Embargoed until Oct. 16, 3:30 p.m. CST
Press Room, Oct. 13–17: (504) 670-4630

Contacts: Kat Snodgrass, (202) 962-4090
Todd Bentsen, (202) 962-4086

NEW FINDINGS ILLUMINATE BASIS IN BRAIN FOR SOCIAL DECISIONS, REACTIONS

Basic social behaviors recorded in distinct regions of social brain

NEW ORLEANS — New insights into the wiring and firing of the "social brain" in humans and primates reveals the brain areas important in altruistic motives and behavior, and the brain regions that respond to the pain of discrimination. The findings were presented at Neuroscience 2012, the annual meeting of the Society for Neuroscience and the world's largest source of emerging news about brain science and health.

The social brain consists of the structures and circuits that help people understand others' intentions, beliefs, and desires, and how to behave appropriately. Its smooth functioning is essential to humans' ability to cooperate. Its dysfunction is implicated in a range of disorders, from autism, to psychopathology, to schizophrenia.

Today's new findings show that:

- Primates employ three different parts of the prefrontal cortex in decisions about whether to give or keep prized treats. These findings illuminate a poorly understood brain circuit, and offer possible insights into human sharing and other social behavior (Steve Chang, PhD, abstract 129.10, see attached summary).
- Different brain regions are engaged in altruistic behavior that is motivated by genuine caring versus altruistic behavior motivated by a concern for reputation or self-image (Cendri Hutcherson, PhD, abstract 129.06, see attached summary).
- The experience of racial discrimination triggers activity in the same brain regions that respond to pain, social rejection, and other stressful experiences (Arpana Gupta, PhD, abstract 402.06, see attached summary).

Another recent finding discussed shows that:

- Competition against a human opponent or a computer engages the same parts of the brain, with one exception: the temporal parietal junction is used to predict only a human's upcoming actions (Ronald Carter, PhD, see attached speaker's summary).

"Whenever we engage with others — or even anticipate others' responses to us — the social brain is at work, shaping our actions, reactions, and interactions," said press conference moderator Anna Rose Childress, PhD, of the University of Pennsylvania, an expert in neuroimaging and addiction research. "The more we understand the brain processes that underlie basic social emotions, the better we will be able to address conditions that involve social dysfunctions."

This research was supported by national funding agencies such as the National Institutes of Health, as well as private and philanthropic organizations.

# # #

Abstract 129.10 Summary

Lead author: Steve Chang, PhD (314) 307-0498
Duke University steve.chang@duke.edu
Durham, NC

Social Decision-making and The Brain: To Give or Not To Give

Primates engage three parts of prefrontal cortex, similarly to humans

Three distinct regions in the primate prefrontal cortex play specific roles in deciding whether to give a treat to another monkey, keep it for themselves, or withhold it altogether, shedding light on the neural basis for social decision-making. The new findings were presented at Neuroscience 2012, the annual meeting of the Society for Neuroscience and the world's largest source of emerging news about brain science and health.

The study by lead author Steve Chang, PhD, and colleagues probes a complex brain puzzle, as decisions made during social interactions are critical for normal social behavior. For example, the ability to respond vicariously when good things happen to someone else appears early in human development and is important to sharing behavior, but the brain circuits involved are not well understood.

"Psychiatric disorders such as autism and schizophrenia are marked by social deficits, including an inability to experience vicarious pleasure at someone else's good fortune," Chang said. "A better understanding of the brain systems involved in making social decisions around sharing may provide insights into new treatments for these potentially devastating disorders."

The primate study examined brain cell activity in three critical nodes of the social decision-making network, as monkeys chose whether to give or withhold rewards (in this case juice) from another monkey. The orbitofrontal cortex mainly signaled a monkey's decision to keep the juice for itself. The anterior cingulate sulcus mainly signaled the decision to forego a reward to oneself rather than reward other or none. However, neurons in the anterior cingulate gyrus fired both when giving the juice away and when keeping it for oneself. Therefore, this brain region appears to be a nexus for evaluating the vicarious social reward associated with giving, versus the direct benefit of keeping the juice. The researchers conclude that variations in the activity of the three brain areas may explain differences in social behavior among individuals and animal species.

Research was supported with funds from the National Institutes of Health, the Ruth K. Broad Biomedical Foundation, the Canadian Institutes of Health Research, the National Institute of Mental Health, and the Department of Defense.

Scientific Presentation: Sunday, Oct. 14, 8–11:30 a.m., Room 387

129.10, Differential encoding of social decision outcomes by neurons in primate orbitofrontal cortex, dorsal anterior cingulate cortex and anterior cingulate gyrus. *__S. W. CHANG__, J.-F. GARIÉPY, M. L. PLATT; Ctr. for Cognitive Neurosci., Duke Univ., Durham, NC

TECHNICAL ABSTRACT: Decisions made during social interactions are critical for normal social behavior. Vicarious responses associated with rewarding events occurring to other individuals appear early in development, and their impairments in neuropsychiatric disorders like autism, psychopathy, and schizophrenia can have devastating consequences. Despite this importance, the neural circuit mechanisms mediating decisions made with regard to others remains poorly understood. To address this gap, we investigated reward outcome encoding during social decision-making by neurons in three regions in primate prefrontal cortex: the lateral orbitofrontal cortex (lOFC), anterior cingulate sulcus (ACCs), and anterior cingulate gyrus (ACCg). We probed neuronal responses while rhesus monkeys performed a reward donation in which donor monkeys were presented with the choices of delivering juice reward to himself or no one, to himself or a recipient monkey, or to the recipient monkey or no one. Previously, we reported that donors prefer to deliver juice to the recipient rather than to no one, consistent with vicarious social reinforcement. We also reported that activity of neurons in lOFC predominantly encodes rewards directly received by the donor, whereas ACCs neurons predominantly encode rewards that are not received by the donors. Here we present data from ACCg neurons in the reward donation task in order to compare the neuronal encoding of social decision outcomes across ACCg (n = 81), ACCs (n = 101), and lOFC (n = 85). We found two major classes of ACCg neurons: one class selectively encoded rewards donated to the recipient monkey, while the other class selectively encoded rewards delivered to the donor. Finally, neurons in lOFC, but not in ACCs and ACCg, encoded received reward outcomes in a push-pull manner relative to omitted reward outcomes by the donors. Specifically, there was a negative relationship between the slopes of firing rates as a function of reward size for received and omitted rewards across lOFC neurons. Our findings endorse the view that distinct regions in primate prefrontal cortex compute social decision outcomes with respect to self and other. We speculate that differential activation of these areas may underlie individual and species-specific differences in motivation to give to others.

Abstract 129.06 Summary

Lead author: Cendri Hutcherson, PhD (650) 353-6444
California Institute of Technology chutcher@caltech.edu
Pasadena, Calif.

Would the Real Altruist Please Stand Up?

Different motivations for generosity seem to activate different regions of the brain

New research finds that different patterns of brain activation seem to be associated with two motivations for altruism: caring about one's own reputation or self-image (normative preferences), and genuinely caring about others (direct preferences). The study found that normative preferences are active only when direct preferences are weak, and that direct preferences yield greater generosity. The findings also suggest that people use self-control to override selfish impulses and make generous choices even when they'd rather not. The findings were presented at Neuroscience 2012, the annual meeting of the Society for Neuroscience and the world's largest source of emerging news about brain science and health.

The research, presented by lead author Cendri Hutcherson, PhD, used human neuroimaging to identify unique patterns of brain activity for the two different motivators of generosity. "Understanding whether people act altruistically because they genuinely care about others or only because they care about their reputation or self-image has important implications for philosophy, economics, and psychology," Hutcherson said. "For the first time, we may be able to identify people's private motives as they behave altruistically."

Study participants made decisions involving a tradeoff between money for themselves or for an anonymous partner. Sometimes the participant's choice was randomly vetoed, which resulted in the non-chosen option; then researchers looked at neural responses using functional magnetic resonance imaging (fMRI).

When people made the generous choice but had it vetoed, the fMRI showed that response in reward-related areas of the brain increased, as if they secretly wanted the selfish outcome. For these people, choosing generously took longer and activated areas of the brain involved in self-control.

The study found that some people seem to choose generously because they genuinely care about others: activation in reward-related areas decreased when they had a generous choice vetoed. Generous choices for these people seemed to be considerably easier, requiring less recruitment of self-control.

Research was supported with funds from the National Science Foundation and the Gordon and Betty Moore Foundation.

Scientific Presentation: Sunday, Oct. 14, 8–11:30 a.m., Room 387

129.06, Distinct neural computations support different motivations for generosity
*__C. HUTCHERSON__, B. BUSHONG, M. RABIN, A. RANGEL; Caltech, PASADENA, CA; Univ. of California, Berkeley, Berkeley, CA

TECHNICAL ABSTRACT: What are the computational and neurobiological mechanisms that support altruistic behavior? We used fMRI of a modified Dictator game to investigate the neural mechanisms underlying two distinct motivations for altruism: 1) normative preferences, in which individuals care about appearing ethical to themselves or others (e.g. "do the right thing"), and 2) direct preferences, where individuals care directly about their own and others' outcomes. We observed dorsolateral prefrontal cortex responses consistent with a normative preference mechanism. The dlPFC is 1) more active when people choose generously than when they choose selfishly, 2) it is functionally connected in a way that suggests it is suppressing the influence of valuation regions like the vmPFC on choice and 3) use of this region to choose generously correlated positively with response in reward regions when experiencing random, experimenter-imposed reversal of their generous choices (suggesting that they had chosen the generous option but secretly wanted the selfish outcome). In contrast, the temporoparietal junction and anterior cingulate cortex showed patterns of responding consistent with the direct preference mechanism. They 1) correlated with the potential monetary benefit to the other player regardless of whether the person chose generously, 2) showed patterns of functional connectivity consistent with influencing valuation and behavioral response selection and 3) the degree to which these regions represented the other's welfare at choice correlated with negative reward-related responses when generous choices were reversed at outcome (suggesting that participants actually wanted the outcome they had chosen). Using these regions as neural markers for normative and direct preferences, we also found that the strength with which the two processes are deployed is negatively correlated across individuals (with normative preferences driving generosity only when direct preferences are relatively weak) and are associated with different levels of generosity.

Abstract 402.06 Summary

Lead author: Arpana Gupta, PhD (865) 406-0839
University of California, Los Angeles aagupta9@gmail.com
Los Angeles, Calif.

Experience of Racial Discrimination Activates Brain Circuits for Pain, Social Rejection

Brain response could link experience of discrimination with stress-related diseases

A new neuroimaging study reveals how perceptions of racial discrimination may be linked to regional activity in the brain. It shows the parts of the brain that respond to racial discrimination are the same ones that respond to pain, social rejection, and emotional regulation. The findings were presented at Neuroscience 2012, the annual meeting of the Society for Neuroscience and the world's largest source of emerging news about brain science and health.

Previous studies used self-reporting to investigate how racial discrimination is related to a range of outcomes, including stress-related illnesses. The new study, by lead author Arpana Gupta, PhD, and colleagues, investigates a neurobiological understanding of the racial discrimination experience.

"Our study suggests that the brain may process experiences of racial discrimination much like many other stressful experiences," Gupta said. "This is an important finding because many studies show that stress can lead to a variety of illnesses, ranging from clinical depression to heart disease."

The study involved audiotaping South Asian American women as they spoke about their experiences with racial discrimination. It used functional magnetic resonance imaging to investigate the impact on brain function of hearing their own stories.

The study found increased activity in brain regions active in response to emotional pain (insula, dorsal anterior cingulate cortex, orbitofrontal cortex) and to emotional regulation (lateral prefrontal cortex). The degree of reported distress was associated with activity in the brain circuitry involved with emotional regulation and pain processing (lateral prefrontal cortex).

Research was supported with funds from the University of California Center for New Racial Studies; Ruth L. Kirschstein Institutional Research Award from the National Institute of Mental Health, and a grant from the UCLA HIV/AIDS Translational Training program from the National Institute of Mental Health.

Scientific Presentation: Monday, Oct. 15, 9–10 a.m., Hall F-J

402.06, The social environment impact: Brain activation and distress during imagery of racial discrimination experiences
*__A. GUPTA__, G. C. GEE, A. F. LEUCHTER, M. S. COHEN, G. E. WYATT, M.-F. O'CONNOR; Ctr. for Neurobio. of Stress, Semel Inst. of Neurosci. and Human Behavior At UCLA, Los Angeles, CA; Fielding Sch. of Publ. Hlth., Dept. of Psychiatry & Biobehavioral Sciences, David Geffen Sch. of Medicine; Semel Inst., Semel Inst. of Neurosci. and Human Behavior, UCLA, Los Angeles, CA; Psychology, Univ. of Arizona, Tucson, AZ

TECHNICAL ABSTRACT: Studies have traditionally investigated racial discrimination using self-report measures in order to explain how racial discrimination is related to a broad spectrum of outcomes. However, recent attention has been directed towards developing a neurobiological understanding of the mechanisms underlying the experience of discrimination. Neuroimaging techniques such as functional magnetic resonance imaging (fMRI) provide an attractive method in this line of investigation. We used fMRI to investigate the impact of discrimination on brain function within a sample of South Asian women, using self-reported incidents of discrimination to elicit ecologically valid experiences. We found increased activity in brain regions active in response to emotional pain (insula, dorsal anterior cingulate cortex, orbitofrontal cortex) and to emotional regulation (lateral prefrontal cortex). The degree of self-reported distress was associated with activity in the circuitry associated with emotional regulation and pain processing (lateral prefrontal cortex). These findings indicate that the experience of discrimination is mediated through brain pathways similar to those involved in social pain and rejection.

Speaker's Summary

Speaker: Ronald Carter, PhD (919) 555-5555
Duke University mckell.carter@duke.edu
Durham, NC

What Makes A Decision Social? Evidence for Selective Neural Predictors of Socially Guided Decisions (129.04)

Nanosymposium: Neural Basis of Decision Making
Sunday, Oct. 14, 2012, 8–11:30 a.m., Room 387

To make adaptive decisions in a social context, humans must identify relevant agents in the environment, infer their underlying strategies and motivations, and predict their upcoming actions. In order to identify regions of the brain involved in determining the relevance of a particular agent, we asked participants to play an incentive-compatible poker game against a human opponent during functional magnetic resonance imaging (fMRI). Spatial patterns in this fMRI data were modeled using combinatorial multivariate pattern analysis (MVPA) to predict human participants' subsequent decisions. Brain regions that were particularly predictive of subsequent decisions, regardless of task activation, were identified using a novel independence analysis. Using this analysis, we found that signals from the temporal-parietal junction (TPJ) provided unique information about the nature of the upcoming decision, and that information was specific to decisions against agents who were both social and relevant for future behavior. The sensitivity of TPJ to both social context and perceived relevance highlights a critical role for this region in coordinating behavior in a dynamic, social environment and demonstrates the capacity of behavioral relevance to modify neural signals.