S4SN 2019 Annual Meeting

Chicago, IL, October 17-18, 2019

S4SN 2019 Annual Meeting | Committees and Staff

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Shrujna Patel, PhD., Autism Clinic for Translational Research, Brain and Mind Centre, The University of Sydney
Jason Ikpatt, Ph.D., University of Texas at Austin
Kohinoor Monish Darda, PhD., Wales Institute of Cognitive Neuroscience, Bangor University, UK.

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Bill Griesar, Ph.D., NW Noggin, Portland State University, Oregon Health & Science University
Jeff Leake, M.F.A., NW Noggin, Portland State University
Aaron Manakai Eisen, Penn State University
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Michael Aaron Chapek, Penn State University
Madison Elizabeth Cho-Richmond, Penn State University
Maria D Galvan-Bravo, Penn State University
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Mollie Marr, Oregon Health & Science University

Journal Affiliation

S4SN is happy to announce that our Society is now affiliated with the journal *Social Neuroscience*, published by Taylor and Francis. We believe that this affiliation will benefit our Society and encourage our members to submit manuscripts to Social Neuroscience.

Society for Social Neuroscience

10th Annual Meeting, October 17-18, 2019
Museum of Science and Industry,
Chicago, IL

2019 Annual Meeting Program

Contents

The Society for Social Neuroscience is an international interdisciplinary, non-profit, scientific society established to advance and foster scientific research, training, and applications.

www.s4sn.org

Schedule Overview

Thursday, October 17, 2019

11:00 am – 8:00 pm	On-site Registration & Pre-Registration Check In
1:00 pm	**Welcome Remarks** by President **Stephanie Cacioppo**
1:00 pm – 4:00 pm	**Social Neuroscience Fair**
4:00 pm – 5:00 pm	Break
5:30 pm– 6:45 pm	**Fireside Chat with Dr. Vivek Murthy (President Obama's Former US Surgeon General),** Presided by Dr. Facundo Manes (Neurologist)
6:45 pm – 8:30 pm	**Cocktail Reception and Poster Session**

Friday, October 18, 2019

7:30 am – 5:00 pm	Onsite Registration & Pre-Registration Check In
7:30 am – 8:00 am	Continental Breakfast
7:55 am – 8:00 am	**S4SN Videos** from S4SN Alumni
8:00 am – 9:15 am	**Symposium 1: Neuronal Circuits and Computations Underlying Social Interactions**. Chair, Hamidreza Ramezanpour (15 minute each with Q&A)
▶ 8:00 am – 8:15 am	S1.1. **Norihiro Sadato**, Across-Brain Networks Emerged from Face-to-Face Social Interactions Probed by Hyper-Scanning fMRI: Eye-Contact, Joint Attention, and it's Memory.
▶ 8:15 am – 8:30 am	S1.2. **Xiaosi Gu**, The Social Brain: Norms, Beliefs, and Model-Based Influence.
▶ 8:30 am – 8:45 am	S1.3. **Hamidreza Ramezanpour**, Decoding of the Other's Focus of Attention by a Temporal Cortex Module.
▶ 8:45 am – 9:00 am	S1.4. **Raymundo Baez-Mendoza**, Prefrontal Mechanisms for Tracking Group Behavior, Reputation, Conformity, and Identity in Monkeys and Mice.
▶ 9:00 am – 9:15 am	**Q&A** Facilitated by the Chair
9:15 am – 9:20 am	**S4SN Videos** from S4SN Alumni
9:20 am – 10:30 am	**Symposium 2 Neural Mechanisms Underlying Social Decision-Making Across Species.** Chair, Patricia Lockwood (15 minute each with Q&A)
▶ 9:20 am – 9:35 am	S2.1. **Gül Dölen,** Social Reward: Developmental mechanisms and therapeutic opportunities.
▶ 9:35 am – 9:50 am	S2.2. **Olga Dal Monte,** Neural circuits of dynamic and interactive social behaviors
▶ 9:50 am – 10:05 am	S2.3. **Patricia Lockwood**, Neural Signatures of Model-Free Learning when Avoiding Harm to Self and Other
▶ 10:05 am – 10:20 am	S2.4. **Marco Wittmann**, Social influences on performance learning in medial prefrontal cortex
▶ 10:20 am – 10:30 am	**Q&A** Facilitated by Chair
10:30 am – 11:00 am	**S4SN Awardees: Where are They Now, and What Are They Working On?** (5 min each)
▶ 10:30 am – 10:35 am	**Zoe Donaldson**, (animal work, 2012 awardee)
▶ 10:35 am – 10:40 am	**Olga Klimecki** (human work, 2014 awardee)
▶ 10:40 am – 10:45 am	**Gül Dölen** (animal work, 2014 awardee)
▶ 10:45 am – 10:50 am	**Steve Chang** (talk, animal work, 2016 awardee)
▶ 10:50 am – 10:55 am	**Eliza Bliss-Moreau** (animal work, 2018 awardee)
11:00 am – 12:15 pm	**Phoenix Diversity Lunch (Served):** Meet & Greet Faculty/Students ▶ Career Fair: Meet & Greet with Faculty in Social Neuroscience ▶ Diversity & Minorities Inclusion Fair: Meet & Greet in Social Neuroscience
12:15 pm – 1:25 pm	**Symposium 3: Role of Contextual and Individual Factors in Modulating Stress Reactivity Across Species.** Chair: *Janelle Beadle* (15 min each with Q&A)
▶ 12:15 pm – 12:30 pm	S3.1 **Stuart White,** Testosterone Reactivity Following a Social Challenge Influences the Neural Correlates of Emotion Regulation in Healthy Adolescents
▶ 12:30 pm – 12:45 pm	S3.2 **Adam Smith,** Oxytocin Induces Reverse Susceptibility to Social Defeat Stress in a Sex-Specific Manner

Schedule Overview

Friday, October 18, 2019

- 12:45 pm – 1:00 pm S3.3 **Janelle Beadle**, Cortisol Reactivity and Prosocial Decision Making in Older Caregivers
- 1:00 pm – 1:15 pm S3.4 **Rosemary Strasser**, Cortisol Synchrony and Stress Buffering in Dog-Owner Dyads
- 1:15 pm – 1:25 pm **Q&A** Facilitated by the Chair

1:25 pm – 1:30 pm **S4SN Videos** from S4SN Alumni

1:30 pm – 3:15 pm **10th Anniversary Session: Social Neuroscience in The City.** Symposium in honor of Prof. John T. Cacioppo. Chair & Keynote: Peggy Mason

- 1:30 pm – 2:00 pm **Peggy Mason**, Exploring the Bystander Effect in Rats.
- 2:00 pm – 2:15 pm **Angela Grippo**, Emotion and the Heart: The Role of Social Neuroscience (From the City and Beyond)
- 2:15 pm – 2:30 pm **Stacy Rosenbaum**, Early Life Adversity, Social Connectedness, and Health Outcomes Among Wild Female Baboons in Amboseli National Park, Kenya
- 2:30 pm – 2:45 pm **Sara London**, Neural Properties that Promote and Limit the Ability to Learn from Social Interactions
- 2:45 pm – 3:00 pm **Josh Correll,** Race, Face Recognition, and Mistaken Interpretations about the Role of the Eyes
- 3:00 pm – 3:15 pm **Agustin Ibanez,** From the Social Lab to the Cognition in the Wild: The Legacy of John Cacioppo

3:15 pm – 3:30 pm Coffee Break

3:30 pm – 3:35 pm **S4SN Videos** from S4SN Alumni

3:35 pm – 4:20 pm **Symposium 4: New Perspectives on the Neurochemical Bases of Social and Non-Social Stress Relief.** Chair: *Siri Leknes*

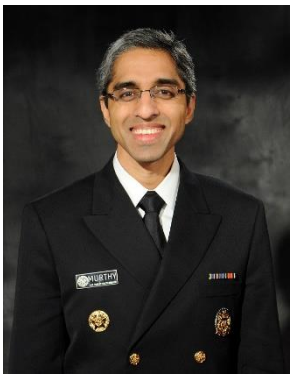
- 3:35 pm – 3:50 pm S4.1 **James Burkett,** Vicarious Distress and Consolation in Prairie Voles as a Model of Empathy
- 3:50 pm – 4:05 pm S4.2 **Leah Mayo,** The Endocannabinoid System as a Novel Target for the Treatment of Stress-Related Psychopathologies: Evidence from Healthy and Clinical Human Populations
- 4:05 pm – 4:20 pm S4.3 **Siri Leknes,** Opioid Drug Relief of Social and Non-Social Stress in Humans: Implications for Addiction

4:25 pm – 4:55 pm **Early Career Awards**

- 4:25 pm – 4:40 pm **Patricia Lockwood,** Neurocomputational Basis of Selfishness and Prosociality
- 4:40 pm – 4:55 pm **Weizhe Hong, Ph.D.**, Understanding the Social Brain – Across Individuals and Between Sexes

4:55 pm – 5:00 pm **Closing Remarks**

Fireside Chat



Dr. Vivek H. Murthy, MD, MBA

19th Surgeon General of the United States

Fireside Chat on The Healing Power of Connection, Open to the Public

Thursday, October 17, 2019 with Dr. Vivek H. Murthy – Presided by Dr. Facundo Manes (Neurologist)

BIOGRAPHY

Dr. Vivek H. Murthy served as the 19th Surgeon General of the United States appointed by President Barack Obama. As the Vice Admiral of the US Public Health Service Commissioned Corps, he commanded a uniformed service of 6,600 public health officers globally. During his tenure, Dr. Murthy launched the TurnTheTide campaign, catalyzing a movement among health professionals to address the nation's opioid crisis. He also issued the first Surgeon General's Report on Alcohol, Drugs, and Health, calling for expanded access to prevention and treatment and for recognizing addiction as a chronic illness, not a character flaw. An internal medicine physician and entrepreneur. In 2017, Dr. Murthy focused his attention on chronic stress and isolation as prevalent problems that have profound implications for health, productivity, and happiness. He has co-founded a number of organizations: VISIONS, an HIV/AIDS education program in India; Swasthya, a community health partnership in rural India training women as health providers and educators; software company TrialNetworks; and Doctors for America.

Dr. Murthy received his bachelor's degree from Harvard and his M.D. and M.B.A. degrees from Yale. He completed his internal medicine residency at Brigham and Women's Hospital in Boston and later joined Harvard Medical School as faculty in internal medicine. His research focused on vaccine development and later on the participation of women and minorities in clinical trials. Dr. Murthy resides in Washington, D.C. with his wife Dr. Alice Chen and their two young children.

S4SN 2019 Annual Meeting sponsored by

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DIVISION OF THE SOCIAL SCIENCES
THE UNIVERSITY OF CHICAGO

Symposium Sessions

Title	Date	Time	Location
Neuronal Circuits and Computations Underlying Social Interactions	**Friday, October 19**	**8:00 – 9:15 am**	**West Pavilion Auditorium**
Neural Mechanisms Underlying Social Decision-Making Across Species	**Friday, October 19**	**9:20 - 10:30 pm**	**West Pavilion Auditorium**
Role of Contextual and Individual Factors in Modulating Stress Reactivity Across Species	**Friday, October 19**	**12:15 – 1:25 pm**	**West Pavilion Auditorium**
10th Anniversary Session in Honor of Professor John T. Cacioppo: Social Neuroscience in The City	**Friday, October 19**	**1:30 – 3:15pm**	**West Pavilion Auditorium**
New Perspectives on the Neurochemical Bases of Social and Non-Social Stress Relief	**Friday, October 19**	**3:35 – 4:20 pm**	**West Pavilion Auditorium**

Symposium Session 1

NEURONAL SUBSTRATES OF INTERACTIVE SOCIAL BEHAVIOR

Friday, October 19, 8:00 - 9:15 am, West Pavilion

Chair: Hamidreza Ramezanpour

Speakers: Norihiro Sadato, Xiaosi Gu, Hamidreza Ramezanpour, Raymundo Baez-Mendoza

TALK 1: Across-Brain Networks Emerged from Face-to-Face Social Interactions Probed by Hyper-Scanning *f*MRI: Eye-Contact, Joint Attention, and its Memory.

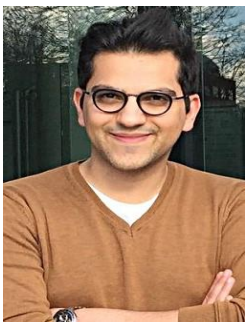
Norihiro Sadato, *MD, PhD, National Institute for Physiological Sciences (Okazaki, Japan)*

Eye contact and joint attention (JA) are tightly coupled to generate the state of shared attention across individuals. Hyperscanning fMRI of eye contact that included on-line and delayed off-line conditions showed that recurrent interaction through eye contact activates the cerebellum and the limbic mirror system, including the anterior cingulate cortex and anterior insular cortex (AIC). Hyper-scanning fMRI during JA showed initiating JA related activation of the right AIC of the participant positively correlated with the responsive JA related activation of the homologous regions of the partner. This area was activated by volitional selection of the target during initiating JA. Thus the shared intention of a selection of the target during JA is represented by the inter-individual synchronization of the right AIC. Finally, the experience of JA was shown to leave its memory trace during a subsequent eye-contact condition as pair-specific neural synchronization of the right inferior frontal gyrus adjacent to the right AIC. These results indicate that both limbic and parieto-premotor mirror systems and the cerebellum are involved in the real-time social interaction through the gaze, and that shared attention is represented and retained by pair-specific neural synchronization during mutual gaze that cannot be reduced to the individual level.

TALK 2: The Social Brain: Norms, Beliefs, and Model Based Influence.

Xiaosi Gu, *Ph.D., Director, Computational Psychiatry Unit Assistant Professor, Psychiatry & Neuroscience Principal Investigator, Friedman Brain Institute & Addiction Institute, Icahn School of Medicine at Mount Sinai*

To maintain the normal functioning of a society, individuals are generally expected to adapt to 'external' norms, or the collective behaviors of social others. In some occasions, however, individuals might also be able to influence social others and cause them to change their behaviors. In this talk, I will present our recent neurocomputational work that attempts to model 1) how humans adapt their 'internal' norms when others' behaviors are not changeable and 2) how individuals can manage to influence others through model-based and future-oriented thinking. Taken together, these findings reveal the dynamic nature of human interactions and the importance of model-based planning in strategic social exchange.



TALK 3: Decoding of the Other's Focus of Attention by a Temporal Cortex Module.

Hamidreza Ramezanpour, *Cognitive Neurology Department Hertie Institute for Clinical Brain Research*
University of Tübingen, Germany

Faces attract the observer´s attention towards objects and locations of interest for the other, thereby allowing the two agents to establish joint attention. Previous work has delineated a network of cortical "patches" in the macaque cortex, processing faces, eventually also extracting information on the other´s gaze direction. Yet, the neural mechanism that links information on gaze direction, guiding the observer´s attention to the relevant object has remained elusive. Here we present electrophysiological evidence for the existence of a distinct "gaze-following patch (GFP)" with neurons that establish this linkage in a highly flexible manner. The other´s gaze and the object, singled out by the gaze, are linked only if this linkage is pertinent within the prevailing social context. The properties of these neurons establish the GFP as a key switch in controlling social interactions based on the other´s gaze.

TALK 4: Prefrontal Mechanisms for Tracking Group Behavior, Reputation, Conformity, and Identity in Monkeys and Mice.

Raymundo Baez-Mendoza, *Department of Neurosurgery, Massachusetts General Hospital & Harvard Medical School, Boston, MA*

Behavior within groups is unique: an individual's actions can affect other individuals' fitness directly or indirectly, through reputation and indirect reciprocity, or conformity. To explore the neuronal mechanisms of group behavior, we performed two series of studies. In one, a triad of macaques performed a structured reciprocity-based social task in which one individual could offer a food reward to one of the other two. In the other, a triad of mice foraged for food simultaneously while we surreptitiously introduced confederate mice to induce bias in the focal mice away or towards a food patch. We recorded neuronal activity from the PFC during task performance in both species. Monkeys demonstrated a strategic preference for other individuals. Distinct subpopulations of dACC neurons tracked the identity of the current actor and reward recipient. In contrast, frontopolar neurons correlated with the current actor's reputation for reciprocity. dmPFC neurons of foraging mice encoded features that defined the animals' collective behavior. These neurons reflected the group's joint decisions, the consensus among their members, and shared success. Together, these studies highlight the role of different prefrontal areas in the mammalian brain play in group behavior and lay the groundwork for studying the neuronal mechanisms of group behavior.

Symposium Session 2

Neural Mechanisms Underlying Social Decision-Making Across Species

Friday, October 18, 9:20 – 10:30 pm, West Pavilion Auditorium

Chair: Patricia Lockwood

Speakers: Gül Dölen, Olga Dal Monte, Patricia Lockwood and Marco Wittmann.

TALK 1: Social Reward: Developmental Mechanisms and Therapeutic Opportunities.

Gül Dölen, *M.D., Ph.D., Assistant Professor in the Department of Neuroscience and Brain Science Institute, Wendy Klag Center*

A critical period is a developmental epoch during which the nervous system is expressly sensitive to specific environmental stimuli that are required for proper circuit organization and learning. Recently we have discovered a novel critical period for social reward learning and demonstrated that a single dose of (+/-)-3,4-methylendioxymethamphetamine (MDMA) reopens this critical period. Moreover, our studies demonstrate that these effects are blocked by oxytocin receptor antagonists and recapitulated by optogenetic stimulation of oxytocinergic terminals in the nucleus accumbens (Nardou, et al. Nature, 2019). These studies have important implications for understanding the pathogenesis of disorders that respond to social influence or are the result of social injury, as well as reveal mechanisms underlying the therapeutic efficacy of psychedelics.

TALK 2: Neural Circuits of Dynamic and Interactive Social Behaviors.

Olga Dal Monte, *Department of Psychology, Yale University, New Haven, CT, US, Department of Psychology, University of Turin, Turin, Italy*

Social behaviors are characterized by a series of dynamic decisions and actions involving at least two individuals. Accumulating evidence suggests that oscillatory coordination between cortical and subcortical brain regions regulate a wide range of social functions. However, it remains unknown whether and how cells from distinct nodes in the social brain network coordinate activity in specialized manners during real-life social behaviors. I will discuss the progress made from two lines of research focusing on the neuronal coordination between the prefrontal cortex and the amygdala involved in social decisionmaking and social gaze interaction between pairs of rhesus macaques. During social decision-making, prosocial and antisocial decision preferences were differentiated by frequency-specific and direction-selective synchronization of spikes and local field potential activity between the rostral anterior cingulate gyrus (ACCg) and the basolateral amygdala (BLA). During social gaze interaction, in which many cells from multiple prefrontal areas and BLA signaled various social gaze events, distinct inter-areal synchrony patterns relating spiking and local field potential activity were also observed across the prefrontal areas and the BLA. Together, these findings support the notion that specialized coordination between the primate amygdala and the prefrontal areas shape complex social behaviors.

TALK 3: Neural signatures of model-free learning when avoiding harm to self and other

Patricia Lockwood, *Medical Research Council Fellow, Junior Research Fellow, Christ Church College, Lecturer in Psychology, Corpus Christi College, Wellcome Centre for Integrative Neuroimaging, Department of Experimental Psychology, University of Oxford*

Moral behaviour requires learning how our actions help or harm others. Theoretical accounts of learning propose a key division between 'model-free' algorithms that efficiently cache outcome values in actions and 'model-based' algorithms that prospectively map actions to outcomes, a distinction that may be critical for moral learning. Here, we tested the engagement of these learning mechanisms and their neural basis as participants learned to avoid painful electric shocks for themselves and a stranger. We found that model-free learning was prioritized when avoiding harm to others compared to oneself. Model-free prediction errors for others relative to self were tracked in the thalamus/caudate at the time of the outcome. At the time of choice, a signature of model-free moral learning was associated with responses in subgenual anterior cingulate cortex (sgACC), and resisting this model-free influence was predicted by stronger connectivity between sgACC and dorsolateral prefrontal cortex. Finally, multiple behavioural and neural correlates of model-free moral learning varied with individual differences in moral judgment. Our findings suggest moral learning favours efficiency over flexibility and is underpinned by specific neural mechanisms.

TALK 4: Social Influences on Performance Learning in Medial Prefrontal Cortex.

Marco Wittman, *University of Oxford*

Humans have to track the success of their actions for survival. However, in a social world, we not only have to monitor our own performance, but also the performance of other people. Here we show using functional magnetic resonance imaging, that dorsomedial prefrontal area 9, an area typically involved in mentalizing, tracks the performance of others. In addition, it encodes information about the relationship between oneself and others (cooperation or competition), and also one's own performance success. Importantly, the presence of self-related signals in area 9 was crucial for how area 9 monitored other's performance. Knowledge about one's own performance spread to how well participants judged others. This resulted in estimating other people as more similar to oneself in cooperative relationships, but more dissimilar to oneself in competitive relationships. In a second study we show that transcranial magnetic stimulation to area 9 enhances this bias, causing judgements of other's performance to me even more merged with knowledge about one's own. These findings highlight a key role for area 9 in monitoring other's performance and suggest it operates in an implicit self-centred frame of reference.

Symposium Session 3

Role of Contextual and Individual Factors in Modulating Stress Reactivity Across Species.

Friday, October 18, 12:15 – 1:25 pm, West Pavilion Auditorium

Chair: Janelle Beadle

Speakers: Stuart White, Adam Smith, Janelle Beadle, Rosemary Strasser

TALK 1: Testosterone Reactivity Following a Social Challenge Influences the Neural Correlates of Emotion Regulation in Healthy Adolescents.

Stuart White, *Ph.D., Assistant Professor, Boys Town National Research Hospital*

Hormonal changes assist an organism in adapting to contexts. With respect to behavior, hormones accomplish this by modulating neural activity. This is true both with respect to both basal levels of hormones, but also with respect to moment-to-moment changes in hormones. The role of moment-to-moment hormone changes in modulating behavior remain under-studied. The first study investigates how acute testosterone change modulates the neural systems underpinning emotion regulation in typically developing adolescents. Greater moment-to-moment testosterone reactivity following a social challenge paradigm was associated with increased activation within posterior cingulate and parietal cortices in response to emotional versus neutral stimuli. In other words, greater increases in testosterone response to social challenge was associated with increased response to salient (emotional) relative to neutral stimuli within attentional control regions. This is consistent with the putative role of testosterone in boosting the salience for short-term, immediate information at the expense of more future-oriented information.

TALK 2: Oxytocin Induces Reverse Susceptibility to Social Defeat Stress in a Sex-Specific Manner.

Adam Smith, *Ph.D., Assistant Professor, Department of Pharmacology and Toxicology, School of Pharmacy, University of Kansas, Lawrence, Kansas, USA*

While there are advantages to social living, social conflict represents a form of encounters which can produce negative outcomes. People who repeatedly experience bullying, rejection, or abuse are more prone to developing social anxiety and aversion to common social situations. Social defeat stress is an animal model of social conflict that reliably induces a social avoidance phenotype and offers an opportunity to explore the neurobiology underlying social anxiety. Here, we demonstrated that social defeat in male and female prairie voles (Microtus ochrogaster) cultivated a social aversion that persisted for at least eight weeks. Receptor autoradiography in limbic regions illustrated restricted oxytocin receptor binding in defeated females which was not observed in males. By contrast, serotonin 1a receptor binding was reduced in defeated males in amygdala and raphe nuclei, implicating 5-HT1a heteroreceptor and autoreceptor sensitivity. Oxytocin and paroxetine were used to alleviate social anxiety in defeated males and females. Intranasal oxytocin treatment reversed susceptibility in females, promoting oxytocin receptor expression and social interactions during novel encounters. Neither treatment was successful in fully eliminating defeat effects in males. These data indicate that oxytocin and serotonin systems, two neurochemical systems which regulate social behavior, are sensitive to defeat experience, divergently in females and males.

TALK 3: Cortisol Reactivity and Prosocial Decision Making in Older Caregivers

Janelle Beadle, *Ph.D., Assistant Professor, Department of Gerontology, University of Nebraska at Omaha.*

It is well-established that providing care to older adults with chronic conditions can be highly stressful due to the many emotional and physical challenges experienced by caregivers. However, it is not known how the social context of caregiving can affect older adults' hormones, emotion, and decision making in response to acute emotional situations. We examine how the caregiving context affects older adults' hormonal, emotional, and decision making responses to an emotionally relevant situation; specifically, an empathy induction in which participants' learn about the suffering of another person. We find that in response to the empathic context, older caregivers show a negative relationship between acute cortisol reactivity and prosocial decision making, such that greater monetary donation in response to the empathic context is associated with a decrease in cortisol levels. Therefore, the findings suggest that the caregiving context is associated with differences in stress reactivity and prosocial behavior that have broader implications for our understanding of the hormonal mechanisms of stress and social decision making in older adults.

TALK 4: Cortisol Synchrony and Stress Buffering in Dog-Owners Dyads.

Rosemary Strasser, *Ph.D., Associate Professor, Department of Psychology, University of Nebraska at Omaha*

Social bonds play an important role in regulating the physiological processes involved in stress coping. Formation and maintenance of social bonds in many species are essential for normal social development, and are inherently tied to physiological processes. Attachments are a special type of affectional relationship that emerge as a means of maintaining security and reducing arousal. The dog-owner relationship exhibits many of the behavioral features unique to an attachment bond: proximity maintenance and contact-seeking with the attachment figure, thus making them a good model species for understanding the physiological basis for social bond formation. We have found evidence that dogs show cortisol synchrony with their owners and that these social interactions can have a stress buffering effect. Further, physiological responsiveness in dogs can be impacted by the quality of the attachment bond, the level of engagement (pet, therapy dogs, and performance dogs), and well as owner personality. Therefore, the findings support the idea that dogs form interspecific social bonds with humans which could provide a valid model for studying social bond formation and maintenance due to shared environment.

Symposium Session 4

New Perspectives on the Neurochemical Bases of Social and Non-Social Stress Relief

Friday, October 18, 3:35 – 4:20 pm, West Pavilion Auditorium

Chair: Siri Leknes

Speakers: James Burkett, Leah Mayo

TALK 1: Vicarious Distress and Consolation in Prairie Voles as a Model of EmpathyXX

James Burkett, *Emory University, USA*

The scientific study of empathy is an emerging topic of great interest, and animal models of empathy hold significant promise as outcome measures relevant to autism research. Empathy for the pain and suffering of others is widespread among social animals and can provide a motivation for prosocial behaviors, including consolation. Oxytocin, which plays a significant role in social buffering of pain and distress, may also act in social observers to promote these prosocial behaviors. Here, we describe a definition-free approach to studying empathy using consoling behavior in the prairie vole (Microtus ochrogaster). Prairie voles respond consistently and selectively to stressed cagemates with an increase in pro-social grooming that provides social buffering. Prairie voles observing a stressed cagemate also match their anxiety-related behaviors, fear response, and stress hormone release, suggesting an empathy mechanism. Exposure to the stressed cagemate increases activity in the anterior cingulate cortex, and oxytocin receptor antagonist infused directly into this region abolishes the consoling response. Additionally, oxytocin receptor density in this region predicts the magnitude of the consoling response. Finally, we demonstrate how empathy-related behaviors in rodents can be used to assess autism phenotypes by discussing our experiments looking at behavioral and neurological effects of developmental toxin exposure in mice.

TALK 2: The Endocannabinoid System as a Novel Target for the Treatment of Stress-Related Psychopathologies: Evidence from Healthy and Clinical Human Populations.

Leah Mayo, *Linköping University, Sweden*

The endocannabinoid system is a neuromodulatory system regulating stress, emotion, and social behavior and has recently garnered interest as a potential therapeutic target. In particular, accumulating preclinical animal research suggests that enhancing endogenous cannabinoid signaling may serve as a novel pharmacotherapeutic treatment for stress- and affect-related psychiatric disorders. For the first time in humans, we show that pharmacologically enhancing the endocannabinoid ligand anandamide (AEA) via inhibition of its main degradative enzyme, fatty acid amide hydrolase (FAAH), produces advantageous effects in stress reactivity, emotion regulation, and social processing. Moreover, in a unique sample of adult patients with prospective assessment of childhood trauma exposure, we find that deficits in social and emotion processing are the mirror opposite of the advantages conferred via enhanced AEA signaling in healthy adults. Together, our data suggest that enhancing endogenous cannabinoid signaling may be ideally suited to treat trauma-related psychopathologies that are hallmarked by deficits in social and emotional processing.

TALK 3: Opioid Drug Relief of Social and Non-Social Stress in Humans: Implications for Addiction.

Siri Leknes, *University of Oslo, Norway*

Acute administration of opioid drugs relieves pain and physiological stress responses such as cortisol release. Opioid dependence is also closely associated with stress; laboratory or real-life stressors increase drug craving, and opioid drugs relieve the stress of impending or actual withdrawal symptoms. Opioid dependence often also leads to increased life stressors due to illicit drug use and related life style factors. Emerging clinical data from chronic pain patients suggests that opioid misuse is driven by a desire to relieve stress rather than pain relief. Somewhat surprisingly, little systematic data exists to support the notion that acute opioid drug administration relieves subjective stress in humans. I will review this literature, including new unpublished data on acute effects of pre-surgery opioid administration. Finally, I will discuss parallels and differences between the effects of acute and chronic opioid administration.

10th Anniversary Session in Honor of Professor John T. Cacioppo: Social Neuroscience in The City.

Friday, October 18, 1:30 - 3:15 pm, West Pavilion Auditorium

Chair & Keynote: Peggy Mason

Speakers: Peggy Mason, Angela Grippo, Stacy Rosenbaum, Sarah London, Josh Correll and Agustin Ibanez.

TALK 1: The Neurobiology of Helping: Lessons from Order Rodentia

Peggy Mason, *Department of Neurobiology, University of Chicago, Chicago, IL*

Among mammals, social interactions are critical for survival of the individual and the species. Moreover, by facilitating safety, food procurement, shelter and well-being, sociality also allows for longer, more rewarding lives. We have found that rats deliberately liberate a conspecific who is trapped. Helping persists even when the free rat is unable to physically interact with the liberated rat. Yet, helping is resource-depleting, requiring emotional regulation, and is applied in a socially selective manner, occurring only for rats of a familiar type. Reminiscent of the human bystander effect, rats are more likely to help in the presence of naïve rats and less likely to help in the presence of non-helper (confederate) rats. Moreover, the effect of bystanders is dependent on the helping rats' familiarity with the bystander rats. In sum, rat helping shows many of the same characteristics as helping in humans.

TALK 2: Emotion and the Heart: The Role of Social Neuroscience (From the City and Beyond)

Angela J. Grippo, *Northern Illinois University*

Negative emotions and affective disorders, such as depression and anxiety, interact bi-directionally with autonomic and cardiovascular functions. Behavioral and neurobiological responses to the social environment may contribute to the association of negative emotions and cardiovascular disease. The prairie vole is a valuable translational model for examining the interactions of social behaviors with emotion and cardiovascular function, given its reliance on the social environment and sensitivity to negative social experiences. Social stressors in prairie voles – such as the disruption of established social bonds and social isolation – alter behavior, autonomic function, and central nervous system processes. It is critical to also explore strategies to prevent or reverse the negative behavioral and neurobiological consequences of social stress. The study of neural and social mechanisms underlying emotion and autonomic function in prairie voles will inform our understanding of affective disorders and cardiovascular disease in humans. Dedication: This presentation is given in fond memory of John Cacioppo.

TALK 3: Early Life Adversity, Social Connectedness, and Health Outcomes Among Wild Female Baboons in Amboseli National Park, Kenya

Stacy Rosenbaum, PhD., Postdoctoral Research Associate, Department of Biological Sciences, University of Notre Dame

Many studies find that early life adversity (ELA) produces negative long-term outcomes in a wide variety of species. In savannah baboons, the cumulative effects of different sources of socio-environmental ELA (e.g. drought, maternal death, competing siblings) have been linked to dramatically shorter adult lifespans, but we do not yet understand the mechanism(s) by which ELA and longevity are connected. The biological embedding hypothesis predicts that early adversity will be linked to poor social relationships and HPA dysregulation in adulthood. However, strong and supportive relationships in adulthood may offer an opportunity to mitigate HPA dysregulation. We investigated the connections among ELA, social connectedness, and fecal glucocorticoids (fGC; a proxy for HPA dysregulation), in 200 wild female baboons in Amboseli, Kenya. Results from mediation models indicate that, after controlling for relevant reproductive state and socioecological variation, ELA predicted higher adult fGC levels and weaker social connectedness to other females in adulthood. Females with stronger adult social connections also had lower fGC levels, independent of ELA. Despite this, we found only a modest role for ELA-fGC mediation via social connectedness. Results are generally consistent with predictions derived from the biological embedding hypothesis.

TALK 4

: Neural Properties that Promote and Limit the Ability to Learn from Social Interactions

Sarah E London,

Developmental social interactions can have profound and life-long consequences on learned patterns of behavior. In humans, a striking example of this is the acquisition of language. Similarity, juveniles of our animal model, the zebra finch songbird, learn to sing from adult "tutors." Interestingly, only male zebra finches sing and their social interactions with tutors are only effective for song learning during a restricted phase of development. We can thus identify genomic, epigenetic, molecular, and cellular neural properties that promote and limit the ability to learn across development, and parse intrinsic features of maturation from dynamic experience-dependent processes. By integrating multiple scales of neurobiology, we ultimately aim to predict neural states that are optimal for social learning during development.

TALK 5: Race, Face Recognition, and Mistaken Interpretations about the Role of the Eyes

Josh Correll, *University of Colorado Boulder*

In 2014, Kawakami and colleagues argued that perceivers fixate on the eyes of a face for a longer period of time when viewing a member of a racial ingroup rather than a member of a racial outgroup. This conclusion is probably correct. However, the authors went on to argue that increased attention to the eyes helps perceivers individuate faces. They suggested that, because eyes offer especially rich information about identity, extended attention to the eyes of same-race faces facilitates recognition; and failure to devote time to the eyes of cross-race faces leads perceivers to have more trouble recognizing them. These claims are probably incorrect. We show that their original conclusion stems from an error in the analysis and is not actually supported by the data. We then report two additional studies exploring the effect of race on both behavioral measures of face processing (as measured by an eye tracker) and on recognition. Using a complex strategy to partition the behavioral measures, we show that integrative face processing (performing many fixations and moving the eyes across the image) is strongly related to recognition. We repeatedly test for evidence that extra attention to the eyes facilitates recognition, and this evidence never emerges.

TALK 6: FROM THE SOCIAL LAB TO THE COGNITION IN THE WILD: THE LEGACY OF JOHN CACIOPPO

Agustin Ibanez, *Institute of Cognitive and Translational Neuroscience (INCYT), INECO Foundation, Favaloro University, Buenos Aires, Argentina; National Scientific and Technical Research Council (CONICET), Argentina; Center for Social and Cognitive Neuroscience (CSCN), School of Psychology, Universidad Adolfo Ibáñez, Santiago de Chile, Chile; GBHI-UCSF, San Francisco, California, US*

Having overcome several shortcomings of old-fashioned neuroscience, social cognitive affective neuroscience (SCAN) represents a promising new approach. Nevertheless, SCAN entails new challenges for a translation into everyday cognitive life. Most of SCAN still conceives human cognition as resulting from the operation of compartmentalized, reflexive, and context-free mechanisms. Our experimental paradigms have provided precise correlates for fragments of analytically decomposed units, such as bodiless faces, intention-blind interactions, language-free actions, and situation-independent words. We have accumulated massive knowledge about isolated phenomena that never manifest as such outside the laboratory. However, as pioneering highlighted by John Cacioppo, the mind is situated beyond experimental precautions in its daily workings. Social interactions in real life involve continuous and active negotiations with other people in profoundly changing conditions. From a theoretical viewpoint, the theories supporting segregated models, the limits of multilevel and transdisciplinary co-construction, and the theoretical distance among disciplines represent essential barriers. I will propose a new research framework called Intercognition. I will provide support for this view from neurocognitive functions, neuropsychiatric disturbances, and naturalistic social cognitive process. I will propose experimental designs (tapping the social-linguistic-motoric triangle; second-person and two-person neuroscience, semiotic integration of multimodal process) and methodological implementations (dynamics of self-organizing networks; machine learning; hyperscanning; decoding) to foster a more naturalistic and ecological approach to intercognition. By moving towards this horizon, the SCAN will plunge from the laboratory into the core of social life.

Early Career Award Talks

Congratulations to the 2019 Early Career Award Winners

Patricia Lockwood, University of Oxford, UK (Human)
Weizhe Hong, Ph.D., University of California, Los Angeles (Animal)

The Early Career Award special lectures take place on Friday, October 18, 2019, 4:25 – 4:55 pm, in the West Pavilion Auditorium of the Museum of Science and Industry, Chicago, IL.

The Society for Social Neuroscience has established this award to recognize Early Career Contributions to Social Neuroscience. The purpose of the award is to recognize outstanding contributions by scientist early in their careers. Two awardees, one for human research and one for animal research, are named by the Awards Committee, and are honored at the S4SN 2019 Annual Meeting.

Neurocomputational Basis of Selfishness and Prosociality

Friday, October 18, 2019, 4:25 –4:40 pm, West Pavilion Auditorium

Patricia Lockwood

University of Oxford, UK

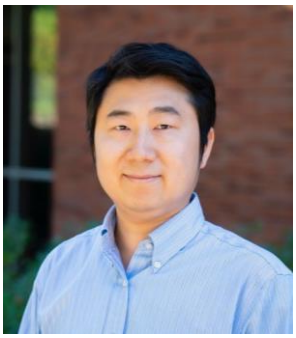
The question of whether humans are fundamentally selfish or prosocial has intrigued many disciplines from philosophy to economics for centuries. From small acts of kindness to major sacrifices, just how willing are humans to help others? Here I will discuss some of the neurocomputational mechanisms that underpin selfishness and prosociality. I will show that in general, people care more about their own outcomes than others, but that there are substantial individual differences. These findings could have important implications for understanding everyday social decision-making and its disruption in disorders of social behaviour such as psychopathy.

Understanding the Social Brain – Across Individuals and Between Sexes

Friday, October 18, 2019, 4:40 –4:55 pm, West Pavilion Auditorium

Weizhe Hong

University of California, Los Angeles



Social interactions involve some of the most complex decisions that animals must make to secure their survival, reproductive success, and overall well-being. A
s social interactions are shaped by dynamic, mutual feedback between participants, an open question is whether and how emergent properties may arise across brains of socially interacting individuals to influence social decisions. By simultaneously performing microendoscopic calcium imaging in pairs of socially interacting mice, we find that animals exhibit interbrain correlations of neural activity in the prefrontal cortex that are dependent on ongoing social interaction (Kingsbury et al Cell 2019). We study how interbrain synchrony arises from activity at the single-cell level, and how it may serve as an emergent property of multi-animal systems to help us understand how individuals engage in social interactions and develop social relationships. Another remarkable feature of social behavior is the extraordinary sex differences between females and males that are universally present across species. We study how neural circuits in males vs. females regulate parental behavior in a sex-specific manner (Chen et al Cell 2019). Together, we aim to provide new insight into the molecular and circuit basis of social behavior, both across individuals and between sexes, and to lay the groundwork for more incisive investigation of the social brain..

Poster Schedule

Poster sessions are scheduled for Thursday in West Pavilion of the Museum of Science and Industry in Chicago, IL. All attendees must present their S4SN 2019 name badge to enter the West Pavilion. Do not leave personal items in the poster room. The presenting author must be present during the assigned session. You may post your materials on the board assigned to you at any time listed below in the "Set-up Begins", but before the beginning of the assigned poster session.

Date	Set-Up	Time	Location
Thursday, October 17	**5:00 pm – 5:30 pm**	**6:45 pm – 8:30 pm**	**West Pavilion**

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

Posters Session

Thursday, October 17, 2019, 6:45 pm – 8:30 pm, West Pavilion

A1 Neural correlates of Empathy for Physical Pain, Attachment Anxiety, and Perceptions of Social Negativity

Kristin Perrone-McGovern, J. Van Hoven, S. Simon-Dack, D.Nicholas, Ball State University

In the proposed poster, we will present findings from an empirical study on emotional adjustment to physical pain. Based on Social Baseline and Attachment Theories, we hypothesized that attachment anxiety would interact with empathy to influence participants' attention to negative social stimuli. We sought to discover if individuals experiencing physical pain could benefit from empathy from an unknown observer, and if higher empathy would allow participants to modulate their attention from negative interpersonal cues (facial expressions) better than individuals who had received low levels of empathy. We further sought to examine if there were differences based on attachment style (anxious vs. non-anxious) in the ability to regulate attention in response to unpleasant social stimuli. Data were collecting using Event-Related Potential (ERP) methodology. A cold-bottle pain stimulation task was administered and participants were given a manipulated empathy rating from a falsified observer. Participants then completed an oddball discrimination task, pushing a button for rare, angry-faced pictures and ignoring more frequent neutral-faced pictures. Neural correlates of attention, measured by the P300 for angry-faces, were then analyzed. We found that among participants with high attachment anxiety, those who were given more empathy demonstrated lower P300 amplitudes, suggestive of less attention for the angry-faced images. Thus, participants with high attachment anxiety appeared to benefit from the empathy of the falsified observer in modulating their attention to unpleasant social stimuli. In the context of chronic pain treatment, psychologists can provide support as a person outside of the patient's attachment system. Such empathy may represent an opportunity to proximally diminish patients' bias for negative social information and, since such bias is linked with and anxiety, distally prevent or reduce psychological distress associated with physical pain.
Keywords: Perceptions of Social Negativity, Event Related Potential, Attachment Anxiety, Empathy

A2 The effect of attachment style on Error-Related Negativity neural waveforms: Is a social component necessary?

Kristin Perrone-McGovern, S.Simon-Dack, C. Marmarosh, J. Matsen, Ball State University

In the proposed poster presentation, we will describe results from an empirical study of neural correlates underlying avoidant and anxious social attachment. Participants were given a flanker task designed to produce a high rate of errors while their brain waves were measured using electroencephalogram (EEG) technology. We were interested in examining an Event Related Potential (ERP) component called Error Related Negativity (ERN). ERN is a neural waveform that occurs when a person makes a response error during the performance of a task. ERN is well-studied in relation to the ability to self-monitor and emotionally regulate during task performance. In the current study, we examined the relationship of anxious and avoidant attachment to ERN using multiple regression analyses. We anticipated that larger ERNs would be indicative of more resources being spent on self-monitoring activities in individuals with attachment avoidance and/or anxiety, since these individuals are more likely to be hyper-vigilant as errors might lead to social and emotional vulnerability. We hypothesized that avoidant and anxious attachment anxiety would contribute to the variance in error-related negativity (ERN) amplitudes. We found that individuals high in avoidance showed a reduced ERN. This suggests that individuals who are more avoidantly attached could be deactivating networks associated with their distress over making errors, even in situations devoid of social content.
Keywords: EEG, Error-Related Negativity (ERN), avoidant attachment, anxious attachment

A3 Perinatal SSRI exposure and rat sexual behavior

Eelke Snoeren, J. Hegstad, D.J. Houwing, J.D.A Olivier and R. Heijkoop, UiT The arctic university of Norway, University of Groningen

Perinatal exposure to SSRIs might have long-lasting effects on the developing child. Regarding sexual behavior, the time of SSRI exposure appears to be crucial: previous studies showed that prenatal exposure did not affect male copulatory behavior, while postnatal exposure decreased the number of mounts, intromissions and ejaculations. In females, on the other hand, it was shown that postnatal SSRI exposure increased proceptive and receptive behavior. To date, little is known about sexual behavior of rats under more naturalistic circumstances, where sexual competition and partner choice might play a role. Our study aims to investigate perinatal fluoxetine exposure in rats and the effects on male and female sexual behavior during the complete behavioral estrous cycle in a seminatural environment. Dams received a daily dose of 10

mg/kg fluoxetine (FLX) per day or vehicle (CTR) from gestational day 0 until weaning on postnatal day 21. In 5 cohorts of 8 rats (4 males, 4 females), the offspring (n=10) were tested in a seminatural environment during 8 consecutive days. To induce sexual receptivity (without which copulation will not take place), females were hormonally primed on day 7. All male and female copulatory behaviors were scored and categorized in "copulatory bouts", defined as the time between the initial mount or intromission (males) or lordosis (females) and the beginning of a period of sexual inactivity lasting for more than 60 min. We studied the timing and content of the bouts, as well as which conspecifics were engaged in the behavior. Furthermore, we studied the display of other social and conflict behaviors over the course of the copulatory bouts.
Keywords: sexual behavior, rats, perinatal SSRI exposure

A4 SOCIAL LEARNING DEFICITS IN FRONTO-TEMPORAL DEMENTIA

Abrevaya, Sofia, González Gadea, María Luz; Alarco Martí, Sofia; García, Adolfo; Sedeño, Lucas and Ibáñez, Agustín, Laboratory of Experimental Psychology and Neuroscience (LPEN), Institute of Cognitive and Translational Neuroscience (INCYT), INECO Foundation, Favaloro University, Buenos Aires, Argentina

Studies have shown that social reinforcement is a facilitator of human learning. This integration between memories and social contextual information, named social learning, is critical to maintain and promote interpersonal interactions. A lesion model to explore this phenomenon is the behavioral variant of the frontotemporal dementia (bvFTD), which is characterized by a spared episodic memory profile alongside insidious changes in behavior, decline in social and emotional conduct, and deficits in the integration of contextual information. There is scant evidence on how social cues modulate the behavioral and neural correlates of learning in this disease. To bridge this gap, we obtained high-density electroencephalography measures from 14 bvFTD patients and 27 controls as they performed a task that tracks the effects of social and non-social reinforcers during the implicit learning of arbitrary associations between letters and numbers. We analyzed two event-related potentials: the N170, which reflects early perceptual processes involving the structural encoding of faces; and the feedback error-related negativity (fERN), which is modulated after high-conflict responses during decision-making and encodes social rejection and explicit social expectancy violations. We also administered the mini-Social cognition & Emotional Assessment to control for the effects of basic emotional recognition. Results showed that social reinforcement significantly improved learning and increased fERN modulation in controls, but no such patterns were observed in the bvFTD group. Also, the groups did not differ in their capacity to recognize basic emotions and N170 modulations showed no disparities between conditions or groups. These results suggest that bvFTD may involve specific alterations in the integration of social information to reinforce learning, and that these are not secondary to primary deficits in processing of facial emotional stimuli and basic emotional recognition.
Keywords: social learning; fronto-temporal dementia; feedback error-related negativity

A5 Responses to Infant Vocalizations in Mouse Oxytocin Neurons

Silvana Valtcheva, Robert C. Froemke, New York University School of Medicine

Healthy maternal sensitivity is characterized by the ability to reliably interpret and respond to infant signals, thus initiating appropriate caregiving responses. Motherhood is a dramatic natural experience but little is known about the specific circuits and neural mechanisms supporting the recognition of different infant cues. Recent studies from our lab (Marlin et al., 2015; Mitre et al., 2016) showed that the neurohormone oxytocin released from the paraventricular nucleus (PVN) of the hypothalamus promotes long-term plasticity of neural responses to infant sounds in mouse auditory cortex in vivo. However, it remains unknown if infant vocalizations can activate oxytocin neurons. Here we used channelrhodopsin-assisted patching (Munoz et al. 2014) to record from optically-identified PVN oxytocin neurons in awake maternal mice. We found that oxytocin neurons reliably respond to pup calls, but not to pure tones. Interestingly, repeated presentation of pup calls specifically induced a gradual increase in tonic firing of individual oxytocin neurons but not of other PVN neurons. Using cell-type specific rabies virus tracing, we identified thalamic inputs which may drive auditory responses in oxytocin neurons. We describe a novel noncanonical auditory pathway potentially relaying acoustic information about social sounds to PVN oxytocin neurons. Finally, we mapped populations of PVN neurons that are activated by pup calls or suckling via c-fos and if these neurons were magno- or parvocellular. Our data suggest that oxytocin neurons differentially integrate auditory and somatosensory information which may be critical for the recognition of different infant cues, and for mediating peripheral and central oxytocin release.
Keywords: maternal behavior, oxytocin, hypothalamus, social communication

A6 Infant neurobehavioral processing of the caregiver: Translating across species during typical and maltreatment rearing

Maya Opendak, E. Theisen, A. Blomkvist, E. Sarro, T. Lind, M. Dozier, R.M. Sullivan, D.A. Wilson, NYU Langone Medical Center

Infants rely on their mothers to provide the sensory stimulation for normal brain development. Altered maternal care, such as maltreatment, initiates a pathway to pathology, much of which remains dormant until later-life. However, atypical infant behavior in the Strange Situation (SSP), a procedure that progressively stresses the child to reveal characteristic ways of responding to the caregiver when distressed (1), has been associated with maltreatment or frightening behavior of parents (2). Here, we adapted this test for use in rat pups to align findings across species and assess neural mechanisms/causation. Using the Scarcity-Adversity Model of maltreatment induced by low bedding (LB) for nest building beginning at postnatal day (PN)8, we compared SSP performance in maltreated rodents (PN13-14) and children; both exhibited behavioral features of disordered attachment in the SSP. In addition, in maltreated pups, reunion with the mother failed to modulate the infant's cortical local field potential (LFP) oscillations, compared to pups with no maltreatment. Next, we measured LFP in both pup and mother during brief periods of LB (between PN10-17). During LB, the dynamic range of LFPs induced by mother-pup interactions decreased, with both pup and mother showing impaired LFP responses to specific interactions, such as milk ejection and grooming. Blocking stress hormone synthesis via metyrapone during maltreatment and the SSP restored pup behavior, maternal regulation of LFP power, and cross-frequency coupling patterns to control levels. These results suggest that when a mother is stressed, she has impaired ability to modulate both her own and her pups' cortical function.
Keywords: Development, Trauma, Oscillations

A7 Exploring shared neural codes across social gaze and reward value in the primate brain

Olga Dal Monte, S. Fan, N. Fagan, C.C. Chu, S.W. Chang, Yale University

Social gaze interaction plays a dominant role in communicating information between individuals both in human and non-human primates. When we direct our attention to someone's eyes, for example, this decision is likely driven by the value associated with acquiring information from the eyes. However, it remains unclear whether neural codes used during social gaze interaction and non-social reward valuation are linked in any way within overlapping neurons in the primate brain. Previous single-neuron recording studies have found that neurons from several cortical and subcortical regions encode juice reward value as well as social value derived from various social contexts. Particularly strong evidence for such relations came from the primate amygdala where identical subsets of neurons are found to encode juice value as well as social value such as conspecific's social status. Here, we extend this line of work by examining neural codes used between social gaze interaction and non-social reward valuation in three distinct prefrontal areas and the amygdala. Single-unit activity was recorded from a large number

of neurons in the basolateral amygdala, the rostral anterior cingulate gyrus, the dorsomedial prefrontal cortex, and the orbitofrontal cortex. Based on a linear decoding analysis, neurons in all these areas discriminated juice value (small vs. large size) and social gaze region (e.g., eyes vs. non-eye region of the face) above chance. Upon applying cross-decoding analyses to directly test if overlapping neurons use generalizable neural codes for differentiating social gaze variables and juice reward value, we found that this generalizability depends on brain regions and specific social gaze variables. Overall, our findings indicate that reward valuation mechanism might be shared with computing social gaze variables in some but not all areas where reward value and social gaze signals are encountered.
Keywords: Social value, Reward value, Amygdala, Prefrontal cortex

A8 Individual Differences in Social and Non-Social Cognitive Control

Kohinoor Darda, E. E. Butler, R. Ramsey, Wales Institute of Cognitive Neuroscience, Bangor University, UK.

A remarkable feature of the human cognitive system is its ability to adapt behaviour depending on current goals. This process, known as cognitive control, has been the focus of growing research in cognitive psychology. However, the extent to which shared cognitive and brain systems underlie cognitive control in social and non-social contexts, and individual differences within these systems, remain largely unexplored. To investigate this, we used a multimodal approach across three large-sample behavioural (N=165, N=205, N=189), and one large-sample fMRI experiment (N=50). Our behavioural results consistently showed that cognitive control systems are invariant to stable aspects of personality, but exhibit a sex difference i.e. females show greater interference than males. Further, we showed that the sex difference is unrelated to the sex of the interaction partner and does not reflect an in-group bias. The sex difference is also neither domain-general i.e. it does not generalise across all types of control, nor is it domain-specific i.e. it is not only tied to social control. Our findings suggest that a sex difference exists in the system or set of subsystems that underlie non-social spatial control. Our fMRI findings found that along with non-social control, social control also recruited areas of the domain-general multiple demand network, instead of a domain-specific brain network unique to social cognition. However, no sex differences were found in the neural correlates of social or non-social control. Functional connectivity profiles differed for social and non-social control, thus suggesting that domain-general brain networks that operate across different tasks may be engaged differentially for different types of cognitive control. In addition, current models of social and non-social control need updating to account for potential interplay between domain-general and domain-specific networks which might make a process distinctly social than non-social.
Keywords: social neuroscience, social behaviour, cognitive control, social cognition, fmri, social control

A9 Individual decision-making underlying the Tragedy of the Commons

Megha Chawla, M. R. Piva, S. Ahammad, R. Jia, I. Levy, S. W. C. Chang, Yale University

The tragedy of the commons is an economic theory (Hardin, 1968) that predicts the overuse and eventual depletion of shared resources. We used a newly developed group decision-making task amenable to behavioral modeling and simulation analyses to study participants' decisions to utilize shared resources for the potential to receive a larger monetary reward or conserve them for a smaller reward. Eighty adults (53F) completed the task and questionnaires about social attitudes online. Choices were modeled to conceptualize subjective value as a function of monetary reward and resource availability to extrapolate sensitivity to resource availability for each participant. Simulation analyses via bootstrapping were used to examine effects of individual differences on task outcomes. Behavioral modeling indicated that a parabolic function best fit participants' responses (BIC: linear=3000, exponential=3241, hyperbolic=3373, parabolic=2572). Simulation analyses revealed that higher reward levels increased resource overuse more than diminished resources available; and that participants who utilized resources more often (high earners) earned more than those who conserved them (low earners), but this effect was reversed when high earners were placed in a group together. As additional high earners were added to a group, mean group earnings catastrophically decreased when at least 30% of the group was comprised of such individuals. Finally, self-reported antisocial attitudes correlated with sensitivity to resource availability across participants (r=-0.348, P=0.004). In this task, subjective value was markedly affected by shared resource availability only when the amount of resources available was exceptionally low, suggesting that participants may have been more likely to overuse middling amounts of resources. Participants with higher measures of antisocial attitudes were less sensitive in their subjective valuation to diminished resources, in turn resulting in resource overuse.
Keywords: decision-making, shared resources, behavioral modeling, simulation

A10 Development of an antibody-free staining method for the visualization of oxytocin receptors: Histochemical detection of a biotinylated ligand

Sara Freeman, M. Palumbo, M. Muttenthaler, and K. Bales, University of California, Davis, Utah State University

Oxytocin (OT) influences complex social behaviors across species and has been implicated in the biology of psychiatric conditions with deficits in sociality. Because of this translational potential, it is crucial that research efforts focus on the fundamental neuroanatomy of the OT system in animals and humans. Thanks to the suite of transgenic tools available, research in mice has contributed considerably to our understanding of OT in the regulation of social behavior. However, non-mouse models are increasingly being used, including monogamous rodents as well as nonhuman primates, and rigorous neuroanatomical work is needed to characterize the underlying neural circuits in these species. Currently, the most reliable and widely available method to localize oxytocin receptors (OXTR) is receptor autoradiography, but this method only resolves receptors at the gross anatomical level. The most common technique to visualize receptors on the cellular level is immunohistochemistry (IHC) but there are no reliable, commercially-available primary antibodies for OXTR. We are developing a novel, antibody-free method for the cellular staining of OXTR in brain tissue that relies on the histochemical detection of biotin, which is covalently bound to a selective OXTR ligand called deamino-lysine vasotocin (dLVT). We report our progress in prairie vole brain tissue to develop this staining technique, which we call "autohistochemistry" because it combines the receptor-binding steps at the start of autoradiography with the deposition of a chromogenic stain at the end of IHC. We have assessed the following variables thus far: tissue freezing methods, sectioning thickness, fixation strength/duration, the type of blocking steps, signal specificity, and washing procedures. Future work will combine this method with IHC for tyrosine hydroxylase in a double-labeling approach to detect OT-sensitive dopaminergic neurons, which will advance the study of OT circuitry in non-mouse organisms.
Keywords: oxytocin, receptor binding, histochemistry, prairie vole, biotin, methods development

A11 Neuronal coordination across primate prefrontal regions and the amygdala in spontaneous social gaze interaction

Siqi Fan, O. Dal Monte, N.A. Fagan, C.C.J. Chu and S.W. Chang, Yale University

In primates, social gaze interaction serves an important function in communicating social information. Yet, how different brain regions coordinate their neuronal activity during social gaze interaction remains elusive. We recorded single-unit and local field potential (LFP) activity from a large number of cells in three prefrontal regions—the rostral anterior cingulate gyrus (ACCg, n=249), orbitofrontal cortex (OFC, n=244), and dorsomedial prefrontal cortex (dmPFC, n=236)—and the basolateral amygdala (BLA, n=564) to examine the coordination of spiking and LFP between BLA and each of these prefrontal areas while pairs

of rhesus macaques spontaneously interacted using gaze. We observed distinct spike-field coherence patterns across regions with respect to looking at the eyes of a conspecific compared to a non-social object. Specifically, spikes from BLA cells and LFP activity from ACCg (BLA[spikes]-ACCg[field]) showed enhanced synchrony in the beta frequency range (15-25Hz) immediately after looking at the eyes compared to an object. By contrast, ACCg[spikes]-BLA[field] coherence was enhanced in the gamma band (45-70Hz) for the same comparison. Intriguingly, we recently observed enhanced spike-field coordination in the same two frequency bands across ACCg and BLA when monkeys expressed prosocial compared to antisocial decision preference in a social decision-making task (Dal Monte et al, 2019, BioRxiv). Moreover, dmPFC[spikes]-BLA[field] coherence was enhanced mostly prior to looking at eyes in the gamma band, suggesting a possible role of dmPFC[spikes]-BLA[field] synchrony in social gaze planning. These results demonstrate that social gaze is facilitated by specialized coordination of spiking and LFP activity in the primate prefrontal-amygdala network. Finally, the shared frequency channels utilized across ACCg and BLA between social gaze interaction and social decision-making imply that these coordination dynamics may be generalized across distinct social behaviors.
Keywords: Amygdala, Prefrontal cortex, Coherence, Social gaze interaction

A12 Oscillatory phase-locking within the primate anterior cingulate gyrus and basolateral amygdala in social decision-making

CHENG C.J. CHU, O. DAL MONTE, N. A. FAGAN, S. W. CHANG, Yale University

In social decision-making, different decisions linked to preference and agency need to be accurately differentiated. In a neural mechanism known as phase-locking, oscillatory properties of LFP may become entrained to a particular stimulus or behavioral event to reset the communication between different frequency channels to enhance signal processing (e.g., see Taub et al., 2018). It remains unknown whether LFP phase-locking is implicated in social decision-making. Here, we investigated this question by examining LFP signals within the rostral ACC gyrus (ACCg) and the basolateral amygdala (BLA) during a social reward allocation task. Behaviorally, actor monkeys preferred to deliver a juice reward to a conspecific (Other) over an empty bottle (Bottle), displaying a prosocial decision preference, but preferred to consume a juice reward alone (Self) over simultaneously with the conspecific (Both), displaying an antisocial decision preference. During these behaviors, we observed two types of phase-locking differences in the LFPs encompassing both theta and beta range. First, both ACCg and BLA exhibited more sustained phase-locking for choosing an option resulting in actor's received juice reward (Self or Both) compared to choosing an option resulting in no juice reward to the actors (Other or Bottle). Second, in ACCg, phase-locking patterns were further differentiated between Other and Bottle choices such that the phase-locking for Other emerged earlier prior to the time of decision and was more temporally widespread. These results suggest that phase-locking in both areas may facilitate the differentiation between one's received and forgone rewards during social decision-making. Moreover, phase-locking in ACCg may be further used to distinguish between prosocial and antisocial decisions. LFP phase-locking in these brain areas may thus contribute to social decision-making by selectively promoting neural communications among different choices.
Keywords: social decision-making, oscillation, anterior cingulate cortex

A13 Effect of sex and autism on oxytocin and vasopressin 1a receptors in the substantia nigra, hippocampus, and primary visual cortex of the human brain

Michelle C. Palumbo, T. Simmons, A. Smith, M. Goodman, K. Bales, S. Freeman, University of California, Davis

Oxytocin (OT) and vasopressin influence complex social behaviors across mammals. In humans, OT is being used to treat Autism Spectrum Disorder (ASD), a condition characterized in part by deficits in sociality. This study quantified putative OT receptor (OXTR) and vasopressin receptor 1a (AVPR1a) densities in postmortem human brain tissue from individuals with ASD and neurotypical (NT) specimens. We examined three regions previously shown to contain dense OXTR or AVPR1a receptor binding in the human brain: the substantia nigra (SN), hippocampus, and primary visual cortex (V1). The NIH NeuroBioBank provided the following specimens: 8-9 ASD males, 6-8 ASD females, 7-8 NT males, and 6-7 NT females. In the SN, OXTR density was lower in ASD females compared to ASD males, though neither group was significantly different from NT. Previous reports have postulated sex differences in ASD severity, and our results in the SN provide neuroanatomical support for this idea. Additionally, OXTR density in the SN was negatively correlated with the patient's Autism Diagnostic Interview-Revised (ADI-R) scores for quantitative abnormalities in reciprocal social interaction and for abnormality of development. The higher the ADI-R score, the more severe the symptoms, so our results show that lower OXTR densities in the SN correlate with more severe social symptoms. We did not find any effect of ASD or sex on AVPR1a density in the hippocampus or V1, nor were there significant associations between age and either OXTR or AVPR1a density in any region of interest. We did find significant positive associations in ASD between AVPR1a density in the dentate gyrus and ADI-R scores for abnormality of development, as well as between OXTR binding and social interaction ADI-R scores in all subregions of V1. Correlations between ADI-R scores and receptor binding in multiple brain regions associated with sensory processing provide some of the first neuroanatomical evidence underlying ASD symptom severity.
Keywords: oxytocin, vasopressin, receptor binding, human brain, autism, ADI-R

A14 Sex difference in the way dorsal hippocampal D2-type dopamine receptors interact with gonadal sex hormones to mediate social learning in mice

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Social learning, the process by which learning occurs via the interaction with, or the observation of, a conspecific (Galef, 1988) is poorly understood, and in animals may be tested using a social transmission of food preference (STFP) paradigm. By antagonizing D2-type DA receptors in the dorsal HPC, the STFP was blocked in female but not male mice suggesting an interaction between these receptors and sex hormones (Matta et al., 2017). These findings suggest that D2-type DA receptors interplay with sex hormones to modulate social learning. Here, we bilaterally infused D2-type DA receptor antagonist raclopride (18 µg/µL, 20 µg/µL, or saline) into the dorsal HPC (0.5 µL per hemisphere) of gonadally intact and gonadectomized 2-3-month old CD1 male and female "observer" mice 10 minutes prior to a 30-minute social interaction with a recently fed same-sex familiar "demonstrator". Immediately following the social interaction, the "observer" mice began an 8-hour flavored food choice test between 2 novel flavored food diets, one of which their respective "demonstrator" mice had consumed earlier. Food intakes were taken at 2, 4, 6, and 8 hours. Findings revealed that raclopride shortened the duration of a socially acquired food preference in gonadally intact females whereas it prolonged the food preference in ovariectomized mice. Ovariectomy alone significantly reduced the duration of a socially acquired food preference. Raclopride prolonged the duration of a socially acquired food preference in gonadally intact males whereas castration prevented the prolonging effects of raclopride. These results suggest that gonadal female sex hormones interact with D2-type DA receptors in the dorsal HPC during the STFP in female mice, and that gonadal male sex hormones modulate social learning in male mice. Thus, there appears to be a sex difference in the way that D2-type DA receptors in the dorsal HPC interact with gonadal sex hormones to mediate social learning.
Keywords: Social learning, dopamine, dorsal hippocampus, D2-type dopamine receptors, sex difference, sex hormones

A15 Effects of social experience on immune parameters and brain transcriptome in mouse social hierarchies

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In social hierarchies, individuals occupy differential ranks based upon their history of competitive interactions. Following acquisition of ranks, adaptive changes in both behavior and physiology occur. Consequently, individuals of different social status experience vastly different social environments which may lead to health disparities. Social subordination has been suggested to compromise individuals' immune systems due to the deleterious effects of elevated stress levels in both humans and non-humans. Further, individual phenotypic differences such as in copying style may lead individuals to being more or less resilient to this stress. In contrast, maintaining high social status, especially alpha status, can be extremely energetically costly as one invests vastly in reproduction and territorial defense and leaving less resources to fight immune challenges. Based on our previous data, we hypothesize that both high- and low-ranked mice living in groups of 10 males show compromised immune systems in compared to mid-ranked mice associated with these metabolic trade-off and stress responses respectively. We collected biological samples from 10 groups of 10 male mice housed in vivaria designed to resemble the wild habitat of the progenitors of laboratory mice. Cytokine levels, corticosterone levels, fkbp5 DNA methylation levels, and the proportions of different types of immune cells in blood were assessed. Moreover, we collected in-depth behavioral data to examine whether individual variation in how animals respond to receiving aggression is associated with differences found in markers of immune functioning. We also microdissected multiple brain regions in social decision making network and sequenced transcriptome. This study emphasizes the importance of considering variation in both individual behavioral phenotypes and social rank when studying the effects of differential social environments on the immune system within an ethologically relevant behavioral paradigm.*--

Keywords: social dominance; immunophenotyping; brain transcriptome; fkbp5; DNA methylation; individual difference

A16 Investigating the Behavioral Effects of Repeated Vicarious Stress in the Prairie Vole

Oreoluwa I Akinbo, W.T.Watanasriyakul, M.C. Norman, M. Cox, S. Ciosek, S. Sujet, N. Holzapfel, J. Wardwell and A.J. Grippo, Northern Illinois University

Social vicarious stress is defined as stress that transfers between social individuals. Observing someone experience an illness or car accident may produce social vicarious stress that alters neural stress pathways. Vicarious stress models subject a rodent to a physical stressor while another animal observes. The prairie vole is an ideal model to investigate neural stress pathways underlying vicarious stress, given its monogamous social structure. We previously observed negative behavioral, cardiovascular, and endocrine consequences of a single vicarious stress exposure. The present study extended the number of vicarious stress exposures, creating a chronic model. Vicarious stress was operationalized by combining a 5-min tail suspension test (TST) and open field test (OFT), repeated 4 times (48hours between each test). One animal was placed in the TST (direct physical stressor), while its sibling was put in the OFT below (observer). Twelve male prairie vole pairs (N=24) were assigned to either vicarious stress, a concurrent test in the combined TST-OFT; or control, one animal in the TST and its sibling in the OFT separately. We hypothesized that concurrent condition observers would show greater behavioral reactivity than the separate condition. Concurrent condition observers spent significantly less time in the center, in motion and grooming in the OFT across four test sessions, suggesting anxiety-like behavior. Both groups spent less time spent in the center section and motion and reared less across the four sessions, suggesting an increase in anxiety-like behavior. The data indicates that the observer animal experienced vicarious stress in response to observing its sibling in the direct TST stressor across four test sessions. The current findings support previous research that vicarious stress may increase behavioral stress responses in the observer and provides a model for investigating neural stress pathway alterations as a function of social vicarious stress.

Keywords: vicarious stress, stress, prairie vole, chronic stress

A17 The behavioural effects of early adolescent lipopolysaccharide administration on adolescent and adult male and female rats

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There is accumulating evidence for sex differences in the behavioural, physiological, and immunological effects of infection. Lipopolysaccharide (LPS), a cell wall component of Gram-negative bacteria, has been effectively used to examine these differences. Generally, males are more susceptible to infection than females. Age-related changes are a contributing factor to this sex difference. There have been limited investigations of: (1) the impact of adolescent infection, (2) the long-term effects in later adolescence compared to adulthood, and (3) whether or not there are sex differences in these long-term effects. The present study was designed to examine sex differences in the long-term behavioural effects of LPS measured in late adolescence and adulthood following early adolescent LPS exposure. Thus far, eight male rats were assigned to each of the LPS (0.2 mg/kg dissolved in 0.9% NaCl) and vehicle control (0.9% NaCl) groups and received early adolescent intraperitoneal injections on postnatal days 30 and 32. After a five-day washout period, (1) general locomotor activity; (2) anxiety; (3) social behaviour; (4) memory; (5) acoustic startle response (ASR); and (6) sensorimotor gating were examined. Physiological tolerance to LPS was established. Early adolescent LPS administration increased locomotor activity in adolescence, decreased anxiety and social initiations in adolescence and adulthood, and had no significant effects on memory, ASR, and sensorimotor gating in male rats. Upon completion of this project, variations in age and sex will be accounted for to better our understanding of differences in the behavioural effects of LPS.

Keywords: Lipopolysaccharide, sex differences, adolescence

A18 Investigating the Behavioral Effects of Repeated Vicarious Stress in the Prairie Vole (UPDATED)

Oreoluwa Akinbo, W.T. Watanasriyakul, M.C. Normann, M. Cox, S. Ciosek, S. Sujet, N. Holzapfel, J. Wardwell and A.J. Grippo, Northern Illinois University

Social vicarious stress is defined as stress that transfers between social individuals. Observing someone experience an illness or car accident may produce social vicarious stress that alters neural stress pathways. Vicarious stress models subject a rodent to a physical stressor while another animal observes. The prairie vole is an ideal model to investigate neural stress pathways underlying vicarious stress, given its monogamous social structure. We previously observed negative behavioral, cardiovascular, and endocrine consequences of a single vicarious stress exposure. The present study extended the number of vicarious stress exposures, creating a chronic model. Vicarious stress was operationalized by combining a 5-min tail suspension test (TST) and open field test (OFT), repeated 4 times (48 hours between each test). One animal was placed in the TST (direct physical stressor), while its sibling was put in the OFT below (observer). Twelve male prairie vole pairs (N=24) were assigned to either vicarious stress, a concurrent test in the combined TST-OFT; or control, one animal in the TST and its sibling in the OFT separately. We hypothesized that concurrent condition observers would show greater behavioral reactivity than the separate condition. Concurrent condition observers showed lower levels of center section exploration, motion, and grooming in the OFT vs. controls, suggesting anxiety-like behavior. Both groups showed a reduction in center section exploration, motion, and rearing across the four sessions, suggesting an increase in anxiety-like behavior over time. The data indicate that the observer animal experienced vicarious stress in response to observing its sibling in the direct TST

stressor across four test sessions. The current findings support previous research that vicarious stress may increase behavioral stress responses in the observer, and provides a model for investigating neural stress pathway alterations as a function of social vicarious stress.
Keywords: vicarious stress, stress, prairie vole, chronic stress

A19 Sexually dimorphic effects of propionic acid in adult rats: implications for an animal model of autism spectrum disorder

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Autism spectrum disorder (ASD) is a developmental disorder of variable severity characterized by impairments in social interaction and communication as well as restricted and repetitive patterns of movement. Past research suggests that certain gut and dietary factors may transiently worsen symptoms in ASD. Propionic acid (PPA) is a short chain fatty acid and an important intermediate of cellular metabolism. PPA is also a by-product of a subpopulation of human gut enterobacteria. Previous studies have shown that treatment with PPA can create both brain and behavioural responses in rats that are characteristic of ASD in humans. A strong and consistent male bias in ASD prevalence has been observed, and several sex-differential genetic and hormonal factors have been suggested to contribute to this bias. Past studies have reported a neuroprotective effect of the sex hormones prolactin and estrogen, for both hippocampal neurodegeneration and neuroinflammation, which have been proposed as potential etiological mechanisms in autism. Very little research has examined the effects of PPA in females. The present study explored putative sex differences in the effects of PPA on a rodent behavioral ASD phenotype. Male (N = 16) and female (N = 16) rats were systemically treated with PPA (500mg/kg) or PBS control and tested in a light-dark anxiety procedure. PPA-treated females displayed similar patterns of anxiety-like behaviour (i.e. duration of time spent in the light chamber and nosepokes into the light chamber) to PPA-treated males, which differed significantly from PBS treated rats.
Keywords: Autism Spectrum Disorder, Propionic Acid, Gut Microbiome, Sex differences

A20 Interplay of the rapid activation of the G-protein coupled estrogen receptor and estrogen receptor b and the oxytocin receptor on social recognition

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Both estrogens and oxytocin (OT) can influence social recognition (SR). Knocking out the genes for the estrogen receptors (ERs), OT, or the OT receptor (OTR) impairs SR, whereas the administration of 17b-estradiol (E2) or the agonists for the ERs facilitates SR. An interplay between estrogens and OT in the mediation of SR has been suggested. A model for this interplay was developed that proposes that estrogens binding to the ERs in the paraventricular nucleus (PVN), where most of the OT is produced in the brain, leads to the release of OT into the medial amygdala (MeA), an important region for SR as the olfactory information of encountered individuals is sent to this region. OT will then bind to the OTR in the MeA to facilitate SR. We have previously tested this model for estrogens' rapid mechanisms of action and found that E2 in the PVN rapidly facilitated SR and that this facilitation was blocked when a subeffective dose of an OTR antagonist (OTRA) was infused into the MeA, supporting estrogens' rapid mechanism interacting with OT to effect SR as the model describes. In the present study we investigated the specific ERs mediating the rapid facilitation of SR by E2 in the PVN. We used agonists for the G-protein coupled ER (GPER) and ER beta (ERb) since both ERs are highly expressed in the PVN. We found that the infusion of the GPER agonist G1 or the ERb agonist DPN were able to rapidly facilitate SR. The next step is to determine whether the same subeffective OTRA dose used in the E2 experiment, a dose that by itself does not block SR, infused into the MeA can prevent the SR facilitating effects of the GPER and ERb agonists in the PVN. A rapid SR paradigm, that occurs within 40 minutes to test estrogens' rapid effects, is used that takes advantage of the natural preference for novelty in mice. If the OTRA blocks the facilitation of SR by the agonist, it would suggest that that ER is mediating the interplay between estrogens and OT on SR. Funded by NSERC.
Keywords: Estrogen Receptors, Oxytocin, Social Recognition

A21 Episodic cells for self and other in the bat hippocampus

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The hippocampal formation is essential for forming episodic memories of where-and-when. Extensive research has revealed place cells and grid cells that encode spatial position (where), and time cells that encode elapsed time (when). However, very little is known about how the brain encodes both space and time simultaneously. Furthermore, it is unknown whether and how the brain encodes elapsed time for other individuals, in a social context. Here we show, for the first time, that CA1 neurons in the bat hippocampus encode simultaneously elapsed time × space, and also encode elapsed time for another bat – in a social task. We trained an observer bat to watch, remember, and imitate the flights of a demonstrator bat to different positions in the room. We found time-cells in dorsal CA1 of the observer bat – neurons which fired transiently at specific times after the observer bat has landed and was hanging motionlessly. Different time-cells had different preferred times at which they fired – and together, ensembles of these time-cells formed internally-generated firing sequences that encoded elapsed-time, and spanned the entire waiting-time of the observer bat. Importantly, these cells generated different temporal sequences at different locations in the room, thus encoding simultaneously space × time (spacetime): hence we termed them 'episodic cells'. A distinct subgroup of neurons exhibited the same preferred-time irrespective of position – thus purely encoding elapsed time. Surprisingly, we also found episodic-cells that encoded elapsed time from the landing-moment of the other bat. Together, our results demonstrate neuronal coding of spacetime for self and other in the hippocampus – which may support both perception of interval timing and episodic memories for self and other.
Keywords: Hippocampus; Time; Social

A22 Physical activity induces brain and behavioral changes in adolescents with subthreshold mood syndromes: A randomized controlled trial study

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Background: Prior literature have supported that physical exercise intervention is effective in enhancing various behavioural domains including cognition in adolescents. The present study aimed to examine the neural and cognitive-emotional changes after physical exercise intervention in adolescents with subthreshold mood syndromes. Method: Thirty nine adolescents with sub-threshold mood syndromes were recruited (Mage = 12.64 years; 16 males) to participate in this study. Twenty one participants were randomly assigned to intervention group (aerobic exercise running) while 18 were assigned to control group (group activities). Both groups underwent cognitive and emotional assessments, as well as the structural Magnetic Resonance Imaging (sMRI) before and after the intervention or group activities. Results: The repeated-measures t-test results showed that the Group x Time interaction effect was significant in the right medial orbitofrontal cortex (mOFC) gray matter volume (GMV) (p= 0.03), left rostral anterior cingulate GMV (p= 0.02) and right rostral anterior cingulate cortical thickness (p= 0.01). The correlational results showed that the change in cognitive and emotional aspects were moderately and significantly correlated with the change in left rostral anterior cingulate GMV/cortical thickness (rs= -0.57) and left and right mOFC GMV/cortical

thickness (rs= -0.50 to -0.54) in the intervention group while these correlations were not significant in the control group. Conclusion: The present findings suggest that after physical exercise intervention, there are structural brain changes specifically in the mOFC and rostral anterior cingulate (cognitive-emotional related brain regions) and these structural brain changes are coupled with the behavioural changes in adolescents. In summary, these findings can help us better understand the neural mechanism of the cognitive- emotional improvements induced by physical activity in adolescents.
Keywords: physical activity, neural mechanism, MRI, adolescents, emotion, cognition

A23 Cross-Brain Neural Coupling of Fusiform and Angular Gyri Share Social Cues During Real Eye-to-Eye Contact

Joy Hirsch, J.A. Noah, X. Zhang, S. Dravida, M. Kelley, Yale School of Medicine

It has been proposed that neural coupling of signals between brains (coherence) is an indicator of shared encoding of information that is transmitted and subsequently received. Previous findings from our group report neural coupling between fusiform gyrus and angular gyrus during a live and interactive face-to-face task where relevant face information is compared to irrelevant face information that is simultaneously transmitted and received. Here we test the hypothesis that this specific cross-brain network is specifically activated by interpersonal eye contact. If so, then the findings advance a theoretical framework for a cross-brain neural system that shares live and rapid eye-to-eye information between interacting dyads. In this study hemodynamic signals were acquired using a two-person neuroimaging paradigm and functional near-infrared spectroscopy (fNIRS) during either live face-to-face contact or viewing a dynamic face-video (15 dyads, n=30). Neural coupling between participants was determined by wavelet analyses that compared cross-brain correlations with wavelet kernels for signals originating from 12 brain regions (previously described). As predicted, neural coupling between angular gyrus and fusiform gyrus was greater during the real face condition than during the video face condition ($p < 0.01$). These two coupled regions are recognized components of social and face systems. This neural coupling was not observed when the partners were computationally shuffled as would be expected if neural coupling represented live encoding of reciprocal and socially informative facial and eye information. Further, no other cross brain region pairs were coherent. These findings suggest that cross-brain entrainment of the fusiform gyrus and angular gyrus may serve a previously unappreciated role associated with encoding of rapidly acquired spontaneous social and facial information detected during live face-to-face and eye-to-eye interaction.
Keywords: Neural Coupling, Hyperscanning, Social Interaction, Cross-Brain Coherence

A24 Molecular anatomy of oxytocin receptors in peripheral sensory ganglia of neonatal mice.

Radhika Vaidyanthan, Elizabeth A.D. Hammock, Florida State University

Neonatal mice abundantly express oxytocin receptors (OXTRs) in a range of peripheral tissues where circulating oxytocin (OXT) can mediate tissue-specific effects via peripheral OXTR. OXTR-containing regions in the face such as the mandibular and maxillary periodontium, eye, and whisker pads are innervated by sensory afferents of the trigeminal ganglion. Similarly, other OXTR-containing regions in the body such as the anogenital region and adrenal glands are innervated by the dorsal root ganglia. We have previously identified Oxtr mRNA in the trigeminal sensory ganglia (TG) and dorsal root ganglia (DRG) of neonatal mice. In this study we aim to A) refine the anatomy of Oxtr in the TG, and B) to determine if peripheral OXTR are synthesized in the peripheral sensory ganglia. Previously, we identified by in-situ hybridization that Oxtr mRNA colocalize with different types of sensory neurons in the TG. Mechanosensory neurons (TrkB positive) show the highest co-expression of Oxtr, but nociceptive neurons (TrkA positive) and proprioceptive neurons (TrkC positive) show low and moderate levels of co-expression with Oxtr in the TG, respectively. In our current study, we use markers for thermoreceptive neurons to identify if Oxtr in the TG colocalize with warm or cold-sensitive neural populations. Preliminary data suggest that Oxtr co-localizes with thermoreceptive neurons. To address aim B, we selectively eliminate Oxtr from sensory ganglia (TG and DRG) using a Cre-lox P approach and quantify peripheral OXTR ligand-binding in the whole body of neonatal C57BL/6J mice. Our preliminary findings suggest that OXTR are not fully eliminated in the periphery due to the deletion of Oxtr from sensory ganglia. We predict that some of these peripheral regions will show a decrease in OXTR-ligand binding compared to their WT controls.
Keywords: Oxytocin Receptor, Periphery, Autoradiography, Neonate, Mouse

A25 Blinks punctuate cognitive states required by a social learning task

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Blink frequency and timing relative to external stimuli and ongoing behaviors may signal attention, social engagement, cognitive effort, and reward expectation or receipt. We have aligned the blink rate of an adult male monkey to the events of a task that required watching videos of conspecifics or inanimate objects and learning by trial and error the reward amount associated with each individual or object (8, 3, or 0 drops of juice). The monkey systematically selected the highest-rewarded item from a pair of simultaneously presented choices (AccuracySocial = 95%, AccuracyNonsocial = 96%). We found brief and precisely timed increases in blink frequency in response to the choice cue and the beginning of the reward delivery period (randomization test, $p < 0.001$). Blinking was suppressed immediately after the choice cue and persisted until the end of the video display ($p < 0.001$). These results suggest that the attention/cognitive effort required to respond to cues and to carry out operant responses is reflected in the blink rate and the precise timing of blinks. Videos with social content elicited higher blink rates during the stimulus presentation (45% increase) and after receipt of reward (12% increase) ($pStim < 0.001$, $pReward < 0.03$). The reward differential also influenced blink frequency. During the choice time (31% increase) and after reward delivery (40% increase), blink rate was the highest for the largest reward differential (8 vs. 0 compared to 3 vs. 0 drops, $pStim < 0.01$, $pReward < 0.001$) in the latter proportion of trials when the monkey had learned the associations. These results suggest that reward expectation and receipt also modulate blink rate. Taken together these results show that blinking is a spontaneous repetitive behavior that does not require training or reinforcement to emerge as a valuable indicator of brain states. Blink rate can be integrated with learning paradigms and complex behavioral tasks to inform multiple dimensions of behavior.
Keywords: Blink rate, Reward, Macaque, Learning

A26 Dopamine dynamics underlying monogamous social bonds

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Despite the critical role social relationships play in our daily lives, the neuronal dynamics underlying the formation and preservation of social bonds remain largely unknown. Unlike traditional laboratory rodent models, prairie voles (Microtus ochrogaster) form life long pair bonds between mates. Dopamine (DA) signaling in the nucleus accumbens (NAc) is necessary for the formation of pair bonds in prairie voles, a finding that corresponds with its known role in reward learning. Additionally, it has been shown that in vitro, evoked dopamine release is altered as a result of bonding. However, it is unknown whether these changes in release dynamics occur in vivo and in response to natural stimuli. I have pioneered the use of fiber photometry with the fluorescent biosensor, GRAB DA, in prairie voles to measure in vivo dopamine release in the nucleus accumbens during social interaction. I compare dopamine release in response to partner and

novel conspecific interaction before and after pair bonding. Additionally, I explore how optogentically evoked dopamine release changes after bonding. This research will elucidate how dopamine dynamics change as a function of bonding, providing insight into the mechanisms that may also support the long-term nature of human social bonds.
Keywords: dopamine, prairie voles

A27 Prefrontal circuitry in control of limbic thalamus requires juvenile social experience to establish adult sociability

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Juvenile social isolation causes long-lasting dysfunction in medial prefrontal cortex (mPFC) and disruption of adult sociability. However, the neural circuit mechanisms underlying these phenomena are poorly understood. Among various subcortical targets, we identified the limbic thalamus, which relays signals to various components of the classical reward circuitry, as the most prominent projection target from the mPFC that is preferentially recruited by social interaction. Chemogenetic or optogenetic suppression of this projection was sufficient to induce sociability deficits without affecting motor activity or anxiety-related behaviors, showing that this circuit is necessary for normal social preference. Importantly, transient juvenile social isolation (p21-35) leads to a failure to activate adult mPFC->limbic thalamic projection neurons in response to a social encounter, due to their reduced intrinsic excitability and aberrantly increased inhibitory drive from low-threshold spiking inhibitory neurons in deep layers of the mPFC. Sociability deficits caused by juvenile social isolation are rescued by an acute chemogenetic or optogenetic activation of mPFC->limbic thalamic projection neurons. Our study identifies a novel pair of mPFC excitatory and inhibitory circuits whose maturation is profoundly affected by social experience during the juvenile period and points toward potential targets for the amelioration of social processing deficits shared across a range of disorders.
Keywords: Social, Sociability, Prefrontal Cortex, Thalamus, Social Isolation, Development

A28 Exploring the neural correlates of empathy deficits following pediatric traumatic brain injury: A functional magnetic resonance imaging study

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Social impairments following pediatric traumatic brain injury (TBI) have been related to a disruption of socio-cognitive skills, such as empathy, the ability to respond to and share others' emotional state. However, research on the neural basis of these difficulties after TBI is limited. This study examined the neural correlates of empathy deficits following pediatric TBI using a pain empathy paradigm (Akitsuki & Decety, 2009). Adolescents with moderate-severe TBI (n=15, 13.21±1.44 years) and typically developing controls (TDC; n=14, 13.53±1.78 years) underwent functional magnetic resonance imaging at one to two years post-injury. They were asked to passively view visual stimuli depicting hands or feet in non-painful and painful situations either caused by accident or intentionally inflicted by another person. The groups' signal changes were compared using 2-sample t-tests; results were corrected for multiple comparisons ($p<.05$, cluster-level). Analysis of covariance was used to compare responses on the Index of Empathy for Children and Adolescents (IECA) questionnaire. Compared to TDC, the TBI group showed higher brain activation when observing two individuals as compared to one individual in pain and non-pain situations. Specifically, watching social agency in pain situations resulted in stronger activation in the left inferior parietal lobe ($k=231$ voxels, $p=.016$). In non-pain scenarios, stronger activation in the TBI group was observed in the right precuneus ($k=172$ voxels, $p=.043$) for stimuli involving two individuals. Adolescents with TBI also showed significantly lower scores on the IECA ($F(1,24)=15.53$, $p<.001$). Sustaining pediatric TBI may lead to altered activity in brain regions involved in social interaction in response to situations involving the understanding and sharing of someone's affect. Findings provide a basis for future work seeking to examine the neural underpinning of empathy and other aspects of socio-emotional functioning after pediatric TBI.

Keywords: Functional magnetic resonance imaging, empathy, social functioning, traumatic brain injury, paediatrics

A29 Fishing for sociality: The role of oxytocin neurons in zebrafish social behavior

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Social species recognize and approach their conspecifics, suggesting conserved neural circuits that process social relevant information. Key neuromodulators such as oxytocin-like family peptides have been implicated in the regulation of different aspects of social behavior across species, through mechanisms that are still not fully understood. We have been using zebrafish, a simpler-minded and highly social animal model with a well-characterized repertoire of social behaviors and a wide-genetic toolbox available, to investigate the role of oxytocin neurons in the regulation of adult sociality. We first characterized sociality in zebrafish, measured as a visual preference towards shoals, and observed that shoal preference emerges around the third week of life. Then we manipulated the function of the oxytocinergic neurons using a transgenic system for conditional and cell-specific ablation of oxytocin neurons, and study how the loss of function of these neurons during larvae or throughout development, modified adult social behavior in this species. Early oxytocinergic neural ablation, but not adult ablation, significantly impaired shoal preference in adults, correlated with a small but significant reduction in the cell number of specific dopaminergic clusters namely the visually-associated posterior pretectal area. In conclusion, our results support an involvement of the oxytocinergic neurons in zebrafish sociality, and a possible link between this system and dopaminergic circuits involved in both visual information processing and social cognition.
Keywords: social behavior, oxytocin, zebrafish, dopamine

A30 Understanding the psychological and physiological correlates of prejudice against consensual non-monogamy

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Consensual non-monogamy (CNM) is a relationship style that is often a target of stigma and prejudice. The present study sought to determine whether anti-CNM prejudice is associated with the same patterns of physiological and emotional responding that have been recorded in other forms of sexual prejudice. Participants completed an online survey of their attitudes towards CNM, their level of disgust sensitivity, narcissism, and religiosity. From those who completed the survey, a subset of were invited to a follow-up laboratory study. Participants listened to a series of audio vignettes describing monogamous, non-monogamous, and neutral relationships while their electrodermal activity (EDA), heart rate (HR), salivary alpha-amylase (sAA) and emotional affective states were measured. Another vignette that asked participants to imagine being asked to engage in CNM by a partner was also included. Consistent with the Personalization of Prejudice theory, participants who were unwilling to participate in CNM relationships showed a negative correlation between narcissism and attitudes towards CNM. There were no differences in the physiological results across the relationship vignettes, but the Imagine vignette resulted in significantly lower mean EDA and significantly higher HR and negative affect. Positive attitudes towards CNM were found to be positively correlated with EDA and heart

rate during monogamy and CNM vignettes. Although the self-report data alone exhibit results similar to other forms of sexual prejudice, the psychophysiological data tend to contrast with past work on other forms of sexual prejudice. The implications of these results for existing accounts of sexual prejudice and anti-CNM attitudes are discussed.
Keywords: Prejudice, Consensual Non-Monogamy, Psychophysiology, Sympathetic Nervous System, Sexual Prejudice, Electrodermal Activity, Heart Rate, Salivary Alpha-Amylase, Relationships

A31 Fair or Selfish? Error-Related Negativity Differences in Resource Allocative Decisions

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While a growing body of literature has documented differences in the neural processing of fairness and resource allocations using EEG and fMRI (e.g., Civai et al., 2010), few studies have explored the online decision-making processes regarding resource allocations and specifically, the individual and dispositional components that shift these neural computations (e.g. Kwak et al., 2014). The current study employs an ERP-adapted variant of the Iowa Gambling Task with four decks: selfish, inequity aversion, altruistic, or dual loss. It sought to ascertain individual differences in event-related potentials during a task that allowed participants to choose between several potential decks. Here, the paradigm allowed for a disentangling of patterns of fairness where participants could be categorized as primarily choosing the selfish deck or primarily choosing the fair deck over the course of 100 trials. We specifically focused on error-related negativity (ERN) and, from our preliminary data on nearly 15 adult subjects, individuals whom are generally "fair" in their deck choices display an amplified ERN wave when choosing the selfish deck compared to both "selfish" individuals and the ERN for fair trials ($F (1, 12) = 7.2$, $p = .02$). Adults who predominantly chose the selfish deck did not appear to differentiate between fair and selfish deck choices in the ERN ($F (1, 12) = 1.5$, n.s.). These results highlight a potential mechanism for individual differences in fairness sensitivity, namely conflict monitoring and error detection, and support inequity aversion as a rationale for, as argued here to be, altruistic decision making.
Keywords: Altruism, Event Related Potentials, Inequity Aversion, Faimess, Error-Related Negativity

A32 Investigation on whether rule-violating behavior can be improved into rule-observing strategy

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Following social rule is indeed orderly resolution of social conflict over limited resource. Thereby, most individuals take this as a strong strategy for the best choice. Meanwhile, how one could have decided to cling to a certain strategy is highly complicated. Here, we suggest a behavioral mechanism of strategy establishment in mice in social conflict. First, we trained pairs of mice to compete over wireless brain stimulation reward. Then, as the pairs developed mutual social rule by 'reward zone allocation,' we sorted out the pairs consist of rule-observing- and rule-violating mice. Those pairs went through further identical competition games. By the end, majority of rule-violating mice became rule-observing mice. We found the payoff equity and individual payoff were affected while the violating mice made attempts for following the mutual rule. We observed that mice could risk their own benefit by keeping the rule, enhancing payoff equity between their partners. These results support that altruistic decision can change socio-economic strategy in mice. To figure out what happens in their brain, a wireless EEG recording system is under development to record simultaneously in both of freely-moving mice.
Keywords: SOCIAL DECISION, SOCIO-ECONOMIC STRATEGY, ALTRUISM

A33 Hyperactivity in the valproic acid marmoset model of autism

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Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder characterized by deficits in social communication and repetitive behaviors. Since human epidemiological studies provide evidence that maternal administration of valproic acid (VPA) increases the risk for ASD in offspring, we sought to establish a non-human primate model of autism induced by prenatal exposure to VPA. The common marmosets, a highly social species commonly used in biomedical studies, have been used in our research. We have previously demonstrated that the VPA-induced autistic marmosets fail to show social cognitive skills such as inequity aversion and discrimination between third-party's reciprocal and non-reciprocal interactions. To investigate whether other prevalent symptoms including hyperactivity and abnormal sleep patterns can also be detected in the marmoset model of ASD, we measured home cage activity of adult marmosets for three weeks using an unobtrusive collar-worn actigraphy device (Actiwatch Mini; Camtech, Cambridge, UK). The data collected from the first two weeks were excluded from the analysis to avoid confounding effects from their unfamiliarity of the apparatus. The VPA marmosets, like many of the other animal models of autism, exhibited significantly higher home cage activity in the 12h light period (7am-7pm) than the VPA-unexposed group. Based on the current and previous findings, we conclude that the VPA marmosets have autistic-like phenotypes including abnormal social cognition and hyperactivity, suggesting that our primate model of autism is one of the clinically useful animal models contributing to the understanding of neurodevelopmental symptoms associated with ASD.
Keywords: autism, marmoset, social cognition, hyperactivity

A34 Maternal immune activation is associated with internalising and externalising symptoms across child development.

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Emerging research suggests maternal immune activation (MIA) during pregnancy may alter foetal neurodevelopmental trajectories, resulting in poorer developmental outcomes. We investigated whether MIA is associated with increased behavioural and emotional problems in offspring, with a focus on increased risk for internalising and externalising behaviours across development. We conducted a cohort study using data from the prospectively collected Western Australia Pregnancy Cohort (Raine) Study (N=2868, recruited between 1989 and 1991). Mothers were classified into 2 groups: 1) Asthma, Allergy, Atopy, Eczema (AAAE) and 2) infection, based on data collected during pregnancy and at 5-year follow-up. The Child Behaviour Checklist (CBCL) was used to assess offspring mental health at ages 5, 8, 10, 14 and 17, generating Total, Externalising and Internalising behaviour scores. Generalised estimating equation models were used to generate β coefficients and 95% confidence intervals (CI) for CBCL scores throughout development. AAAE conditions (N=1267) were associated with increased Total (β: 2.49, CI: 1.98, 3.00; $p<0.01$), Externalising (β: 1.54, CI: 1.05, 2.03, $p<0.01$) and Internalising (β: 2.28, CI: 1.80, 2.76, $p<0.01$) behaviour scores. Infection conditions (N=1082) were also associated with increased Total (β: 1.27, 95% CI: 0.77, 1.78; $p<0.0001$) and Externalising (β: 1.18, CI: 0.70, 1.66, $p<0.0001$) scores. Offspring of mothers who reported more than one AAAE and/or infection condition showed greater increases in CBCL scores than single conditions, suggesting a cumulative impact. Results show, for the first time, that MIA increases overall risk for the onset of major psychiatric symptoms in the child across all stages of childhood. MIA may interfere with foetal neurodevelopment, conferring risk for impaired social and emotional development.
Keywords: Maternal immune activation, externalising, internalising, neurodevelopment, social development

A35 The mediodorsal thalamus to anterior cingulate cortex circuit modulating social fear transmission.

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Empathy is an important capacity to recognize and share emotions with others. Neural networks comprising anterior cingulate cortex (ACC) and the mediodorsal thalamus (MD) were shown to be activated when people engage in empathy and be involved in acquisition of socially transmitted fear in mice. However, how the MD modulates observational fear is not understood. Here, we demonstrate that a distinct thalamocortical sub-circuit, originating from the lateral part of MD (MDl) to the ACC, is specifically responsible for this modulatory function. Mice with the MDl-ACC circuit-limited deletions of phospholipase C beta4 (Plcb4) exhibited a marked increase in observational fear, with the null or MD-restricted deletion showing similar results. In vivo recording in behaving Plcb4-deficient mice revealed that an enhanced excitability in MD, an increased activity of ACC, and augmented theta synchrony between MD and ACC. We further confirmed that the enhanced MD firing was accompanied by increased T-type Ca2+ channel activity: an MD-restricted deletion of CaV3.1 T-type Ca2+ channel suppressed the enhanced OFL phenotype of Plcb4 mutant mice. In addition, optogenetic stimulation of the MD input to the ACC evoked an elevation of observational fear, mimicking the Plcb4 mutation, whereas a specific inhibition of this thalamocortical projection impaired vicarious fear response. Our results demonstrate that the MDl-ACC pathway constitutes an essential circuit for observational fear, and uncover a novel role of the MD in cognitive processing for social learning of fear.
Keywords: social fear transmission, observational fear, mediodorsal thalamus, cingulate cortex, phospholipase C beta4

A36 Sociosexual experience shapes oxytocin action on glutamate transmission in the nucleus accumbens of prairie voles

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In socially monogamous prairie voles, sociosexual experience establishes enduring pair bonds between mates. Oxytocin (OXT) signaling in the nucleus accumbens (NAc) plays a crucial role in mating induced pair bonding. It is hypothesized that OXT signaling in the NAc links the neural encoding of partner cues to the reward system by modulating coordinated activity within a social salience network. Multiple brain regions, including prefrontal cortex and basolateral amygdala, send glutamatergic projections to NAc, and may contribute to the transition to a bonded state. However, how OXT and pair bonding affects communication within this network is unknown. Using in vitro electrophysiology in prairie voles , we examined the effect of OXT signaling on excitatory transmission in the NAc of pair bonded and non-bonded voles. Animals were either cohabitated with an opposite-sex partner for 24 hours to establish a pair bond, or a same-sex sibling as a non-bonded control. In pair bonded animals, OXT receptor agonist, TGOT, did not alter the frequency or the amplitude of spontaneous excitatory postsynaptic currents (sEPSCs) in whole cell recordings. However, field excitatory postsynaptic potential (fEPSP) induced by local electrical stimulation of NAc was increased by TGOT relative to baseline. In contrast, in non-bonded voles, TGOT increased the frequency of sEPSCs without changing their amplitudes, and modestly decreased fEPSP. Thus, OXT signaling affects excitatory transmission within the vole NAc differentially depending on sociosexual experience. Further, OXT signaling has different effects on spontaneous and evoked activity, perhaps modulating the signal-to-noise ratio in excitatory signaling in a state-dependent manner. Hence, our study suggests that sociosexual experience transitioning to a pair bonded state can reshape how OXT acts on glutamatergic transmission in the NAc, which may reflect a novel form of plasticity underlying pair bonding.
Keywords: oxytocin, sociosexual experience, glutamatergic transmission, nucleus accumbens, prairie vole

A37 How the ageing brain reacts during and after exposure to others' suffering

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Social emotions such as empathy have been widely studied in young adults. Conversely, empathy-related brain functions in older adults are poorly understood. In addition, most of the studies in younger adults focused on static - rather than dynamic- aspects of empathic responses. Therefore, the main goal of the current study is to assess whether exposure to other people's suffering produces sustained carryover effects on the activity and connectivity of emotion network in the brain of older adults, i.e., , after exposure to this information. To this aim, we acquired functional resonance imaging data while 132 participants over 65 year-old watched emotional video-clips from the Socio-affective Video Task (SoVT, Klimecki et al., 2013) followed by rest periods of 90 seconds. Participants also provided self-report on their feelings in response to each video as well as measures of dispositional empathy, depression, anxiety, and emotion regulation. Elderly participants reported higher empathy and negative feelings, as well as lower positive feelings in response to others' suffering compared to everyday life situations. Witnessing others' suffering induced greater brain activity in areas related to empathy and social cognition, including the anterior insula, middle cingulate gyrus, and medial prefrontal cortex. During the 90 seconds of resting state after exposure to videos, we observed increased activations in brain regions related to the default mode network as well as different connectivity patterns, following the emotional relative to the neutral videos. Our study shows that when faced with others' suffering, older adults experience stronger emotional states , with concomitant changes in brain activity that persist over time even at rest. These effects reveal carryover effects of emotional episodes into subsequent periods and modulation of resting state activity by emotional information.
Keywords: Ageing, empathy, fMRI, DMN, resting state, emotional inertia

A38 Unravelling the neurogenomic basis of aggression in males and females of the Siamese fighting fish Betta splendens

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The display of aggression varies among species, populations, sexes, and individuals, implying differentiated access to resources, predation survival, mating strategies, and life history patterns in both sexes. Aggression is a complex set of behaviors, influenced by a broad range of genetic, hormonal, neuronal, and social environmental factors. However, this behavior has been more extensively studied in males than in females, with divergent results presented in the literature. Hence, in this work, we focused on the neurogenomic mechanisms mediating aggression in a fish species where both males and females readily express aggressive behavior, the Siamese fighting fish Betta splendens. In this species, highly aggressive fighting strains have been selected across centuries in Southeast Asia. A strain of wild-types and a strain of fighters were reproduced under lab conditions for several generations and differences in behavior and in the brain transcriptome (RNA-seq) were compared between sexes. As expected, when presented to an aggressive challenge, either a mirror image or an interacting conspecific, fighter males were more aggressive than wild-type males. Remarkably, these differences also occurred for females, although only males have been directly subject to artificial selection. Whole-brain gene expression analyses, using as a reference the B. splendens genome, revealed that the selection for aggression induced a markedly different neurogenomic baseline state and response to the challenge in both sexes within and between strains. The study provides evidence on brain gene regulation associated with the expression of aggression and presents the first comparison of males and females for B. splendens strains, a promising species for the investigation of the proximate and ultimate mechanisms of aggression in vertebrates.
Keywords: aggression, sex differences, neurogenomics

A39 Pair bonding attenuates fear memory acquisition in monogamous prairie voles.

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We previously showed that the application of single prolonged stress (SPS) to male prairie voles, which is known to induce PTSD-like symptom in rodents, disturbs the of pair bond formation. Here, we examined whether SPS treatment enhances fear memory. In contrast to our previous report, SPS treatment did not disrupt pair bonding when it was applied to males which were already bonded with their partner females. In a contextual fear conditioning test, SPS treatment significantly prolonged the freezing duration in subjects cohabited with a male conspecific (cagemate). Interestingly, such effect was not observed in pair bonded subjects (pair bond). Since freezing behavior by prairie voles was subtle, we confirmed reduced fear memory using a passive avoidance paradigm. The latency to enter a dark chamber, in which electric shocks were delivered to subjects, was significantly shorter in the pair bond group than that of cage mate group. Repeated exposure to the apparatus without electric shocks shorted the latency in both pair bond and cagemate groups with similar manner, suggesting that pair bonding disturbs the fear memory acquisition. Immunohistochemical analyses revealed that the intensity of oxytocin at the periventricular nucleus of hypothalamus and the number of cFos-positive cells at the central amygdala were significantly increased in pair bond group, compared with the cagemate group. Hence, we investigated the effects of the intracerebroventricular administration of oxytocin antagonist (OTA). OTA administration significantly prolonged the latency at the memory test than the conditioning even in pair bonded subjects ($p < 0.0001$), whereas vehicle administration did not ($p > 0.05$). OTA administration significantly delayed the latency to enter a dark chamber, compared to that of vehicle administration ($p < 0.008$). These results suggest that pair bonding attenuates fear memory acquisition probably through central oxytocin receptor signaling.

Keywords: Pair bonding, Oxytocin, Fear

A40 Social cognition after early brain insult : the role of genetically driven differences

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Pediatric traumatic brain injury (TBI) is highly prevalent, especially in the first years of life. TBI can interfere with social competence by disrupting the social brain, that is, the neural network that underpins children's ability to understand social cues and interact appropriately. Some children appear to be more vulnerable than others to adverse socio-cognitive outcomes after TBI. Genetically driven individual differences may contribute to this variability in outcome, but have rarely been investigated in young children with TBI. The aim of this study was to investigate the association between the presence of a common variant of the BDNF gene (Val66Met), known to be involved in neuroplasticity, and theory of mind skills after early TBI. 46 children with mild TBI sustained in early childhood (i.e., 18 to 60 months; 29 males) were recruited from a tertiary urban Emergency Department and compared to same-age community control participants (n = 55; 30 males) six months post-injury. Participants were compared on a theory of mind task targeting false belief understanding. They were also invited to provide a saliva sample (0.75 ml) with the use of sponges, swabbed along the child's gums and inner cheek. Results reveal a significant Injury x Genotype interaction ($p = .01$), such that children with mild TBI had poorer theory of mind skills compared with non-injured peers, but only for non-carriers of the Val66Met, who are known to have an enhanced potential for brain plasticity. These findings are counter to previous findings suggesting that BDNF Val66Met constitutes a risk factor for poorer outcome after a neurological insult. It is possible that the current results in young children with mild TBI are due to the distinctive features of an insult to the immature brain, in a period in which several neural changes are occurring through neuroplasticity mechanisms in the context of typical development.

Keywords: social cognition, traumatic brain injury, children, genetic

A41 The role of developmental social complexity on adult zebrafish social behaviou1

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The social brain hypothesis (SBN) posits that cognitive and brain evolution is mainly driven by the social environment. Although this relationship between social context and cognitive abilities has been shown in primates at the evolutionary scale (group size as a measure of complexity, and relative brain size of the neocortex as an indicator of cognitive skills), violations of this hypothesis have been reported when trying to generalize it across vertebrate taxa. So far, this hypothesis has ignored the potential effects of developmental processes, which may help to explain some of the current controversies, since early experience is essential in the development of the adult phenotype. In the present work, we studied the proximate causes of brain evolution: how development affects cognitive functions and neuronal numbers. Therefore, zebrafish were raised in different social environmental complexities (i.e. group size and group stability) until adulthood and tested for their social abilities, and neuronal numbers in different brain regions. At the behavioural level, our results indicate differences between the groups, for instance, group cohesion is influenced by group size, while shoal preference is influenced by group stability. For cognitive function, a short-term memory test demonstrated that different developmental environments lead to differences in discrimination and preferences, when given a choice between familiar and novel individuals. Thus, the neuronal numbers across the brain will provide a quantitative measure of how social environment influences brain development and adult social skills. This study will establish the effects of environmental complexity on brain development and behaviour in a complementary fashion by setting together different aspects of brain evolution.

Keywords: Development, Social competence, Neuronal numbers, Zebrafish

A42 "Infant neurobehavioral processing of the caregiver: Translating across species during typical and maltreatment rearing

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Infants rely on their mothers to provide the sensory stimulation for normal brain development. Altered maternal care, such as maltreatment, initiates a pathway to pathology, much of which remains dormant until later-life. However, atypical infant behavior in the Strange Situation Procedure, a paradigm that progressively stresses the child to reveal characteristic ways of responding to the caregiver when distressed, has been associated with maltreatment or frightening behavior of parents. Here, we adapted this test for use in rat pups to align findings across species and assess neural mechanisms/causation. Using the Scarcity-Adversity Model of maltreatment induced by low bedding (LB) for nest building beginning at postnatal day (PN)8, we compared SSP performance in maltreated rodents (PN13-14) and children; both exhibited behavioral features of disordered attachment in the SSP. In addition, in maltreated pups, reunion with the mother failed to modulate the infant's cortical local field potential (LFP) oscillations, compared to pups with no maltreatment. Next, we measured LFP in both pup and mother during brief periods of LB (between PN10-17). During LB, the dynamic range of LFPs induced by mother-pup interactions decreased, with both pup and mother showing impaired LFP responses to specific interactions, such as milk ejection and grooming. Blocking pup stress hormone synthesis via metyrapone during maltreatment and the SSP restored behavior, maternal regulation of LFP power, and cross-frequency coupling patterns to control levels. These results suggest that when a mother is stressed, she has impaired ability to modulate both her own and her pups' cortical function.

Keywords: Development, Attachment, Oscillations, Trauma

A43 Artificial selection for winners changes the structure of fights and the brain neurogenomic pattern in the Siamese fighting fish Betta splendens

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In social species, aggression underlies the establishment of dominance hierarchies and differentiated access to resources. In spite of its relevance for the survival and fitness of an individual, the genetic, hormonal and neuronal mechanisms of aggression are not yet well understood and are biased towards a few model species for which powerful molecular toolboxes have been developed. However, following Krogh's principle, the study of aggression may benefit from selecting species that may be better suited for that purpose. That is the case of the Siamese fighting fish Betta splendens where, across several centuries, males have been selected for winning paired staged fights, originating highly aggressive strains herein referred to as fighters. In this study, a strain of wild-types and a strain of fighters were reproduced in the lab for several generations and differences in behavior and in their brain transcriptome compared. Fighter males displayed not only a much higher frequency of aggressive behaviors but also presented a markedly different fighting pattern, avoiding close contact with the opponent, exhibiting threat displays from a distance and charging more often, both against their mirror image or an interacting conspecific. The frequency of air breathing, a correlate of metabolic activity, was more than three times higher in fighters than in wild-types during aggressive challenges, demonstrating a higher energetic investment of fighter males in contests. The two strains had a markedly different brain neurogenomic baseline state and, interestingly, also a divergent neurogenomic response to the aggressive challenge. The study shows the significant impact that selection for winners had in aggressive behaviour and brain neurogenomic state in B. splendens and confirms it as a promising species for the investigation of the proximate and ultimate mechanisms of aggression in vertebrates.

Keywords: Aggression, brain, transcriptome, neurogenomics

A44 Serotonin impairs social avoidance

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Many primate species gather information about the social intention of conspecifics to select appropriate social behavior. For macaques, threatening expressions and directed eye contact generally communicate dominance and an intent to aggress. Lipsmacks communicate affiliation and intention to submit. By monitoring these, and other facial expressions, individuals are able to learn and maintain dominance status. We have shown the serotonin precursor l-5-hydroxytryptophan (5-HTP) increases central concentrations of serotonin and modulates looking duration to social images in rhesus macaques (Weinberg-Wolf et. al 2018), suggesting that the serotonergic system is involved in social monitoring. However, successful social monitoring requires approaching appetitive, while avoiding threatening, stimuli (Weinberg-Wolf and Chang, 2019). Here, we tested if the serotonergic system is implicated in approaching or avoiding affiliative and threatening social stimuli. Monkeys were cued to look to (approach), or look away from (avoid), faces of unfamiliar conspecifics displaying threatening or affiliative expressions or luminance-matched scrambled images. We then examined how 5-HTP, compared to saline baseline, impacts approach and avoid behaviors using a repeated, within-subject, study design. At baseline, monkeys approached stimuli nearly perfectly. However, individuals varied in avoidance behaviors and erroneously approached to-be-avoided stimuli frequently, indicating an overall prepotency for approaching. While 5-HTP generally impaired performance in the task, it especially decreased monkey's ability to avoid social stimuli. Our results suggest that approach and avoidance behaviors are regulated by the serotonergic system, especially when these stimuli contain social information. These findings are consistent with the view that the serotonergic system is implicated in adaptive regulation of social approach and avoidance, ultimately contributing to adaptive social monitoring.

Keywords: Serotonin, approach, avoidance, inhibition, saccade, eye movement,

A45 Brain activities associated with theory of mind and attention in schizotypal adolescents and young adults: an event-related potential study

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Theory of mind and attention deficits are associated with schizophrenia- spectrum disorders. Prior brain studies focused on the clinical adult samples while the sub-clinical samples especially the adolescents were neglected. This present study aimed to examine the brain activities that were associated with theory of mind and attention in schizotypal adolescents and young adults. A total of 48 adolescents and young adults (31 males; mean age: 20.21 years) were recruited in the community. Participants were categorized into two groups according to their self-reported schizotypy scores: 1) schizotypy (N=16) and 2) controls (N=32). The performance accuracy and reaction time as well as the electroencephalogram (EEG) data were recorded with 64-channel Quikcap while the Reading the Mind in the Eyes Test (RMET) and the Auditory Oddball Task were introduced to measure participants' theory of mind and attention. Event-related potentials (ERP) of these two tasks were extracted after EEG preprocessing using CURRY 7 and Matlab respectively. For the RMET ones, P300 amplitudes (290ms – 500ms) were extracted. Results showed that the reaction time recorded in the RMET was negatively correlated with a number of EEG components including C5, CP5, TP7, TP8, P1-8, and PO3- 8 ($ps < 0.05$) in the schizotypy group while these correlations were not significant in the healthy controls. For the Auditory Oddball Task, the reaction time in the high pitch condition was positively associated with various EEG components such as FP1, FPZ, and TP7 ($ps < 0.05$) in the schizotypy group. Findings suggested that there are differential brain activities associated with theory of mind and attention in the schizotypal adolescents and young adults from those in healthy controls. Furthermore, theory of mind ability and attention shares the same neural substrate which is the middle temporal gyrus (TP7) (subserving the visual function).

Keywords: Schizotypy, EEG, theory of mind, attention, middle temporal gyrus

A46 Effect of lofc lesion on social value unblocking of Pavlovian reinforcement learning in male rats

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Reinforcement learning theory states that when a stimulus is added to a stimulus that fully predicts reward, learning about the additional stimulus will be blocked (Kamin, 1969). Learning about added stimuli can become unblocked by increasing reward value (Holland, 1984). Here, we hypothesised that unblocking of learning about an added stimulus would occur when additional rewards are delivered to a social partner and that learning about an added stimulus is blocked when a social partner is not rewarded. As Lateral Orbitofrontal Cortex (lOFC) neurons have been found to code upshifts during unblocking (Lopatina et al, 2015) we hypothesised that inactivation of the lOFC would impair social unblocking. Actor and partner rats learned to discriminate a CS+ from a CS-. Next, the rats went through compound conditioning, receiving Both Reward (Actor CS+, Partner CS+), Own Reward (Actor CS+, Partner CS-) and No Reward (Actor CS- , Partner CS-) trials. Then, the rats went through probe trials. Here, actor CS+ & CS- and partner CS+ & CS- were presented in extinction. In a control experiment, information exchange between rats during the compound phase was impeded. Finally, we inactivated the lOFC during compound phase. We found that when actor rats fully learned a stimulus producing reward for themselves, delivering an additional reward to a partner rat, in association with an added stimulus delivered

in compound to the learned stimulus unblocked learning about this stimulus in the actor rats. Additional cues that did not predict additional reward remained blocked. In the control experiment the unblocked stimulus remained blocked as expected. Preliminary data shows that inactivating lOFC did not impair social unblocking. These results suggest that social value can drive reinforcement learning in rats, and that the transmission of social cues is necessary for this learning to occur. In addition, these results provide evidence that social unblocking does not require the lOFC.
Keywords: Social value, unblocking, pavlovian conditioning, reinforcement learning, rats

A47 Prefrontal parvalbumin Interneurons require juvenile social experience to establish adult social behavior

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Social isolation (incl. 'loneliness' experience) during the juvenile critical window is detrimental to proper functioning of mature prefrontal cortex (PFC) and establishment of appropriate adult social behaviors. However, the specific circuits that undergo social experience-dependent maturation to regulate social behavior are poorly understood. We identified a specific activation pattern of parvalbumin-positive interneurons (PVIs) in medial PFC (mPFC) only prior to an active bout, but not during a passive bout. Optogenetic and chemogenetic manipulation of mPFC-PVI activity revealed that brief mPFC-PVI activation triggers an active social approach to promote sociability. Juvenile social isolation critically decoupled mPFC-PVI activation with subsequent active social approach by "freezing" the functional maturation process of mPFC-PVIs during the post-pubertal period of juvenile-to-adult transition. Chemogenetic modulation of mPFC-PVI activity in the adult animal mitigated juvenile isolation-induced social deficits. Therefore, social experience-dependent maturation of mPFC-PVI is critically linked to long-term impacts on social behavior.
Keywords: social parvalbumin prefrontal cortex development

A48 Empathy and Psychological pain: an Electroencephalography Study

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The central role of empathy in social functioning has led to longstanding interest in the construct. Previous studies have demonstrated a link between one's prior experience of pain and their empathetic response. However, much less is known about emotional hurt derived from psychologically painful incidents (loss of a loved one through death, divorce/ breakup) situations and the expression of empathy, despite evidence that physical and social pain can be experienced in similar ways. Thus, by using EEG technique the current paper explored the relationship between psychological pain and empathy and the effect of similarity on empathic reactions. Forty-one participants were grouped into two (Loss and No-Loss) based on their prior experience of losing a loved one and observed strangers in painful (physical pain, loss, and divorce/break up) and non-painful conditions. Once all artifacts were removed, the ERP between conditions and groups were compared. The result of condition comparison showed significantly greater late positive components in C3 and Pz, and greater P200 in F7 in the loss condition compared with the divorce condition. Moreover, the result of examining intergroup ERP differences in the loss condition showed significantly greater N170 in T5 in the loss group compared with the no-loss group. Along with Hoffman's (2000) argument, it seems when the empathizer encounters another individual in a negative situation that is similar to their own past experiences, the empathizer's memory will be triggered and comparable emotions will be elicited. The implication for research on empathy for psychological pain and theories of similarity are discussed.
Keywords: Empathy, Prosocial behavior, Physical pain, Psychological pain, Similarity

A49 Embodied Mechanisms Of Emotion Recognition

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Recognising other people's emotions is essential for social interactions. Facial expression are recognised, at least in part, via embodied mechanisms: observers mimic the emotion to be recognised (facial mimicry) and use the sensory feedback to inform them of what the other is feeling. However, previous findings on mimicry are inconsistent (see Wood et al., 2016). Differences in the ability to detect and interpret internal signals (interoception) might be responsible for these inconsistencies, as well as differences in the intensity of the facial expressions used, or the type of task. Here, we used a variety of stimuli and tasks to address some of these inconsistencies, and we measured interoceptive accuracy (IAcc) with a heartbeat-tracking task (Schandry, 1981). 480 facial expressions (anger, happiness; fear and neutral as fillers) were presented at low (25%), medium (50%) or high-intensity (75%). Participants (N = 40) performed a fast valence decision task (VDt), and an explicit 4-choice categorization task (ECt) on the same faces in two separate sessions, a week apart. Performance at both tasks did not correlate with self-reported (MAIA) or objective (IAcc) measures or interoception (all $p > .05$). However, significant differences in mimicry were found between hi- and low-IAcc participants: only hi-IAcc participants showed early (200-500ms) zygomaticus activity for happy vs angry high-intensity expressions, and both early and late (500-800ms) corrugator activity for angry vs happy medium-intensity expressions during ECt. Interestingly, hi-IAcc participants also showed significant early and late zygomaticus activity for low-intensity happy vs angry faces in VDt, despite accuracy at recognising low-intensity expressions was at chance levels. These results indicates interoception should be taken into account when investigating embodied mechanisms of emotion recognition, and could explain discrepancies in previous findings.
Keywords: emotion recognition; mimicry; interoception

A50 Hyperscanning during interactive joint attention reveals co-localization of hemodynamic and EEG theta band activity

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Questions regarding the relationship between hemodynamic and electrocortical responses are long-standing in neuroscience and under-studied in live social interactions such as in joint attention. Joint attention is a form of communication during which one person ("the initiator") directs the attention of another person ("the responder") to an object. Using simultaneous functional near-infrared spectroscopy (fNIRS) and electroencephalography (EEG), we examined the relationship between hemodynamic and electrocortical signals when people engage in live joint attention interactions. We predicted increased hemodynamic responses in brain areas involved in social cognition and communication during interactive compared to non-interactive joint attention. Further, based on recent findings of co-localization of theta band sources with hemodynamic activity during face perception (Dravida et al., Submitted), we hypothesized that the source of theta oscillations would co-localize to areas of increased hemodynamic activity. Twenty pairs of adults participated in the fNIRS experiment and of these nine pairs also underwent simultaneous EEG. Each partner performed three conditions: as initiator, as responder, and with a non-social cue. Lights cued the initiator to direct their attention to one of three targets, and the initiator used eye movements to cue the responder to the target (interactive runs), or a light indicated the correct target to both participants (non-interactive runs). When participants interacted as either the initiator or responder, social cognition (right temporoparietal junction) and language areas (left superior temporal gyrus) were engaged more than during the non-interactive runs. As predicted, the theta band oscillations localized to these areas during interactive runs, while alpha and beta band oscillations did

not. The results suggest a possible role of theta band oscillations in relating electrocortical and hemodynamic signals during dynamic interactions.
Keywords: joint attention, fNIRS, EEG, theta band

A51 Weakened superiority illusion in bipolar depressive disorder: a combined functional and structural magnetic resonance imaging study

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Superiority illusion (SI) is a positive cognitive bias related to self, being universal in healthy human. Negative self-schema has been proven to be the core feature of the cognitive model of depression, including bipolar depressive episode in bipolar disorder (dBD). However, only few research has explored the abnormal self-processing in dBD, the potential defect in SI and its corresponding neural basis is far from clear. This study aimed to investigate the neural mechanism underlying the defect of SI in dBD combining task-related functional magnetic resonance imaging and high-resolution T1 structural imaging. 40 dBD and 41 healthy controls underwent a SI task where they evaluated how they compared with their average peers on a serial of positive and negative traits. The altered gray matter volume (GMV), abnormal brain activation during SI task, as well as the function-structure coupling of these abnormal regions were detected in dBD. And a moderation analysis was adopted to test the relationship among SI score, brain function-structure coupling and clinical symptom. The results revealed a significantly decreased SI in dBD, especially for negative traits (SI for negative traits, NSI). dBD showed both reduced task-activation and GMV in the bilateral insula and inferior parietal lobule (IPL), as well as decreased function-structure couplings in these regions. The associations between the function-structure couplings in the right insula and IPL and NSI were moderated by depression symptom. Further simple effect showed that significant correlation between function-structure coupling and NSI was only found in participants who had low symptom. Our findings proved a weakened superiority illusion in dBD, which may be resulted from lose of function-structure couplings in multiple regions as the aggravation of depression symptoms.
Keywords: superiority illusion, bipolar depressive disorder, the function-structure coupling, moderation effect

A52 Mice prefer oxytocin-containing social stimuli.

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Oxytocin (OXT) interacts with early life experience to regulate species typical social behaviors. Recent data from our lab characterizing oxytocin receptor (OXTR) ligand binding in the mouth and nasal cavity as well as the brain and behavioral response of orally-applied OXT in developing mice suggest that socially-acquired OXT may affect sensory processing and subsequent brain development through peripheral OXTR. If OXT is exchanged between individuals and this influences social behavior, then mice should be able to distinguish between a conspecific with and without OXT as indicated by behavioral preference in a two-choice assay. To begin to address this, we tested social preference of adult C57 male (N=13) and female (N=12) mice for OXT containing wild-type (WT) versus OXT knock-out (KO) same-sex mice. Next, we tested if mice show a preference for same-sex mouse bedding with and without OXT. Bedding collected from cages containing only OXT KO mice was contaminated with either synthetic OXT or saline. One week later, this test was repeated to evaluate responses to opposite-sex bedding with and without OXT. Behaviors were video recorded and scored by a researcher blind to stimulus mice genotype and bedding condition. During the preference test for OXT WT versus KO same sex stimulus mice, both males and females spent more time sniffing the face of OXT WT mice compared to OXT KO mice. In the soiled bedding test, there were no differences in investigation of same sex OXT KO bedding with OXT compared to saline. However, males spent more time investigating female bedding containing OXT compared to saline. In contrast, females did not show a preference for male OXT KO bedding with OXT over saline. Combined, these data implicate socially-transmitted OXT to modulate species-typical social interactions, with potential for sex-specific effects. Next, we will attempt to replicate and extend these findings using mice with a deletion of Oxtr from peripheral sensory ganglia.
Keywords: Oxytocin, social behavior, preference

A53 Comparison of neural responses during eye contact with a human partner and a humanoid robot partner using functional near-infrared spectroscopy

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Robots have a growing social role in companionship, education, and therapy. (Tapus, et al, IEEE, 2007) It is widely accepted that social connections between individuals affect emotional, mental, and physical health, and robot design to maximize the effects of natural interpersonal interaction is an active area of research. Recent studies of live two-person eye-to-eye contact have provided evidence for a neural system which processes direct eye-contact with a person differently than a picture or video of a face. (Hirsch, et al, Neuroimage, 2017) However, it is not known what human features are associated with this neural effect. Humanoid robots allow for the dissection of the importance of individual features in this processing. Hemodynamic signals were acquired using fNIRS during a task which consisted of alternating blocks of eye-contact with a partner and diverted gaze. Subjects performed the task with a real person and with a robot with eyes that could direct gaze in order to simulate eye-contact, but which otherwise lacked naturalistic movements. Data were analyzed using a general linear model. Previous findings of right temporoparietal junction and Wernicke's area for processing eye-contact with a human partner were replicated with the real human and not the robot. These findings suggest that humans are influenced by more subtle aspects of the task than is represented by simulated robot eyes. This paradigm offers the opportunity to explore ways that elements of humanoid robot design may increase processing conformity to that of humans.
Keywords: fNIRS, robotics, eye contact, TPJ, Wernicke's area

A54 Exploring the role of memory in partner preference formation

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Both social cognition and affiliative behavior rely on complex neural networks which integrate functionally diverse structures – including structures involved in memory formation and recall. In the prairie vole, Microtus ochrogaster, memory aptitude and partner preference are strongly correlated. Spatial memory aptitude predicts partner preference such that animals with more accurate spatial memory spend more time engaging in socially monogamous partner preference behavior. Additionally, animals exhibiting partner preference behavior express higher amounts of the vasopressin receptor (V1AR) in the retrosplenial cortex (RSC); a learning and navigation stucture conserved across mammalian species. This work begins to investigate the neural mechanisms linking partner preference to memory in the prairie vole brain. Excitatory neurons facilitate learning and memory through the process of long term potentiation. We hypothesize a role for glutamatergic neurons as mediators of synaptic plasticity in the mechanistic process of learning a new partner. Using in situ hybridization, we show that avpr1a, the mRNA precursor to V1AR, co-localizes with vglut1, the mRNA precursor to VGLUT1, a glutamate transporter found exclusively in excitatory neurons, in the retrosplenial cortex. Here, we adopt a cellular neurophysiological approach to the behavioral phenomenon of partner preference, aiming to set the stage for investigation of the partner memory engram.
Keywords: partner preference, engram, RNAScope, memory

A55 Neuroanatomical distribution of oxytocin and vasopressin v1a receptors in chimpanzees

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Despite our close genetic relationship with chimpanzees, there are notable differences between chimpanzee and human social behavior. Two neuropeptides known to regulate social behavior across mammalian species are oxytocin and vasopressin. Yet little is known about the neuroanatomy of these systems in primates, and virtually nothing in great apes. Here, we used receptor autoradiography with a competitive binding protocol to localize oxytocin and vasopressin v1a receptors in seven chimpanzee brains. Oxytocin receptors were detected in the lateral septum, hypothalamus, cortical amygdala, nucleus basalis, and substantia nigra. Vasopressin v1a receptors were observed in the cortex, lateral septum, hypothalamus, entire amygdala, dentate gyrus, and substantia nigra. These findings suggest evolutionary conservation in receptor distribution among other primate species in several areas, including those important for social visual attention, as well as in the interaction with other neuromodulatory systems such as dopamine and acetylcholine. They also suggest potential differences between humans and chimpanzees in neuropeptide receptor expression in the reward system as well as areas important for threat.

Keywords: oxytocin, vasopressin, primate, chimpanzee, evolution

A56 The coordination of song: Characterizing the singing-mouse vocal circuit using dual pseudorabies-virus tract tracing.

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Vocalizations, like many social displays, are often elaborate, rhythmically structured behaviors that are modulated by a complex combination of internal and external cues. Such motor patterns require close coordination of neural circuits governing the muscles of the larynx, jaw, and diaphragm, while contextual cues require modulation by the limbic system and other higher level circuitry. In the elaborate vocalization of Alston's singing mouse (Scotinomys teguina), for example, each note of its rapid, frequency-modulated trill is accompanied by equally rapid modulation of breath and gape. This complex behavior is shaped by gonadal and energetic cues, as well as by changes in social context. To elucidate the neural circuitry underlying this behavior, we introduced the polysynaptic retrograde neuronal tracer pseudorabies virus (PRV) into two relevant vocal muscles: the cricothyroid (which controls frequency modulation) and the digastricus (which directs jaw opening). The two isogenic PRV Bartha strains differed only in their fluorophore reporters, each expressing either GFP or RFP. Because PRV traverses synapses progressively over time, we used 48h, 60h, 72h, 84h and 96h post-infection times to identify the circuits that coordinate vocalization and the approximate order of their projections to one another. We first observed infection in separate motorneuron pools for the muscles. The two strains then co-infected putative pattern generators (reticular formation, parabrachial nucleus), followed by hypothalamic regions (paraventricular nucleus, lateral hypothalamus), and other limbic regions (preoptic area, lateral septum, arcuate nucleus). Surprisingly, neurons within both orofacial motor cortex and laryngeal motor cortex were also co-labeled. Together, our data suggest a hierarchical control of S.teguina song that resembles circuits delineated for both rodent social behavior and primate vocalization.

Keywords: Vocalization, neural circuits, PRV

A57 Oxytocin normalizes altered social circuit connectivity in the Cntnap2 knockout mouse

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Aberrant functional connectivity (FC) is frequently found in autism spectrum disorders (ASD), notably correlating with the degree of social impairment (Supekar et al., 2013). In our previous work, exogenous administration of oxytocin (OXT) or DREADD activation of paraventricular nuclei (PVN) OXT neurons improves social deficits in mice lacking an ASD risk gene, Cntnap2 (Penagarikano et al., 2015). Given the ability of OXT to increase circuit signal-to-noise via modulating interneuron function (Owen et al., 2013), we hypothesized that OXT might exert its prosocial effects via rescuing alterations in FC potentially present in the Cntnap2 KO mouse. To test this, we used high field (7T) fMRI to measure resting-state FC at the baseline and after exogenously administered OXT in dexmedetomedine-sedated wild-type (WT) and Cntnap2 KO mice (n=15/group). In line with observations made in individuals with ASD (Rudie et al., 2013), we observed significantly lowered mean FC between regions with established roles in social behavior in the KO mouse (e.g. PVN, nucleus accumbens (NAcc), medial prefrontal cortex; $p<0.001$ vs WT, Monte Carlo exact permutation test), and higher mean FC between these and other regions not typically involved in social functions (e.g. sensory cortices, thalamus) ($p<0.001$ vs WT). Strikingly, both FC phenotypes were normalized by i.p. administration of OXT, significantly elevating the mean FC between social regions and attenuating that between social and other regions ($p<0.001$). Further analyses using pairwise ROI and independent component analysis revealed that OXT induced a KO-specific modification of functional circuit connectivity involving the NAcc, a result that was confirmed by quantifying neuronal activity using c-Fos immunohistochemistry. These results suggest that the observed social deficits in KO mice are potentially related to lowered FC between social brain regions such as the NAcc, which can be temporarily normalized by OXT administration.

Keywords: oxytocin, autism, cntnap2

A58 Factor Analysis of Complex Decision-Making Tasks

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Decision-making research has largely taken place using individual tasks or comparing performance between two or three tasks, and often with a restricted age demographic. Furthermore, decision-making is a term that is frequently used to in the literature to refer to performance on a variety of tasks as a single variable. In this study we utilized a life-span sample of 349 healthy adults, aged 26-91 years, with choice outcome data for seven laboratory-based decision-making tasks totaling nine measures: 1) Cups Task – gain and loss measures; 2) Columbia Card Task – hot and cold measures; 3) Ellsberg Task; 4) Iowa Gambling Task; 5) Ultimatum Game; 6) Moral Judgment Task; and , 7) Financial Decision-Making Task, to employ an exploratory and confirmatory factor analysis (EFA and CFA respectively) in search of a latent variable structure that might influence choice outcomes across tasks. The EFA fit indices, root mean-square-error of approximation (RMSEA) and standardized root-mean-square (SRMR) of residuals indicated a five factor model as the best fit. Upon appraisal of the factor loadings and uniqueness values in the five factor model, each measure appeared to address distinct aspects of decision-making. The RMSEA and SRMR indices for our CFA corroborated our appraisal indicating a nine factor model as the best fit. These analysis indicate that all nine measures are tapping discrete aspects of decision making with no indication of a latent structure influencing performance. This finding could be utilized to identify individuals with discrete, or combinations of discrete decision-making deficits, resulting from neurological damage or disease, and taken together with individual difference measures (e.g. IQ, neural structural data, personality), we could begin to differentiate phenotypic profiles of individuals who are at greater risk for displaying a decision-making deficit, in order to better tailor interventions.

Keywords: Factor analysis, Iowa Gambling Task, Decision-making

A59 Automated tracking of social interaction as a tool to capture the emergence of prairie vole pair bonds

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Prairie voles are one of the few mammalian species to form stable attachments, or pair bonds, between mating partners. Although prairie voles have become

major models for studying the neurobiology of attachment, most research continues to rely on manual scoring of partner affiliation. Manual scoring can be labor-intensive, limiting the precise characterization of social interaction as it unfolds over the course of bond formation. Here, we describe our use of video-tracking and acoustic recording to quantify and compare time-courses of social interaction in prairie vole pairs. Following 4-5 days of social isolation, subjects were paired with either a familiar same-sex cage mate or a novel opposite-sex mating partner for up to 22h while we continuously tracked their movements and vocalizations. The integration of automated movement variables (e.g., pair distance, velocity) reflected manual classification of behaviors (e.g., investigation, following, mating, huddling). We found that social interaction time courses varied within and across pair types. Reunited same-sex pairs showed a brief period of investigation followed by prolonged periods of huddling. Conversely, mating pairs showed multiple and progressively shorter bouts of investigation and mating, interspersed with increasingly longer periods of huddling. Finally, we found that bouts of ultrasonic vocalizations (USV) mirrored bouts of socio-sexual interaction. USV repertoire and production rates varied based on the type of partner and social interaction. Together, these findings support the use of automated behavioral classification as a reliable tool to quantify pair-bond development in studies of attachment and its neural substrates.
Keywords: social monogamy, socio-sexual behavior, vocal communication, automated methods

A60 Glucocorticoid receptor activity in the prelimbic cortex prevents emotional contagion in mice

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Empirical evidence indicates that rodents are capable of low-level forms of empathic responding, such as emotional contagion. Recent studies have demonstrated that mice have the ability to transmit pain status between paired cagemates resulting in contagious pain hypersensitivity (hyperalgesia). The transmission of pain status only occurs during interactions where both mice of the dyad are in pain and share a social history with each other. We've previously shown that the hypothalamic-pituitary-adrenal (HPA) stress axis is an important modulatory system of pain contagion in mice and people. The objective of the current study was to uncover the stress-related neural circuitry that regulates empathy-like behaviours in mice by mapping activated (phosphorylated) glucocorticoid receptors following an emotional contagion of pain paradigm. Our histochemical analysis revealed increased glucocorticoid receptor phosphorylation in unfamiliar mice compared to isolated and familiar mouse conditions in brain areas known to be important for empathy in humans such as the medial prefrontal cortex (mPFC) anterior cingulate cortex (ACC) and anterior insula. Targeted microinfusions of RU-486, a glucocorticoid receptor blocker into the prelimbic cortex of the mPFC, but not the ACC, was sufficient to increase pain behaviour among unfamiliar mice. Furthermore, microinfusions of corticosterone in the prelimbic cortex blocked pain contagion in familiar dyads. Additionally, unfamiliar mice demonstrated a significant increase in synaptic drive in the prelimbic cortex compared to cagemates and mice tested alone. These experiments suggest a top-down mechanism by which glucocorticoid receptor activity in the prelimbic cortex can suppress pain contagion in mice.
Keywords: Emotional Contagion, Stress, Corticosterone, Social stress

A61 Wireless recording of projection-defined PFC neurons during a novel social dominance task

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Although hierarchies are central to successful group dynamics, the neural basis of dominance behaviors remains poorly understood. Cross-species evidence suggests that the medial prefrontal cortex (mPFC) is crucial for social dominance behaviors. Given the role of the lateral hypothalamus (LH) in homeostatic functions, and its connectivity with the mPFC, it is well-positioned to help modulate social behaviors in a rank-dependent manner. Considering that dominant animals typically exercise priority access to resources, we designed a novel behavioral task, the "reward competition assay". This assay utilizes a trial structure to facilitate statistical comparisons wherein mice compete for a reward that is signaled by a tone. Mice were trained to associate a tone with an Ensure reward and paired with a cage mate to compete for the reward. To validate this task, we ranked mice using the tube test. Across the session, dominant mice (as defined by tube rank) won more rewards than subordinates, as the percent of rewards obtained for the dominant mice was higher. Using this assay, we investigated the role of mPFC->LH projectors in social dominance. Optogenetic stimulation of the mPFC->LH projectors increased winning in subordinate mice ($p=0.0047$; $n=5$). Furthermore, we used wireless electrophysiology to investigate how mPFC activity relates to social dominance during the reward competition assay. We recorded mPFC single units in both dominant and subordinate mice ($n=4$) while they competed for Ensure rewards. Preliminary data suggest that mPFC single units represent competition as they fired differentially in trials when there were high vs low levels of competition for the reward ($n=74$ single units recorded). We hypothesize that these "competition cells" in the mPFC project to the LH in order to inform social homeostatic circuits and integrate these signals with other homeostatic systems such as those regulating energy balance (hunger).
Keywords: optogenetics, social dominance, mice, mPFC

A62 Medial prefrontal cortex activity during pain observation of social familiars in mice

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In order to succeed in a social context, humans and other animals alike perceive cues, such as a species member in pain, and take appropriate actions due to both proximal and ultimate causes. Empathy, which can contain other behaviors- such as emotional contagion, helping behavior, and identification behaviors- is governed by evolutionarily conserved functional neuroanatomy that help humans and other animals perceive social cues and then take action based on the perception. While the anatomical structures involved in empathy for pain have been thoroughly specified including the media prefrontal cortex (mPFC), the mechanisms through which these behaviors occur, or are inhibited, are not yet well understood. Recent studies have implicated the mPFC in the social modulation of pain in rodents including the prelimbic cortex, of which little is known with respect to activity during social interactions and pain perception. We developed an observation pain assay in C57 mice based on a rat model where amount of allogrooming- grooming of the conspecific- and affiliative behavior in the observer animal were measured. We then applied fiber photometry recording to the prelimbic cortex using a genetically encoded calcium indicator to measure neural activity during the observation session. We compared prelimbic cortex activity between animals observing a cagemate in pain, animals experiencing pain in the presence of a cagemate, and baseline activity with a cagemate and alone. Our results show differences in neural activity of the prelimbic region in social and pain experience contexts.
Keywords: empathy, pain, social contexts, mPFC, fiber photometry, mice

A63 Correlated Neural Activity and Encoding of Behavior Across Brains of Socially Interacting Individuals

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Social interactions involve some of the most complex decision-making tasks that animals must navigate to secure their survival and reproductive success. In interacting dyads, individuals thus become entrained as they attend to, predict, and react to each other's decisions. To date, social neuroscience has mostly

focused on behavior in individual animals to interrogate the neural computations underlying social decision-making. An open question is whether and how emergent properties of neural systems may arise across brains of interacting individuals to shape behavior. Here, by simultaneously performing microendoscopic calcium imaging in pairs of socially interacting mice, we find that animals exhibit interbrain correlations of neural activity in the prefrontal cortex that are dependent on ongoing social interaction. Interbrain coupling arises from two neuronal populations that separately encode one's own behaviors and those of the interacting partner. Strikingly, interbrain correlations predict future social interactions as well as dominance relationships between animals in a competitive context, suggesting a functional link between neural activity coupling and the evolution of real-time social engagements. They also reflect an asymmetry in encoding of partner behavior across dominants and subordinates, suggesting that brain coupling depends partially on attention of subordinates directed toward dominants. Together, these results demonstrate that interbrain synchrony exists in rodents, indicating generality and conservation of the phenomenon across diverse species beyond what has previously been observed in humans and non-human primates. By uncovering how interbrain synchronization arises from activity patterns at the single-cell level, this work also sets the groundwork for more incisive, circuit-level investigation into the emergent neural properties of multi-individual systems and their role in coordinating social interactions.
Keywords: social behavior, neural circuit, interbrain synchrony, hyperscanning, social dominance, prefrontal cortex, mPFC, mouse, miniscope, calcium imaging

A64 Exploration of Uncertainty with Trust Decisions in Social Networks

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In our modern society, we live in an increasingly connected environment. We encounter and communicate with people who we previously are not familiar with. Such explorative aspect of social interaction has not attracted much attention in the previous studies. Here, we addressed this issue with the specially designed paradigm to examine the act of trust. Specifically, we developed the variant of the task called network prisoner's dilemma (Network PD) in which subjects decided whether to cooperate or defect with a social partner in each trial.We examined cognitive mechanisms of trust in the behavior of subjects performing the network PD task. We found that an act of trusting the other (cooperation) does not mean simple bias toward trusting decisions. In a sequence of trials involving interactions with a same social partner, initial trusting decision (cooperation) kept the flexibility of behavioral strategy so that the subject can easily adjust their responses to both cooperating and non-cooperating partners. In other words, the trusting decision made the subject's mind open to the different possibilities of the relationship in subsequent interactions. Finally, we investigated the neural mechanisms underlying such trusting decisions. Network-based fMRI experiment was conducted by socially connecting the subject within a scanner with the other subjects outside the scanner. In the brains of scanned subjects performing the network PD task, "reward-related" brain areas were active. Specifically, cooperate/defect decision involved dorsal anterior cingulate cortex, which has been previously associated with uncertainty and long-term prospect of the environment.
Keywords: Trust, Social Network

A65 Biographical context and intensity modulate mimicry of emotional facial expressions

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Observing emotional facial expressions is often associated with a spontaneous and rapid simulation of the emotion on the reader's face. It has been recently proposed that mimicry is not a simple reflex-like response, but rather a context-specific response influenced by contingent factors regarding the observer's knowledge about the expresser (Seibt et al., 2015). According to this hypothesis, facial mimicry is a supplementary aid that might contribute to facial expressions' understanding when it is not straightforward (e.g. with ambiguous expressions, or when the context does not provide enough information; see Wood et al., 2016 for review). We investigated whether the knowledge of recent past's facts about the expresser influences the observer's performance at a valence rating task, and how it modulates mimicry intensity. Low- and high-intensity angry and happy facial expressions were presented after congruent, incongruent or neutral scenarios. Participants rated the faces as happier or angrier after reading emotionally-congruent scenarios. Corrugator activity was higher for angry than happy faces, but only following a neutral or positive scenario; with negative scenarios, activity was higher than baseline for both happy and angry faces. An Expression x Intensity interaction revealed that corrugator activity was higher for angry than happy faces only at high-intensity, and it differentiated as early as 200-400ms post onset, while with low-intensity expressions activity was high for both angry and happy faces with no differentiation during the whole period analysed (1sec). No context- or intensity-dependent modulation of mimicry was found for the zygomaticus. However, looking at participants' ratings, corrugator activity seemed related to the subjective judgement while zygomaticus activity was related to the objective valence of the face. Implications of the results and limitations of the study are discussed.
Keywords: facial mimicry, facial expressions, embodied cognition, EMG

A66 Virtual social-spatial maps: Integrating across levels of analysis

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Researchers in education/psychology/the learning sciences have wrestled for more than a century to develop comprehensive explanatory frameworks sufficiently robust to make sense of learning in meaningful social context across perspectives and levels of analysis, from individual brain to affective social mind. What is it about the structure of human mind/brain that causes integrating across levels of analysis to be such a challenging issue? An earlier version of the current theoretical framework was developed through a systematic case study of discourse interactions among teacher/students in a diverse technology-enriched middle-school inquiry-based science classroom over extended time. The work explored questions central to the learning sciences regarding what learning is occurring within/across levels of analysis and meaningful ways to characterize such learning over extended time. To meaningfully explore such questions, this theoretical elaboration of that earlier work proposes building a coherent theoretical framework integrating across levels of analysis, from the various levels of social structure within the science classroom to the individual level of mind/brain. The work proposes thinking not in terms of developing "building blocks" at the finer grain levels of analysis to incorporate into the coarser grain levels of analysis, nor building a "bridge" from one level of analysis to the next. Instead, the work proposes identifying key patterns—key systems structures/processes—within each level of analysis that have important explanatory power across all levels. Key structures/processes proposed to exist within all levels include: Social-spatial maps, virtual social-spatial maps, and coherence processes. The validity of the work is strengthened by comparing/contrasting key patterns identified in this study with key patterns identified by other researchers at various levels of analysis from social to neuroscience for non-human primates and brain-injured humans.
Keywords: levels of analysis; virtual social-spatial maps

A67 Oxytocin enhances visual attention to others' eyes even in the presence of competing socially salient stimuli (cleavages)

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The neuropeptide oxytocin has been linked to a wide range of affiliative behaviors, including partner selection and sexual motivation. One proposed mechanism that may underlie these effects is an increase in salience of and attention to socially relevant stimuli, such as eyes. However, it is not known if this effect is selective to the eyes, or to informative social features in general. To investigate this, we conducted a double blind, randomized, placebo-controlled, within-subjects oxytocin administration study. Fifty healthy male participants performed an eye-tracking task where they viewed pictures of female celebrities with or without a clearly visible cleavage. Previous work has shown that intranasal oxytocin increased visual attention to female fertility cues in male rhesus macaques. We hypothesized a similar effect of oxytocin in human males, with oxytocin increasing visual attention towards a visible cleavage – either at the expense of attention to the eyes, or by increasing gaze towards both regions. A preliminary GLMM analysis revealed a statistically significant increase in number of gaze fixations towards the eye-region with oxytocin compared to placebo (oxytocin: 4.3±2.9(mean±SD), placebo (4.0±3.1), p<.001). The presence of cleavage biased visual attention away from the eyes (with cleavage: 3.7±2.9; no cleavage: 4.5±3.0, p<.001), but this effect was not significantly moderated by oxytocin. The findings support that oxytocin significantly increases gaze activity towards the eyes, and show that this effect was not weakened by competition from other socially salient stimuli.
Keywords: oxytocin, eye-tracking

A68 Resting-State Functional Coupling of Reward is Linked to Positive Affect in Social Anxiety Disorder

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This study aims to determine whether (1) there are group differences between Social Anxiety Disorder (SAD) and controls on functional coupling in reward areas, and (2) examine the link between functional connectivity of reward and positive affect (PA) in SAD. Data were obtained from a sample of adults with SAD (N=20) and healthy controls (N= 19). All participants filled out the Positive and Negative Affect Schedule (PANAS), and underwent a 6-minute resting-state fMRI scan. Regions of interest (ROI) were selected from Harvard-Oxford Atlases: bilateral ventral striatum (VS), orbitofrontal cortex (OFC), and ventromedial prefrontal cortex (vmPFC). For each participant, time-series were extracted from each ROI using C-PAC (Craddock et al., 2013). ROI-to-ROI coupling was performed at individual and then group levels (Janes et al., 2018). SAD and control groups did not differ on age or sex (p>.600). Groups did not differ in any ROI-to-ROI couplings (p>.562). Consistent with our hypothesis, a significant correlation between left VS-vmPFC coupling and self-reported PA emerged for the SAD group (r =-0.549, p =.012), such that increased coupling of left VS-vmPFC was linked to diminished PA. This correlation was not significant for controls (r= -0.275, p =.254). Interestingly, these findings were specific to PA, and not negative affect (NA) (r = 0.242, p = 0.303) for SAD. Altogether, these results suggest there is a significant relationship between reward connectivity and PA in SAD. Increased left VS-vmPFC coupling may be a biomarker for diminished PA in SAD and demonstrates the potential as a target for psychological interventions (Strege et al., 2018).
Keywords: Reward, Social Anxiety Disorder, fMRI, Affect

A69 Neurophysiological signatures for imitation-induced social emotional regulation

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Imitation is important for the development of social skills and for social bonding. Could imitative interactions induce physiological changes that result in increased social closeness and in decreased stress? Social interactions have been previously linked to oxytocin, a hormone that can decrease anxiety and increase bonding. We hypothesized that following social imitation we would find human neural correlates for social emotional regulation in limbic structures receiving oxytocin neuromodulation. We tested this on a group of volunteers who had a congruent imitative interaction (synchronized movements with an instructor, and positive feedback from instructor) and an incongruent interaction with a different instructor (asynchronous movements with an instructor, or mild negative feedback from instructor). We adapted the behavioral task to be used with stereoelectroencephalography (SEEG) in epileptic patients. We designed a paradigm where the subject visualizes emotionally charged images either alone ('alone') or in the presence of the instructor ('social'). Compared to the pre-interaction condition, a congruent imitative interaction decreases stress and increases closeness to the interaction partner. Incongruent interactions had no significant behavioral effect. Imitative interactions significantly increased salivary oxytocin levels. In SEEG recordings, we detect ERPs in the amygdala, the hippocampus, posterior and anterior insula, visual cortex, frontal and temporal cortical areas. For each brain structure we analyzed the maximum ERP response, and then calculated a modulation index between the 'social' and 'alone' conditions. In the amygdala, the modulation index significantly increased for negative but not neutral IAPS pictures. In the hippocampus, the modulation index for both negative and neutral pictures increased.
Keywords: Oxytocin, imitation, SEEG

A70 Social Curiosity: how subjective uncertainty informs social exploration

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Environments furnish multiple information sources for making predictions about subsequent events. How do we select predictors that are useful? First, we may hold the belief of an option as having high (or low) value and therefore might choose it (i.e. exploitation). Second, we may be more or less certain about the value and based on this decide to explore this option further (i.e. exploration). In social situations, we often consider these two features of an option, for example when seeking out advice from other people – do they give good advice and how certain are we about our estimate of the quality of their advice. In this experiment, we combine computational modelling and neuroimaging to investigate, in a social and non-social context, how humans select useful predictors according to their subjective beliefs in the accuracy and uncertainty of that predictor. First, during early encounters with potential predictors, participants' selections were explorative and directed towards uncertain predictors. This is particularly the case when the time horizon is long and many future opportunities remain to exploit knowledge gained. However, preferences for accurate and certain predictors increased over time. The behavioural transition is accompanied by changes in representations of belief uncertainty in ventromedial prefrontal cortex (vmPFC). The polarity of uncertainty representations (positive or negative encoding of uncertainty) changed with behavioural mode: uncertainty and certainty were signalled during exploration and exploitation respectively. Moreover, the two periods were separated by a third transitional period in which beliefs about predictors' accuracy predominated. We show that vmPFC signals a multiplicity of decision variables, the strength and polarity of which vary with behavioural mode for both social and non-social contexts.
Keywords: social curiosity, uncertainty, vmPFC, Bayesian model

General Information

Abstracts
Poster abstracts can be found on the S4SN website:
https://www.s4sn.org/poster-schedule

ATM
An ATM is located in the Entry Hall by Guest Services.

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

Thursday, October 17, West Pavilion Foyer

Cocktail Reception, 6:45 – 8:30 pm

Friday, October 18, West Pavilion Foyer

Continental Breakfast, 7:30 – 8:00 am
Phoenix Diversity Lunch (Served), 11:00 – 12:15 pm
Coffee Break, 3:15 – 3:30 pm

Certificate of Attendance
To receive a Certificate of Attendance please visit the Registration Counter in the West Pavilion Auditorium Foyer at the end of meeting. If you require any changes, we will be happy to email/mail a copy after the meeting. See also Receipts.

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

Code of Conduct
The Society for Social Neuroscience is committed to providing a safe and professional environment during our annual meeting. All S4SN members are expected to conduct themselves in a business-like and professional manner. It is unlawful to harass a person or employee because of that person's sex or race. Harassment is defined by hostile or offensive behavior towards another.

Contact Us
To contact us onsite, visit the Registration Counter in the West Pavilion Auditorium Foyer or send an email to info@s4sn.org. We will respond to your email at our soonest opportunity.

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

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Find us on Facebook search for "*Society for Social Neuroscience*" and like us!

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Lost and Found is located at the Museum of Science and Industry's Coat Check in the Museums main entrance. To inquire about a lost item, you can contact the Coat Check at (773) 753-6862 or coatcheck@msichicago.org. Museum's business hours are 9:30am – 4:30pm

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

Name Badges
The Museum of Science and Industry is open to public access. For security purposes, attendees, speakers and exhibitors are asked to wear their name badges to all sessions and social functions.

Entrance into sessions is restricted to registered attendees only. Entrance to the West Pavilion will be limited to badge holders only. If you misplace your name badge, please go to the Registration Counter in the West Pavilion Auditorium Foyer for a replacement.

Nursing Room
MSI welcomes nursing mothers, who may nurse their babies in any public space in the Museum. MSI also has a nursing room in the Idea Factory exhibit on Lower Level 1. This room is only available during the Museums business hours- 9:30 am – 4:00 pm.

Parking
Museum of Science and Industry has a convenient, underground garage. The entrance is located at the northwest corner of our building, at E. 57th Street and S. Cornell Ave. Parking Fee for General Public is $22 per vehicle.

Poster Session
Poster session is scheduled on Thursday, October 17, 2019. The presenting author must be present during the session and other authors may be present to answer questions. The poster session is in the West Pavilion. Badges are required at all times. Do not leave personal items in the poster room.

Receipts
Please email the registration desk if you require a copy of your registration receipt. See also Certificate of Attendance.

Reception
The Cocktail Reception will be held in the West Pavilion during the Poster Session from 6:45 – 8:30 pm on Thursday, October 17th.

Registration
The Registration Counter is located in the West Pavilion Auditorium Foyer. The Registration Counter will be open at the following times:

Thursday, October 17	11:00 am – 8:00 pm
Friday, October 18	7:30 am – 5:00 pm

Speakers
All speakers must register and wear name badge to present. Please ensure that you are available in the West Pavilion Auditorium at least thirty minutes before the start of the session. See also Audiovisual equipment for Talks.

Transportation
For Transportation information please visit the "Transportation" page on the S4SN website.
https://www.s4sn.org/directions-to-the-museum-of-science-and-industry

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Statement on Principles of Community and Code of Conduct

An open exchange of ideas, the freedom of thought and expression, and respectful scientific debate are central to the aims and goals of the Society for Social Neuroscience (S4SN). S4SN stands firmly for an environment that recognizes the inherent worth of every person and group, that fosters dignity, understanding, and mutual respect, and that celebrates diversity. The Governing Board and committee members of S4SN endorse a safe, respectful and harassment-free experience for members, speakers/presenters and staff of the S4SN.

Harassment and hostile behavior are unwelcome at S4SN before, during and after organized lectures and poster sessions. We stand against harassment based on race, gender, religion, age, appearance, national origin, ancestry, disability, sexual orientation, and gender identity, or any other category. Harassment includes degrading verbal comments, deliberate intimidation, stalking, harassing photography or recording, inappropriate physical contact, and unwelcome sexual attention. The policy is not intended to inhibit challenging scientific debate, but rather to promote it by ensuring that all are welcome to participate in a shared spirit of scientific inquiry. These principles apply equally to scientific and social events organized by S4SN.

Any concerns should be conveyed to James Curley at curley@utexas.edu.

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