicated that pathogen, sexual, and moral disgust indeed activate common neural systems, and planned comparisons provided evidence that each functional disgust domain also has additional, unique neural correlates. Self-report data revealed distinct patterns of reactions to pathogen, sexual, and moral disgust providing additional support for our proposed model. We will discuss these and other related findings, as well as consider the implications our data have for the study of morality.

1:50-2:10PM **"Orbitofrontal Cortex: Making Emotion Work for You and Not Against You"**

Jennifer Beer, University of California, Davis

Emotion has long been vilified for its disruptive role in decision-making but recent conceptualizations have taken a more charitable view of emotion. In particular, recent models of decision-making consider two systems of thought that support decision-making: an intuitive, emotion-driven system and a controlled, rational system. From this perspective, emotion-driven decisions are not necessarily suboptimal and may offer a time advantage over rational decision-making. Additionally, the rational system is in place to correct mistakes made by the emotion-driven decision-making system. One line of evidence used to support the two-system perspective comes from claims of neural independence between these two systems. However, the orbitofrontal cortex has been implicated in both the emotion-driven decision-making system and the rational decision-making system. Research from our lab investigates the dual role of the orbitofrontal cortex in decision-making and suggests that this region supports emotional experience (rather than emotion-driven decision-making) and also plays a role in rational decision-making.

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2:10-2:30PM **"Unpacking the developmental trajectory of the neural circuits underlying emotion regulation"**

Kevin Ochsner, Columbia University

Responding adaptively to life's emotional ups and downs is one of our most important challenges. One way to cope with these challenges is to cognitively reinterpret or reappraise the meaning of an emotional experience so as to lessen its negative or enhance its positive impact. In recent years, functional imaging research has begun to shed light on the mechanisms underlying this ability. Multiple studies from various labs have converged to suggest that interactions between prefrontal cortex and the amygdala underlie the use of cognition to regulate emotion. Current work seeks to translate this model of PFC-amygdala interactions to understanding when and how these interactions develop from childhood to young adulthood. This talk will describe an experiment examining the developmental trajectory of reappraisal from ages 10-22. Behavioral results indicated that the ability to use reappraisal to dampen negative emotional experience increased both with age and with performance on standard behavioral measures of cognitive control. Similarly, imaging data indicated that recruitment of PFC mechanisms associated with reappraisal increased as a function of age. These results dovetail with work on the development of other forms of working memory, selective attention and response inhibition suggesting that prefrontal control mechanisms develop to adult-like levels in the early teens.

2:30-3:10PM **"The Neural Reference Space for Emotion: New Meta-Analytic Insights" Lisa Feldman Barrett**, Boston College, & Tor Wager, Columbia University

Questions about the nature of emotion have existed since psychology emerged as a scientific discipline in the late nineteenth century. Until recently, scientists have been unable to measure emotions at their source, and so relied on behavioral, experiential, and multi-channel measures of the peripheral nervous system to address fundamental questions about what emotions are and how they function in the economy of the mind. While much has been learned that is of both scientific interest and practical value, age-old questions about the nature of emotion remain fundamentally unresolved. The relatively recent introduction of neuroimaging techniques, particularly functional magnetic resonance imaging (fMRI) and positron emission tomography (PET), provide a new perspective on the emotion in the intact human brain, and have the potential to identify which brain areas are consistently and specifically associated with particular types of emotional states. We report on a series of meta-analyses of the first fifteen years of neuroimaging research to investigate the consistent and specific neural underpinnings of emotions including basic affective responses to stimuli (such as pictures or odors), the experience and regulation of discrete emotions such as disgust, anger, and desire, and the perception of emotion in others.

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3:50PM-5:30PM: PAPER SESSION C

3:50-4:10PM **"The Neural Basis for the Computation of Decision Values in Simple Economic Choice"**
Hilke Plassman, John O'Doherty, & **Antonio Rangel**, Caltech

Almost all models of decision-making assume that choices are made in two stages: first a decision value (DV) is computed for each alternative, then the DVs are compared to generate a choice. We study the neural mechanisms underlying the first set of computations in simple choice situations. These types of choices are defined by the following characteristics: individuals choose between two highly familiar items, the chosen object is consumed immediately, there is no uncertainty about the costs and benefits generated by the items, and the individual faces no self-control problem regarding their consumption. In this talk we will present results from a series of fMRI experiments that combine tools from experimental economics and cognitive neuroscience to identify brain areas associated with the computation of DVs. There are two difficulties in finding the neural basis for the computation of DVs. First, a trial-by-trial measure of DVs is necessary. Second, it is important to dissociate anticipatory reward and DV signals. We propose a novel experimental design that solves both problems. A key innovation is the use of incentive compatible Becker-DeGroot auctions to reliably measure DVs on each trial. We find that areas of the orbitofrontal and anterior cingulate cortex are associated with the computation of DVs in simple choices. Our results are consistent with recent primate electrophysiology studies by Padoa-Schioppa (Nature, 2006).

4:10-4:30PM **"Emotions and goal-maintenance in decision-making"**
Mascha van't Wout, University of Arizona, René S. Kahn, Rudolf Magnus Institute of Neuroscience, University Medical Center Utrecht, Alan G. Sanfey, University of Arizona, & André Aleman, BCN NeuroImaging Center

The emerging field of neuroeconomics implies that emotional as well as cognitive processes contribute to economic decision-making. Indeed, activation of the insula, a brain area implicated in emotions, has been shown to predict decision-making in the Ultimatum Game. In addition, activation of the dorsolateral prefrontal cortex during offers experienced as unfair was suggested to subserve goal-maintenance in this task. However, converging evidence on the role of emotions as well as whether the dorsolateral prefrontal cortex is crucial for strategic decision-making in the Ultimatum Game is important. In order to investigate the role of emotions and the dorsolateral prefrontal cortex in strategic decision-making, we first measured skin conductance while playing the Ultimatum Game. In a second study, we used repetitive transcranial magnetic stimulation over the right dorsolateral prefrontal cortex before playing the game. The results revealed that skin conductance activity was higher for unfair offers and was associated with the rejection of unfair offers in the Ultimatum Game. Interestingly, this pattern was only observed for offers proposed by human conspecifics, but not for offers generated by (non-human) computers. Results from the second study showed that repetitive transcranial magnetic stimulation over the right dorsolateral prefrontal cortex resulted in an altered decision-making

strategy, i.e. shifted from the 'default' strategy, compared to sham stimulation. These results provide direct support for economic models that acknowledge the role of emotional brain systems in everyday decision-making and that the dorsolateral prefrontal cortex is causally implicated in strategic decision-making.

4:30-4:50PM **"The Evolution of Decision-Making Biases: The Endowment Effect in Non-Human Primates"**
Venkat Lakshminarayanan, Keith Chen & Laurie Santos, Yale University

A number of classic studies have demonstrated that human subjects display an "endowment effect." — they place a higher value on a good that they own versus an equally-priced good that is not in their possession Here, we present the first evidence that the endowment effect also exists in an ancestrally related new-world primate, the capuchin monkey (*Cebus apella*). We presented capuchin monkey subjects with a token trading task in which they could exchange tokens for foods. For each subject, we identified a pair of treats (fruit disc and a cereal cube) between which they were indifferent. Given a limited number of tokens that they could hand to experimenters for food, capuchins purchase equal quantities of both rewards. However, subjects were generally unwilling to trade away fruit-discs in order to obtain the cereal-chunks (or vice versa). In contrast, all subjects were willing to exchange these goods for a highly-desirable candy. These data suggest that a common evolutionary ancestor may have provided both humans and capuchins with the neural prerequisites for the endowment effect. Additionally, the presence of these anomalous choices in capuchins indicate that decision-making biases such as the endowment effect do not rely on uniquely-human cognition, and rather owe to more architecturally primitive and evolutionarily ancient neural systems which could be fully characterized using primate models.

4:50-5:30PM **"Hyperscan fMRI imaging of buyer-seller bargaining with asymmetric buyer values"**
Meghana Bhatt, Caltech, Terry Lorenz, Baylor, Read Montague, Baylor, & **Colin Camerer**, Caltech

We study buyer-seller bargaining when buyers have privately-known valuations (from 0 to 10) and sellers have zero cost. Buyers learn their value v, announce a "suggested price", sellers choose a take-it-or-leave-it price p, and trade occurs at the price p if the buyer valuation is greater than the price (v>=p). In the game-theoretic equilibrium where both players anticipate correctly will do and maximize expected profits, the buyer always has an incentive to claim that her value is low to get a lower price from the buyer; strategic buyers understand this incentive and ignore the "cheaptalk" suggested price, then name a price p=5 to maximize their expected value. We study behavior in this game using hyperscan fMRI which images brain activity of buyers and sellers simultaneously. Players switch roles so we can perform a within-subject comparison of a single subject as buyer and as seller. Behaviorally, buyer suggested prices are often correlated with values, and seller actual prices are correlated with suggested prices. These stylized facts are consistent with a model of limited strategic thinking in which some buyers

honestly announce their actual values; sellers who anticipate this honest revelation of values then choose prices which respond to suggested prices. The design enables us to compare activity when agents form beliefs about values (as sellers do) and when agents form beliefs about what others agents believe (as buyers do in choosing suggested prices to influence seller beliefs). The goal of hyperscan is to use joint fMRI signals to predict dyadic behavior (e.g. when trades do not occur, and when pairs coordinate on a value-revealing pattern of behavior).

6:15PM-7:15PM: Keynote Address: **"Neurobiology of Social Behavior in the Rhesus Monkey"**
David G. Amaral, University of California, Davis

This presentation will provide an overview of strategies, complications and outcomes associated with using the nonhuman primate animal model to establish components of the social brain. Many of the conclusions will be based on ongoing studies in which permanent lesions have been made of the amygdaloid complex in either adult rhesus monkeys or in newborn animals. More generally, questions will be raised about how to establish an adequate definition of the "social brain" and the extent to which any animal model can act as a proxy for studying human social behavior and human social cognition. Time permitting, findings from rhesus monkeys will be related to the pathophysiology of autism.

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9:15AM-10:55AM: PAPER SESSION D

9:15-9:35AM **"Neural Evidence for the Person Positivity Bias"**
Lasana Harris, Wouter van den Bos, Susan Fiske, Sam McClure, & John Cohen, Princeton University

The medial prefrontal cortex (mPFC) tends to respond to social cognition (Amodio & Frith, 2006). However, this strip of cortex is also a crucial component of the reward circuitry in the brain (McClure et al., 2004). This paper attempts to reconcile the dual functions of the mPFC using neural imaging. Past studies have demonstrated reduced mPFC activity to extremem outgroups: Groups perceived as low in warmth and competence (homeless people, drug addicts) that elicit the non-exclusively social emotion of disgust (Harris & Fiske, 2006). We present evidence for a main effect of valence and an interaction of social stimuli. Participants saw pictures of both positive and negative people and objects while deciding if the stimuli were positive/ negative or people/ not people. The mPFC makes a valence distinction between positive and negative stimuli across tasks, but the effect is driven by the simple effect within people. This suggests that people are intrinsically rewarding stimuli and we are particularly sensitive to people as mainly positive stimuli, and are more vigilant to people that generate negative affect.

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9:35-9:55AM **"The Role of Empathy in Fear Learning through Social Observation"**
Andreas Olsson, Columbia University, Jamil Zaki, Columbia University; Elizabeth A. Phelps, New York University; Niall Bolger, Columbia University; & Kevin N. Ochsner, Columbia University

Observing another individual expressing fear of a stimulus provides a powerful means of learning the affective value of that stimulus. Indeed, across species, observational fear learning (OFL) may involve the same basic learning mechanisms as classical fear conditioning. However, to provide adaptive learning in complex human social situations, OFL is likely to be sensitive to top-down manipulations affecting mental attributions and personal goals. The present research used several variations of an OFL paradigm to explore the behavioral, psychophysiological and neural processes supporting the impact of empathy and self-relevance on emotional learning. All subjects watched a movie of another individual (the model) being exposed to the painful consequences of a particular stimulus. Empathy was manipulated by providing the subjects with information about the model's emotional state and instructions about perspective taking. Self-relevance was manipulated by altering the subjects' beliefs about whether or not they were themselves placed in an analogous situation subsequently. After watching the movie, all subjects were presented with the same stimuli as the model in the movie, but with no painful consequences. The results showed that neural circuits known to be involved in empathy and mental attributions were engaged during observational fear learning, and that the magnitude of these activations predicted subsequent learning responses. Further supporting the causal link between empathizing with and learning from a distressed other, psychophysiological data indicated that instructions to empathize facilitated emotional learning, but that this effect can be modulated by the perceived self-relevance of the situation in which the other is placed.

9:55-10:15AM **"The Neural Correlates of First Impressions"**
Jon Freeman, NYU, Jason P. Mitchell, Harvard, Jim S. Uleman, NYU, Elizabeth A. Phelps, NYU,& **Daniela Schiller,** NYU

Making sense of others is a challenging endeavor for social observers. This process requires integration of complex and occasionally conflicting information into impressions of the social beings around us. As compared to non-social cognitive processing, social encoding recruits a distinct set of neural mechanisms, primarily localized in the dorsomedial prefrontal cortex (dmPFC; Mitchell et al., 2002). In the present study we further characterized the neural processes accompanying inferences about others. We hypothesized that neural activity engaged in the processing of conflicting information will reflect which information is subjectively relevant and which is ignored while forming social-related decisions. To test this hypothesis, we measured BOLD signals during exposure to different person profiles. Each profile consisted of varying degrees of positive and negative information. In each profile presentation, there was a gradual transition from positive to negative information or vice versa. Subjects were requested to form an impression of each person using a valance scale. These responses were used to determine which information was subjectively significant, influencing their impressions (decision-related), and which was ignored (non-decision related). We then looked for brain areas responding

differentially to these different types of information. We found that the dmPFC was engaged during the presentation of social information but did not respond differentially to decision-related versus non-decision related information. Interestingly, areas that did show such pattern of responding, with higher responses to decision-related information, were areas implicated in emotional and value encoding, namely, the amygdala, the striatum, and the ventomedial PFC. These results suggest that impression formation recruits not only brain systems specialized for social encoding but also emotional and value processing systems. This integrated activity may be important for decision making in a social context.

10:15-10:55AM **"Social Learning of Fear"**
Elizabeth A. Phelps, New York University

Using simple classical fear conditioning paradigms, detailed animal models of fear learning have outlined the underlying neural circuitry from stimulus input to response output. These models are a starting point for understanding the mechanisms of emotional learning in humans. However, human fear learning may differ fundamentally from traditional classical conditioning in a number of important ways. Humans often learn about the potential aversive properties of stimuli through social means, such as language and observation. In addition, the object of fear learning for humans is often another person. In this talk, I will review our work examining how the neural mechanisms of fear learning extend from classical conditioning to social means of learning in humans. I will also discuss how social group factors, specifically race, may influence the neural circuitry of fear learning, and the potential implications for understanding the persistence of race bias.

1:30PM-3:10PM: PAPER SESSION E

1:30-1:50PM **"When do Amygdala-Lesioned Patients Recognize Fear and Anger in Faces?"**
Kevin LaBar, Duke University, Reiko Graham, Texas State University & Orrin Devinsky, New York University Medical Center

We report data from two experiments that re-examine fear and anger recognition deficits in amygdala-lesioned patients using morphed facial stimuli. In both experiments, participants were exposed to Ekman face photographs that were morphed to express different levels of fear and anger intensity, fear-anger blends, and blends of facial identity (with neutral expression). Experiment 1 was a card-sorting task in which subjects were provided with cards showing different morph increments; subjects were asked to sort the cards to form a progressive morph order. Temporal lobectomy patients and a bilateral amygdala-lesioned patient (SP) showed normal abilities to sort the progressions. However, a postencephalitic patient with more widespread left temporal lobe damage exhibited impairments in sorting the fear-anger blends and identity morphs. Experiment 2 was a two-alternative forced choice recognition test for the morph increments, which were presented individually on a computer screen. Under limited exposure durations, SP showed impairments in categorical perception of fear and anger but performed normally on the identity morphs. When provided unlimited exposure, SP showed a speed-

accuracy tradeoff in recognizing fear, suggesting a reliance on a heuristic such as feature analysis. Results indicate that, under some circumstances, amygdala-lesioned patients are able to distinguish subtle featural displacements that characterize incremental changes in facial expression and identity. These results point to the importance of considering both speed and accuracy in interpreting facial recognition abilities, highlight the utility of signal detection models to quantify discrimination abilities, and reveal potential compensatory strategies available following amygdala damage.

1:50-2:10PM **"Two Neural Systems for Calculative and Unconditional Trust in Two-Person Reciprocal Exchange"**
Frank Krueger, National Institutes of Health, Kevin McCabe, George Mason University, Jorge Moll, Roland Zahn, Maren Strenziok, & Jordan Grafman, National Institutes of Health

Unlike other species, humans are trustful and cooperate with genetically unrelated strangers or with individuals they will never meet again. Recent studies in neuroeconomics have started to explore the neurobiological basis of trust and cooperation in reciprocal exchanges. We employed event-related hyper-fMRI while two strangers (22 males and 22 females) interacted with one another each in a separate MRI scanner. Paired participants (same gender) played rounds of multi-shot reciprocal voluntary trust games in alternating roles as first and second mover bargaining for money. The experimental design allowed us to address two questions: Which brain regions modulate decisions to trust and how does trust evolve over time? Our findings indicate that decisions to trust draw upon general mammalian neural systems underwriting social attachment (subgenual region), social reward and aversive responses (medial and lateral orbitofrontal cortex, respectively) as well as on the uniquely developed human anterior prefrontal cortex recruited for mentalizing (paracingulate cortex) and assessment of prospective outcomes (frontopolar cortex). In addition, we identified two interlocking neural systems that exist for maintaining trust in partnerships. One system activated the ventral tegmental area and mediated a calculative strategy linked to the dopaminergic system used to evaluate expected and realized reward. A second system activated the subgenual cortex and mediated an unconditional strategy linked to the social attachment behavior. Working in conjunction, these neural systems allow reciprocal exchange to operate beyond the immediate spheres of kinship; one of the distinguishing features of the human species.

2:10-2:30PM **"Neural Representation of Social Hierarchy in Humans"**
Caroline Zink, Yunxia Tong, Qiang Chen, Jason L. Stein, Courtnea A. Rainey, Catherine K. Draper, Lucas Kempf, & Andreas Meyer-Lindenberg, National Institute of Health

While status in a particular social construct is greatly influential on behavior, virtually nothing is known about the brain regions encoding social hierarchy in humans. Using fMRI, we investigated the neural correlates of social dominance and inferiority in the context of an interactive game. Subjects performed a task with monetary reward for correct responses simultaneously with (not against) one of two other players represented by pictures. Covertly,

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outcomes for each player were fixed, and the two other players were simulated. In an initial test run, a social hierarchy was created by identifying one other player as better and one as worse than the subject. Each round began with the picture and rank of the other player participating in that round and ended with the outcomes of the round. Every fourth round, the ranks were updated based on performance (i.e. the game was explicitly noncompetitive, but hierarchy was reinforced by outcome/rank changes throughout). In an event-related, random effects analysis, we demonstrated that the dominant player elicited greater activity in several areas related to social saliency, including occipital/parietal regions, prefrontal cortex, hippocampus, amygdala and ventral striatum. In the outcome phase, neural responses were unrelated to reward (win or lose) or the status of the particular other player, per se, but rather were related to the *hierarchical value* of the outcome. Being "beat" by an inferior player engaged occipital/parietal regions, ventral striatum, and insula. "Beating" a dominant player engaged frontal regions and precuneus. To our knowledge, we present the first human data on the neural representation of social dominance hierarchy. Our results suggest that the neural encoding of dominance and inferiority in humans are dissociable, even in the absence of explicit competition. Differential activation patterns to dominant and inferior agents and to outcomes with hierarchical value may explain how social hierarchy in humans influences our behavior.

2:30-3:10PM **"Facial Processing, the Amygdala and Autism"**
Ralph Adolphs, CalTech

I will provide an update to work from our laboratory that builds on our prior studies of facial emotion processing. Certain features of faces are used in order to discriminate specific emotions, notably the eyes for fear. Some of these same features also drive emotional response and regional brain activation. Data from neurological subjects with focal amygdala lesions show some striking parallels to data from high-functioning people with autism, as well as their first-degree relatives. Key open questions concern how the amygdala participates in a network with other structures, such as the fusiform gyrus and prefrontal cortex, and at which stage of processing in this network dysfunction arises in illnesses such as autism.

POSTER SESSION TITLES

SATURDAY, MAY 12 **11:00AM-12:00PM PAPER SESSION A**

1. Goal Pursuit In Action: Neural Correlates Of The Behavioral Inhibition And Activation Systems During Goal Pursuit (*Berkman, Elliot; UCLA*)

2. Effects of Appetitive Attitudes Towards Affective Pictures on Asymmetrical Frontal Cortical Activity (*Gable, Philip; Texas A&M*)

3. Motivational Significance of Social Stimuli Contributes to Activation in vmPFC *(van den Bos, Wouter; University of Leiden)*

SATURDAY, MAY 12 **11:00AM-12:00PM PAPER SESSION A**

4. Is mental effort aversive?: Some behavioral and psychophysiologic evidence *(Rosen, Zev; University of Pennsylvania)*

5. Origins of Cognitive Dissonance *(Egan, Louisa; Yale University)*

6. Action and consequence in neural representations of uncertainty *(Bhanji, Jamil; UC Davis)*

7. Reappraising Losses: Physiological and Neural Correlates of the Intentional Regulation of Loss Aversion *(Sokol-Hessner, Peter; NYU)*

8. Does reward context influence anticipatory affect and nucleus accumbens activation? *(Cooper, Jeff: Stanford University)*

9. Neural correlates of impulsivity during intertemporal choice *(Kable, Joe; NYU)*

10. The impact of Depression on Social Economic Decisions in the Ultimatum Game *(Harle, Katia; University of Arizona)*

11. The neural correlates of post-decisional attitude change *(Jarcho, Johanna; UCLA)*

12. Contribution of white matter integrity to socio-emotional processing after traumatic brain injury (TBI) in children *(Wilde, Elisabeth; Baylor)*

13. Development of Common Ground in Social Communication in Patients with Bilateral Ventromedial Prefrontal Cortex Lesions *(Duff, Melissa; University of Iowa)*

14. Mediational effects of traumatic brain injury on social problem-solving during first year recovery compared to orthopedically injured pediatrics *(Menefee, Deelene; Baylor)*

15. Slowed Timing of Cortical Integration in Acquired Brain Injury *(Brick, Gabriela; CUNY Brooklyn)*

16. Relation of neural substrate to social problem solving in children with traumatic brain injury (TBI) *(Ghosh, Alokananda; Baylor)*

17. The ventromedial prefrontal cortex is important for updating moral judgments *(Croft, Katie; University of Iowa)*

18. The role of the amygdala in affective experience *(Duncan, Seth; Boston College)*

19. Life without the amygdala: Minimal fear and anxiety *(Feinsten, Justin; University of Iowa)*

20. Classifying spatial patterns of brain activity associated with human face categories *(Bronstad, Matt; Brandeis)*

21. The Emostroop effect: Task-irrelevant facial emotions are processed spontaneously, rapidly and at the level of the specific emotion *(Preston, Stephanie; University of Michigan)*

22. Lighting Up! The neurophysiological effects of anti-tobacco advertising on smokers and non-smokers *(Campbell, Shoshanna; University of Montreal)*

SATURDAY, MAY 12 **11:00AM-12:00PM PAPER SESSION A**

23. Neural Correlates of Belonging: An fMRI Study of Social Exclusion *(Knack, Jennifer; UT Arlington)*

24. Dissociable Effects of Social Pressure on Frontal- and Striatal-Mediated Classification Learning: Choking and Excelling Under Pressure *(Worthy, Darrell; UT Austin)*

25. Getting stressed when cheated? On Cortisol-reactions in a social dilemma situation *(Herrmann, Benedikt; University of Nottingham)*

26. Neural Dynamics of Rejection Sensitivity *(Kross, Ethan; Columbia University)*

27. Examining the neural relationships between social rejection and motivation *(Peterson, Carly; Texas A&M)*

28. EEG Correlates of Spontaneous and Intentional Trait Inferences *(van Overwalle, Frank; Vrije Universiteit Brussel)*

29. Self-referencing, memory, & aging *(Gutchess, Angela; Harvard University)*

30. A shared basis for thinking about self and other: the effects of perceived similarity *(Jenkins, Adriana; Harvard Univeristy)*

31. Appraisals of Self During Social Interaction and the Medial Prefrontal Cortex *(Berger, Gail; Rome, NY)*

32. Imagining a positive future: The neural mechanism mediating the optimism bias *(Sharot, Tali; NYU)*

33. Is My Future Self Really Me?: An fMRI Study *(Ersner Hershfield, Hal; Stanford University)*

34. The lasting effect of words on feelings: fMRI and psychophysiology investigations *(Tabibnia, Golnaz; UCLA)*

35. The neural correlates of adult attachment and mentalizing in Borderline Personality Disorder *(Sharp, Carla; Baylor)*

36. The Neurotransmitter Attributes Questionnaire (NAQ): Another Perspective on Psychopathology *(O'Connor, Lyn; The Wright Institute)*

37. Emotional Enhancement of Distinct Neural Systems By the Form and Motion of Fearful Bodies *(Atkinson, Tony; Durham University)*

38. University of Texas Imaging Research Center

SUNDAY, MAY 13 **11:00AM-12:00PM PAPER SESSION B**

1. Commonalities in Anorexia Nervosa and Autism Spectrum Disorders: Investigation of Social Cognitive Endophenotypes *(Zucker, Nancy; Duke University)*

SUNDAY, MAY 13 **11:00AM-12:00PM PAPER SESSION B**

2. Perinatal Polychlorinated Biphenyl Exposure Disrupts Developing Motor Skills and Hormonal Regulation: A Possible Model for Autism *(Krishnan, Dena; Bowling Green State University)*

3. Neural Correlates of Early-Stage Intense Romantic Love in Chinese Participants *(Xu, Xiaomeng; SUNY Stonybrook)*

4. Cultural background modulates neural correlates of attention to visual-spatial stimulus dimensions *(Hedden, Trey; MIT)*

5. The Effects of Memory Consolidation on the Cerebral Asymmetries of Person Perception *(Chavez, Clarissa; UT El Paso)*

6. Effects of Secondary Categorization Processes on Explicit Categorization Using Event-related Potentials *(Corral, Guadalupe; UT El Paso)*

7. ERP N400 Effect With Evaluatively Incongruent Attitudes *(Taylor, Jennifer; UT El Paso)*

8. Inhibition of Social Categorization *(Rivera, Luis; UT El Paso)*

9. The effects of unilateral hand contractions on contra-lateral hemispheric activity and aggression *(Peterson, Carly; Texas A&M)*

10. Are preverbal infants lateralized for language? Using NIRS to track hemispheric dominance for speech in 6- to 9-month-olds *(Fava, Eswen; Texas A&M)*

11. The resting brain tells us about individual differences in temperament *(Whittle, Sarah; University of Melbourne)*

12. The Personality/Temperament Trait of High Sensitivity: fMRI Evidence for Independence of Cultural Context in Attentional Processing *(Ketay, Sarah; SUNY Stonybrook)*

13. Neural Substrates of Perceiving Variations in Facial Attractiveness *(Zhang, Yi; Brandeis University)*

14. Are the Brains of Sensitive People Different? A VBM Study *(Ersner Hershfield, Hal; Stanford University)*

15. An fMRI study of interpersonal trust with exogenous oxytocin infusion *(Park, Jang Woo; Claremont Graduate University)*

16. Attention and reality constraints on the neural processes of empathy for pain *(Gu, Xiaosi; SUNY Stonybrook)*

17. Neural Systems Underlying Agency Perception Predict The Propensity Toward Altruism *(Tankersley, Dharol; Duke University)*

18. Different circuits for different pain: Patterns of functional connectivity reveal distinct networks for processing pain in self and others *(Zaki, Jamil; Columbia University)*

19. Kindness to Strangers: Altruism, Empathy, and Guilt *(O'Connor, Lyn; The Wright Institute)*

SUNDAY, MAY 13 **11:00AM-12:00PM PAPER SESSION B**

20. Disorders of interpersonal aggression in children: The failure to trust *(Sharp, Carla; Baylor)*

21. Domain-Specific Understanding of Self-Propelled Motion in Infant Rhesus Macaques (Macaca mulatta) *(Mahajan, Neha; Yale University)*

22. The Evolution of Decision-Making Under Uncertainty: Framing Effects in Non-Human Primates *(Lakshminarayan, Venkat; Yale University)*

23. Acute tryptophan depletion alters valuation of social images in the rhesus macaque *(Watson, Karli;Duke University)*

24. Brain mechanisms of persuasive communication *(Klucharev, Vasily; F.C. Donders Centre for Cognitive Neuroimaging)*

25. The Neuropsychological Approach to the Problem of Freedom, based on the writings of Friedrich A. Hayek and on the current trends of Cognitive Neuroscience *(Ochoa, Juan Jose Ramirez; Universidad Francisco Marroquin)*

26. Alternative neural mechanisms for regulating affective vs. stereotypic judgments in person perception *(Potanina, Polina; NYU)*

27. The independent effects of race and emotion cues in early perception *(Kubota, Jennifer; University of Colorado at Boulder)*

28. Negative Stereotypes Produce Better Performance in Frontal-Mediated Classification Learning *(Narvaez,Llisa; UT Austin)*

29. The Effects of Music on the Fast and Slow Perception of Outgroup Faces: An fMRI Investigation *(Forbes, Chad; University of Arizona)*

30. Neural Systems of the human Multidimensionality: the Relational approach (*Niklolenko, Olena; Romodanov Institute of Neurosurgery)*

31. Neuroreflection": from “mind / brain” problem to the “social reality / neural systems” problem *(Nikolenko, Oleg; Odessa National University)*