S4SN 2022 PROGRAM

November 11-12, 2022

Marriott Marquis Marina Ballroom E, San Diego, California

7:00am-7:00pm PST, streaming 3:45pm-1:00am GMT

Contents

MEETING AT A GLANCE

FRIDAY, NOVEMBER 11

Marriott Marquis Marina Ballroom E, San Diego, California

7:00am-7:00pm PST, streaming 3:45pm-1:00am GMT

7:00-7:45am	*Coffee, bagels, pastries, on-site registration*
7:45-8:00am	*Welcome*
	Symposium: Parental care in humans and animals
8:00-9:00am	***Keynote address:*** **Ruth Feldman**, "The parental brain and the emergence of human sociality," Reichman University, Israel
9:00-9:30am	**Kumi Kuroda**, "Parental care circuits in laboratory mice and their implication for social affiliation," RIKEN, Japan *(remote)*
9:30-10:00am	**Andres Bendesky**, "Evolutionary neuroendocrinology of monogamous behaviors in deer mice," Columbia University, USA
10:00-10:30am	*Coffee break*
10:30-11:00am	*Poster blitz preview*
11:00-12:00pm	*Poster session A*
12:00-1:00pm	*Lunch (included)*
	Symposium: Language and vocalization in social communication
1:00-1:30pm	**Sophie Scott**, "The neuroscience of laughter and affective speech," University College London, UK. *(remote)*
1:30-2:00pm	**Michael Goldstein**, "How parents scaffold early language: Perceptual and neural mechanisms connecting social to vocal development," Cornell University, USA
2:00-2:30pm	**Cory Miller**, "Social communication and the marmoset brain," University of California at San Diego, USA
2:30-3:00pm	**Arkarup Bannerjee**, "Neural circuits of vocal communication in the singing mice," Cold Spring Harbor Laboratory, USA
3:00-3:30pm	*Afternoon break*

Open science and early career awards

3:30-4:00pm *Open and reproducible science awards*

Talmo Pereira, "Quantifying social behavior using deep learning," Salk Institute for Biological Studies, USA

David Smith, "Age-related differences in neural responses to social reward," Temple University, USA

4:00-4:30pm *Early career award in animal research*

Monique Smith, "Anterior cingulate inputs to nucleus accumbens control the social transfer of pain and analgesia," University of California San Diego, USA

4:30-5:00pm *Early career award in human research*

Irene Perini, "Probing social acts in experimental settings," Linköping University, Sweden

5:00-6:00pm *Poster session B*

6:00-7:00pm *Reception, cash bar*

SATURDAY, NOVEMBER 12

Online only, 9:00-11:30am PST, 6:00-8:30pm GMT

9:00-9:30am *Virtual coffee & social time*

Featured speakers:

9:30-10:00am **Evelina Federenko**, "A universal language network in the human brain," Massachusetts Institute of Technology, USA

10:00-10:30am **Elseline Hoekzema**, "Pregnancy changes a woman's brain structure and neural network organization," Amsterdam University Medical Center, Netherlands

10:30-11:30am *Virtual poster session*

POSTERS

POSTER SESSION A: Fri., Nov. 11, 11:00am-12:00pm, **posters A1-A18**
POSTER SESSION B: Fri., Nov. 11, 5:00Pm-6:00pm, **posters B1-B16**
POSTER SESSION C: Sat., Nov. 12, 11:00am-12:00pm, **posters B5-B16 & C1-C8 (virtual)**

A1. S. Ray, I. Yona, L. Las and N. Ulanovsky, "Hippocampal representations during natural social behaviours in a bat colony," Department of Brain Sciences, Weizmann Institute of Science.

A2. Q. Fu, J. Harper, J. Palka, C. McAdams, X. Gu, "Altered sense of social control in adolescents with eating disorder," Icahn School of Medicine at Mount Sinai, UT Southwestern Medical Center.

A3. O. C. Meisner, O. Dal Monte, N. Fagan, P. Putnam, S. W. Chang, "Oxytocin promotes prosocial behavior via amygdala-mediated alterations in ACC neural activity," Yale University, University of Turin, Kavli Institute for Neuroscience, Wu Tsai Institute.

A4. M. Barbier, K. Thirtamara Rajamani, S. Netser, S. Wagner, H. Harony-Nicolas, "Studying the impact of Shank3-deficiency on the mesoaccumbens pathway of reward," Icahn School of Medicine at Mount Sinai, University of Haifa.

A5. W. Zajkowski, Ryan Badman, Masahiko Haruno and Rei Akaishi, "Neural correlates of emergent prosocial behavior during dynamic human group formation," RIKEN Institute.

A6. J. Kim, S-W. Kim, MS. Kim, JH. Baek, C. Latchoumane, G. Gangadharan, YW. Yoon, D-S. Kim, and H-S. Shin**, "**Hemispherically lateralized rhythmic oscillations in the cingulate-amygdala circuit drive affective empathy in the mouse," Institute for Basic Science (IBS), Manipal Academy of Higher Education, Soonchunhyang University, SL Bigen.

A7. N. Rigney, S. Belkasim, S. Singh, R. Beaumont, G.J. de Vries, A. Petrulis, "Optogenetic activation and inhibition of extended amygdala vasopressin neurons modulates sex-specific social approach and communication in mice," Georgia State University.

A8. M.R. Jones, H. Engelbrektsson, C. Haggarty, I. Morrison, M. Heilig and L.M. Mayo, "Exploring the relationship between the perception of affective touch and endocannabinoid function in trauma and non-trauma-exposed humans," Linköping University.

A9. J. Santiago Perez, M. Cum, N. Lopez, R. Iwata, E. Wangia, E. Wright, A. Li, C. Garcia Restrepo, N. Padilla-Coreano, "Dominance behaviors differ across strains of mice," University of Florida.

A10. P. Gangopadhyay, S. Fan, O. Dal Monte*, N. A. Fagan, and S. W. Chang**, "**Subtle differences in social gaze target discriminability by broad-spiking and narrow-spiking neurons in the primate prefrontal-amygdala circuits," Yale University, University of Turin.

A11. N. DiCola, "Code breaking cognition: The history and philosophy of information theory's use in neuroscience," University of Florida.

A12. N. Bass, M. Leclair, E. Choleris, "The role of dihydrotestosterone in dorsal hippocampal D2-type dopamine receptor regulated social learning in male mice," University of Guelph.

A13. H. Engelbrektsson, M.R. Jones, M. Heilig, & L.M. Mayo, "Endocannabinoid and neuroendocrine contributions to fear learning in humans with or without chronic stress exposure histories," Linköping University, University of Calgary.

A14. E. Rodriguez, C. Adeyemi, D. Salzman, "Dissecting the circuit mechanisms underlying olfactory-driven social behavior," Columbia University.

A15. K. Thirtamara Rajamani, M. Barbier, A. Lefevre, K. Niblo, N. Cordero, S.Netser, V. Grinevich, S Wagner, H. Harony-Nicolas, "Oxytocin activity in the paraventricular and supramammillary nuclei of the hypothalamus is essential for social recognition memory in rats," Icahn School of Medicine at Mount Sinai, University of Heidelberg, University of Haifa.

A16. S. Peng, O. Kachmarchuk, M. Wilson and E. Choleris, "Estrogens in the medial Prefrontal Cortex of ovariectomized female mice rapidly facilitate social recognition but not object recognition or object placement," University of Guelph.

A17. S. Omyan, I. Nolan, J.K. Leong, "Pupil dilation can bias observers' pain perception intensity while empathizing with painful facial expressions," University of Arkansas.

A18. D. Aspesi, S. Matta, S. Sethuraman, T. Manning, E. Choleris, "The role of estrogen receptor alpha and beta in the BNST in social recognition and aggression in male mice," University of Guelph.

B1. J. Tripp, D. Zheng and S.M. Phelps, "Song production is sexually dimorphic and song circuit neurons are androgen-sensitive in Alston's singing mouse," University of Texas at Austin, Cornell University.

B2. I. Ahmed, J Liu, K. Gieniec, C. Bair-Marshall, A. Adewakun, B. Hetzler, C. Arp, L. Khatri, G. Vanwalleghem, A. Seidenberg, P. Cowin, D. Trauner, M. Chao, F. Davis, R. Tsien, R. Froemke, "Optopharmacological tools for precise spatiotemporal control of oxytocin signaling in the central nervous system and periphery," New York University, University of New South Wales, Aarhus University, University of Pennsylvania.

B3. R. Báez-Mendoza, E. P. Mastrobattista, A. J. Wang, Z. M. Williams, "Frontopolar mechanisms for driving social and economic decisions in primate groups," German Primate Center, Harvard Medical School, Massachusetts General Hospital.

B4. E. Caldbick, N. Watson, "Distinct sex steroid responses to social and nonsocial decisions under risk," Simon Fraser University.

B5. M. Kim, M. Barbier, K. Thirtamara Rajamani, H. Harony-Nicolas, "The impact of social isolation on social reward behavior and mesoaccumbens circuitry," Icahn School of Medicine at Mount Sinai.

B6. A. Leithead, A. Godino, H. Harony-Nicolas, "Social stimuli elicit glutamatergic neuronal activity in the posterior intralaminar complex of the thalamus in male and female mice," Icahn School of Medicine Mt Sinai.

B7. M. Eikemo, GE Løseth, G Ernst, M Carlyle, C Pazmandi, M Thompson, C Vezzani, IM Meier, M Trøstheim, T Johnstone, M Heilig, G Biele, S Leknes, "Social stress enhanced opioid self-administration in healthy men," Univ. of Oslo, Norway, Kongsberg Hosp., Oslo Univ. Hosp., Swinburne Univ. of Technol., Linköping Univ., Norwegian Inst. of Publ. Hlth.

B8. S. W. Li, P. Gabrieli, M. Suzuki, O. Zeliger, J. Demaree, R. Cauchon, N. Occidental, and Z. Williams, "Insular-prefrontal circuit driving compassionate social behavior," Massachusetts General Hospital.

B9. M. L. Gustison, R. Muñoz-Castañeda, P. Osten, S. M. Phelps, "Sexual coordination in a whole-brain map of pair-bonding," University of Texas at Austin, Cold Spring Harbor Laboratory, Certego Therapeutics.

B10. M. Cum, J. Santiago-Perez, R. Iwata, E. Wright, E. Wangia, N. Lopez, A. Li, A. Chambers, N. Padilla-Coreano, "Mind the social history gap: A Systematic review of social memory neuroscience studies," University of Florida.

B11. G. Løseth, M. Trøstheim, M. Eikemo, & S. Leknes, "Opioid modulation of social bonds in humans – a meta-analysis," University of Oslo.

B12. R. Kee, K. Jantzen, J. Frederick, Z. Royer and A. Hahn, "Does cleft palate repair restore normal visual scanning and neural processing for infant faces?" California Polytechnic Institute Humboldt, Western Washington University.

B13. K. Duskin and A. Hahn, "Does having siblings affect the reward value of infant faces?" California Polytechnic Institute Humboldt.

B14. B. Lau, M. Mykins, B. Kartal, B. Bridges, J. Elrod and K. Krishnan, "Role of perineuronal nets in the primary somatosensory cortex of adult female mouse model for Rett syndrome," University of Tennessee at Knoxville.

B15. L. Schuster, R. Henderson, D. Ananth, A. Mar and R. Froemke, "A novel, open-source, high-throughput monitoring system for maternal behavior in mice," New York University, North East Ohio Medical University, NYU Langone.

B16. P. Paletta, A. Palmateer and E. Choleris, "Interplay between estrogens in the supraoptic nucleus and the oxytocin receptor in the medial amygdala on the rapid mediation of social recognition," University of Guelph.

C1. C.J. Haggarty, C. Murray, I. Tare, R. Lee and H. de Wit, "Dose-dependent effects of acute methamphetamine on EEG alpha power, self-reported stimulation and blood pressure in healthy adults," University of Chicago.

C2. M. Jin Yee Neoh, A. Bizzego, J. Hui Teng, G. Gabrieli, and G. Esposito, "Neural correlates of sexist criticism: Associations between perceptions of sexism and prefrontal activity," Nanyang Technological University, University of Trento, Italian Institute of Technology.

C3. B. de Souza, R. Lyra Romero, A. Alves and P. Boggio, "Modulation of perceived gratitude using transcranial direct current stimulation on medial prefrontal cortex," Mackenzie Presbyterian University.

C4. C. Harp and A.Hahn, "Does postpartum depression reduce the reward value of infant stimuli?" California Polytechnic Institute Humboldt.

C5. A. Hahn, Z. Royer, J. Frederick, R. Kee, R. Crimmins, B. Huber, D. Harris and K. Jantzen, "Effects of cleft lip on visual scanning and neural processing of infant faces," California Polytechnic Institute Humboldt, Western Washington University.

C6. Z. Royer, A. Hahn, K. Jantzen, J. McCabe and A. Gaffney, "Does threat to maternal identity impact neural responses to emotional faces?" California Polytechnic Institute Humboldt, Western Washington University.

C7. T.C. Marcal, **E.F. Albregard**, I. Rezende, M.B. de Almeida, P.S. Boggio, "Racially biased decisions in facing injustice modulated by transcranial magnetic stimulation in Ultimatum Game," University of São Paulo.

C8. H. Kim, J. Jang and **H.-Y. Koh**, "Abnormal maternal behavior in mice lacking phospholipase Cβ1," Korea Institute of Science & Technology (KIST) Brain Science Institute (BSI).

SPEAKER ABSTRACTS

FRIDAY, NOVEMBER 11

Marriott Marquis Marina Ballroom E, San Diego, California, and online

7:00am-7:00pm PST, streaming 3:45pm-1:00am GMT

7:00-7:45am *Coffee, bagels, pastries, on-site registration*

7:45-8:00am *Welcome (live stream begins)*

Symposium: Parental care in humans and animals

8:00-9:00am Keynote address: Ruth Feldman, "The parental brain and the emergence of human sociality," Reichman University, Israel

Abstract: For mammalian young, who are born with immature brain and require maternal caregiving to develop life-sustaining systems, reorganization of the maternal brain upon childbirth is critical. The talk begins by describing the mammalian caregiving network and how the subcortical structures that enable mammalian mothers to recognize, invest, and care for their offspring extended into the global "human attachment network" that sustains human affiliative bonds; parental, pair, and filial. Our conceptual model on the "neurobiology of human attachment" is presented and its dependence on biobehavioral synchrony highlighted. Several studies on the maternal brain demonstrate its links to social synchrony and describe specific disruptions in cases of maternal anxiety (hyper social behavior) and depression (minimal social synchrony). Studies on the paternal brain address its expression in primary- and secondary-caregiving fathers and impact on children's development and resilience. The long-term effect of the mother-child relationship on consolidation of the child attachment network is indicated by research spanning infancy to adulthood. Finally, I present studies on mother-infant brain-to-brain synchrony and its associations with social behavior and sensory stimuli (chemosignals). We end by contemplating the social implications of research on the parental brain and how the human attachment network sustains the transfer from the parent-infant bond to life within social groups.

Keywords: Parental brain, biobehavioral synchrony, oxytocin, mothering, fathering, longitudinal studies

9:00-9:30am **Kumi Kuroda**, "Parental care circuits in laboratory mice and their implication for social affiliation," RIKEN, Japan *(remote)*

Abstract: Accumulating evidence indicates that the medial preoptic area (MPOA) is the hub for maternal, paternal and alloparental care in mammals.

MPOA neurons expressing estrogen receptor alpha or galanin mediate mainly pup retrieval and pup grooming, respectively. To further specify the essential neurons for pup retrieval anatomically and molecularly, we have screened the candidate molecular markers and identified the calcitonin receptor (Calcr) in the central part of the MPOA (cMPOA) (Yoshihara, 2021). Specific deactivation of Calcr+ MPOA neurons inhibits both maternal and allomaternal behaviors, without affecting mating and parturition in female mice. Pharmacogenetic activation prevents infanticide in virgin males. Suppression of peripartum Calcr increase in the cMPOA hampers pup rescue from the elevated open platform, the behavior performed only by peripartum mothers. These data indicate that Calcr+ MPOA neurons are indispensable for parental nurturing behaviors, and that Calcr molecules in the MPOA facilitate risk-taking maternal care. Recently it turned out that Calcr and its brain ligand amylin also induce contact-seeking behaviors among adult females (Fukumitsu, 2022). Isolation of females from free social interactions first induces active contact-seeking, then depressive-like behavior, concurrent with a loss of Amylin expression in the MPOA. Reunion with peers induces physical contact, activates both amylin+ and Calcr+ neurons, and leads to a recovery of Amylin expression. Chemogenetic activation of amylin neurons increases, and knockdown of amylin or Calcr attenuates contact-seeking behavior, respectively. These data are in line with the notion that female mammals tend to group-house more than males for the benefit of maternal care, and also support the hypothesis that parental care is one of the evolutionary origins of social affiliation in mammals.

Keywords: Maternal care, parental behavior, sociality, Mus musculus

9:30-10:00am **Andres Bendesky**, “Evolutionary neuroendocrinology of monogamous behaviors in deer mice,” Columbia University, USA

Abstract: Monogamous animals are fascinating because they display some of the strongest affiliative behaviors known in nature. They establish pair bonds, which are typically formed between a pair of reproducing individuals, and then the pair jointly takes care of their offspring. The mechanisms underlying the evolution of these social behaviors are still largely unknown. We discovered that a monogamous species of deer mice has evolved a novel cell type in the adrenal cortex and that this cell type is characterized by the expression of a sex-hormone modifying enzyme. We found that the product of the reaction catalyzed by this enzyme is more abundant in monogamous mice than in a closely-related promiscuous species and that this product induces monogamous-typical parental behaviors when administered to promiscuous mice. We then discovered that genetic variation between monogamous and promiscuous species in two genes is at the root of the existence of this cell type. Our work provides an example by which the evolution of a new cell type in a gland outside the brain contributes to the evolution of complex social behaviors.

Keywords: Parental behavior, monogamy, evolution

10:00-10:30am *Coffee break*

10:30-11:00am *Poster blitz preview*

11:00-12:00pm *Poster session A*

12:00-1:00pm *Lunch (included)*

Symposium: Language and vocalization in social communication

1:00-1:30pm **Sophie Scott**, "The neuroscience of laughter and affective speech," University College London, UK. *(remote)*

Abstract: In this talk, I will explore the different kinds of information that humans produce when they vocalize, with an emphasis on emotional expression. I will explore some different perspectives on how these sounds are produced, and how they are processed in the human brain. I will conclude with some potential distinctions between the neural processing of different kinds of emotions.

Keywords: Laughter, emotion, affective speech

1:30-2:00pm **Michael Goldstein**, "How parents scaffold early language: Perceptual and neural mechanisms connecting social to vocal development," Cornell University, USA

Abstract: The ability to learn a vocal repertoire is a rare phenomenon, emerging in only a handful of groups, including humans and songbirds. A key parallel in the vocal development of birds and babies is the social function of immature vocalizations. The contingent responses of adults to the plastic song of birds and the babbling of babies create social feedback that guides the young towards mature vocalizations. My studies show how the immature sounds of young birds and babies regulate and are regulated by social interactions. The form and timing of these interactions facilitate real-time vocal learning and have strong influences on the development of mature birdsong and language. What makes contingency effective? We hypothesized that social feedback is rewarding to young learners. Circuitry linking basal ganglia with cortical areas may integrate social reward with vocal control and may underlie socially guided vocal learning. We tested this hypothesis with studies in human infants and the zebra finch. We first used interactive video playbacks to assess the role of contingent feedback in song learning. Juveniles in the experimental condition received video playbacks of females exhibiting feather fluff-ups contingent on their own singing. These juveniles developed significantly better song matches to tutor song than did yoked controls. Next, to examine the neuroendocrine mechanisms involved in socially guided song learning, we manipulated the brains of young male zebra finch with argenine vasotocin (AVT) or Manning Compound (MC) so that they found social interaction more rewarding or less rewarding than controls. AVT birds learned song significantly better than MC birds, suggesting that vasotocin helps organize the reward circuitry that influences

socially-guided vocal learning. We also investigated whether social feedback was similarly rewarding for human infants. We used a conditioned place-preference paradigm in which social cues (infant-directed or adult-directed speech) were paired with different contexts. Infants developed a place preference for the infant-directed context. Taken together, these studies indicate that temporal characteristics of social interaction are rewarding to young songbirds and human infants, and reward pathways may drive learning in social contexts.

Keywords: Social learning, vocal learning, language development, songbirds, infants

2:00-2:30pm **Cory Miller**, "Social communication and the marmoset brain," University of California at San Diego, USA

Abstract: Communication is an inherently interactive system involving the exchange of information between conspecifics. While the social signals themselves are critical to this process, the dynamics of the social interactions in which these signals exchanged also convey meaningful information. Here I will present several studies from my lab examining how different areas of the marmoset monkey brain support the different facets of communication. Specifically, I will discuss ongoing experiments that highlight the complementary roles of primate prefrontal cortex and hippocampus for natural social communication.

Keywords: Marmoset, communication, PFC, hippocampus

2:30-3:00pm **Arkarup Bannerjee**, "Neural circuits of vocal communication in the singing mice," Cold Spring Harbor Laboratory, USA

Abstract: The ability to act upon sensory information to generate a desired motor output is a fundamental component of animal behavior. During conversation, for instance, we listen to the words of another person, interpret them and modify our speech appropriately. We know little about the neural mechanisms that underlie vocal communication, especially in mammals. We have recently begun to investigate neural mechanisms of vocal communication in Alston's singing mouse (Scotinomys teguina) – a highly vocal neotropical rodent native to the cloud forests of Central America. S. teguina produce a stereotyped series of vocalizations (in the human audible range) that are often performed in concert with the songs of other individuals of the same species. This vocal coordination has similarities to 'turn taking' in human speech as well as vocal behaviors observed in nonhuman primates. In this talk, I will first describe the vocal behavior of these rodents. We find evidence for rapid and context-dependent switching between two vocal modes – ultrasonic vocalizations (USVs) and human-audible songs. Next, I will discuss a series of experiments that were performed to identify neural

circuits underlying vocal behavior in this species. I will end by discussing our ongoing efforts to identify neural circuit differences between lab mice and singing mice using optogenetic perturbations and high-throughput connectomics.

Keywords: Systems neuroscience, Vocal communication, neural circuits, high-throughput connectomics

3:00-3:30pm *Afternoon break*

Open science and early career awards

3:30-4:00pm *Open and reproducible science awards*

Talmo Pereira, "Quantifying social behavior using deep learning," Salk Institute for Biological Studies, USA

Abstract: A core goal of neuroscience is to understand how the brain adaptively orchestrates movements to execute complex behaviors. Quantifying behavioral dynamics, however, has historically been prohibitively laborious or technically intractable, particularly for unconstrained and naturalistic behaviors which the brain evolved to produce. Driven by advances in computer vision and deep learning, new methods are being developed to overcome these limitations and enable precise and automated quantification of behavior from conventional across species and experimental settings. In this talk we will: introduce the problem of pose tracking for behavioral quantification; show how deep learning can be employed to achieve markerless motion capture; and highlight examples of how our work on making this technology accessible through open-source tools like SLEAP (sleap.ai) is enabling studies across domains and application areas ranging from social and motor neuroscience in flies, rodents, and primates, to ecology, human dance, and even plant biology to tackle climate change.

David Smith, "Age-related differences in neural responses to social reward," Temple University, USA

Abstract: Older adults are at increased risk for financial exploitation and also age-related health problems, including neurodegenerative diseases such as Alzheimer's Disease. Yet, we have little insight into how we can reduce the risk of (or delay) the associated cognitive decline and functional impairments, including those associated with vulnerability to financial exploitation. In this talk, I will present some of the ongoing work from my lab that uses functional magnetic resonance imaging and behavior to explore the underlying neurocognitive mechanisms that shape how older adults make social decisions, particularly those that involve trusting other people. I will also

review how we have pre-registered our initial studies and how we have shared our materials and data.

4:00-4:30pm *Early career award in animal research*

Monique Smith, "Anterior cingulate inputs to nucleus accumbens control the social transfer of pain and analgesia," University of California San Diego, USA

Abstract: Empathy is a core social ability that is critical for social functioning, yet little is known about the neurobiological mechanisms of sensing and responding to the emotions of others. Historically, empathy was considered unique to humans, but many species, including rodents, display empathy-related behaviors. Cross-species evidence indicates that the anterior cingulate cortex (ACC) encodes information about the affective state of others, though relatively few studies have investigated which downstream targets of the ACC contribute to empathy. We recently developed the rapid social transfer of pain as a model of empathy in mice and compared the ACC-dependent neural circuitry responsible for this behavior with the neural circuitry required for the social transfer of two related states: analgesia and fear. Social transfer activates neurons in the ACC and several downstream targets, including the nucleus accumbens (NAc). Bidirectional manipulation of activity in ACC-to-NAc inputs influences the acquisition of socially transferred pain and analgesia. By contrast, the social transfer of fear instead requires activity in ACC projections to the basolateral amygdala. These studies show that mice rapidly adopt the sensory-affective state of a social partner, regardless of the valance of the information (pain, fear, or pain relief). In addition, the ACC generates specific and appropriate empathic behavioral responses through distinct downstream targets. Elucidating circuit-specific mechanisms that mediate various forms of empathy in experimentally accessible animal models is necessary for generating hypotheses that can be evaluated in human subjects using noninvasive assays. Additionally, a more sophisticated understanding of evolutionarily conserved brain mechanisms of empathy will expedite the development of new therapies for the empathy-related deficits associated with a broad range of neuropsychiatric disorders.

4:30-5:00pm *Early career award in human research*

Irene Perini, "Probing social acts in experimental settings," Linköping University, Sweden

Abstract: Social acts are highly integrative and bidirectional processes, where interoceptive information, physiological responses and emotions are weighted in and integrated with current social feedback to generate the upcoming social behavior. The social difficulties often observed in psychiatric patients highlight the link between mental-health and successful socialization,

and the importance of characterizing the behavioral and neural mechanisms of social interaction. Using a simulated social online environment, we showed that rostral portions of the cingulate are activated when anticipating and receiving social feedback. During the talk, I will present human and non-human primate evidence suggesting that activity in this cingulate region during socialization might be related to flexible and integrative high-order behavior, including facial expressions. In addition, I will present the impact of induced or perceived social stress on social processing and behavior.

(end of live stream)

5:00-6:00pm *Poster session B*

6:00-7:00pm *Reception, cash bar*

SATURDAY, NOVEMBER 12

Online only, 9:00-11:30am PST, 6:00-8:30pm GMT

9:00-9:30am *Virtual coffee & social time*

Featured virtual speakers:

9:30-10:00am **Evelina Federenko**, "A universal language network in the human brain," Massachusetts Institute of Technology, USA

Abstract: To understand the architecture of human language, it is critical to examine diverse languages; however, most cognitive neuroscience research has focused on only a handful of primarily Indo-European languages. Here we report an investigation of the fronto-temporo-parietal language network across 45 languages and establish the robustness to cross-linguistic variation of its topography and key functional properties, including left-lateralization, strong functional integration among its brain regions and functional selectivity for language processing.

Keywords: Language universals, fMRI, language localizer

10:00-10:30am **Elseline Hoekzema**, "Pregnancy changes a woman's brain structure and neural network organization," Amsterdam University Medical Center, Netherlands

Abstract: Pregnancy involves radical hormone surges and biological adaptations that facilitate the pending transition. Animal studies have demonstrated reproduction-related neural and behavioral changes that are

evident across the lifespan. However, very little is known on the impact of pregnancy on the human brain. Using prospective neuroimaging studies in which women are followed from pre-conception until the late postpartum period, we have shown that pregnancy renders selective and pronounced changes in grey matter architecture and neural network organization. These neural changes are most pronounced in the default mode network and are related with third-trimester estrogen levels, while no association was observed with other factors such as osmolality, stress or sleep. Interestingly, the observed brain changes related to various aspects of gestational maternal behaviors, such as preparatory nesting behaviors, the physiological responsiveness to infant cues and maternal-fetal bonding. Furthermore, they predicted measures of mother-infant bonding and bonding impairments in the postpartum period. These findings point to selective pregnancy-related modifications in brain structure and function that facilitate peripartum maternal processes of key relevance to the mother-infant dyad.

Keywords: Pregnancy, brain, motherhood, hormones

10:30-11:30am *Virtual poster session*

POSTER ABSTRACTS

POSTER SESSION A, Friday, November 11, 11:00am-12:00pm

A1. S. Ray, I. Yona, L. Las and N. Ulanovsky, "Hippocampal representations during natural social behaviours in a bat colony." Department of Brain Sciences, Weizmann Institute of Science, Rehovot, Israel.

Abstract: Highly-social animals live in complex communities, and interact with each other at times, locations and manner of their choosing. However, neurophysiological investigations of social responses are rarely conducted in rich multi-animal settings that allow such natural behaviours. To understand how the brain represents social information – when the animals' behaviour is not experimentally constrained to a particular task – we established a laboratory-based "bat cave" for a mixed-sex colony of 5–10 Egyptian fruit bats. The bats lived there 24/7 for several months, free to engage in any behaviours. Here, we tracked the identities and social behaviours of all the bats using a set of high-resolution cameras. Simultaneously, we tracked their 3D locations during flights using a radiofrequency-based localization system, while conducting wireless single unit neuronal recordings in 1–2 male and female bats for several hours every day. This allowed us to understand what information is represented by dorsal CA1 neurons during naturalistic, rich and unconstrained behaviours. We found that the bats exhibited three distinct and interleaved behavioural phases: (i) Flight phase – where a large fraction of "classical" place cells exhibited social modulation and identity coding. (ii) Social Interaction phase – where a subset of hippocampal neurons encoded specific social interactions (e.g. allogrooming or aggression). (iii) Sedentary phase – where we utilized generalized additive models (GAM, a nonlinear extension of GLM) and explainable machine learning methodologies (like Shapley values) – and found that hippocampal neurons simultaneously encoded the positions of both self and others. This information was represented either allocentrically or egocentrically. Some of these neurons exhibited

sparse coding, and represented only a few behavioral dimensions, while other neurons encoded many dimensions. Overall, we found that hippocampal dorsal CA1 neurons combine complex social and spatial information to form a multidimensional representation of the natural world.

Keywords: neuroethology, natural behaviours, hippocampus, identity representation

A2. Q. Fu, J. Harper, J. Palka, C. McAdams, X. Gu, "Altered sense of social control in adolescents with eating disorder," Icahn School of Medicine at Mount Sinai, New York, NY, UT Southwestern Medical Center, Dallas, TX.

Abstract: Adolescence is a critical period for learning to navigate the social world and exploit its controllability. As such, a diminished sense of social control is detrimental to mental health, such as observed in eating disorders (ED). Here, we examined social controllability in adolescents with (n = 27; age = 15.10 1.36) and without (n = 28; age = 15.49 1.53) ED as they played an interpersonal exchange paradigm in which they could use their actions to influence the monetary offers from others. We applied computational modeling to estimate two key parameters: estimated control (i.e., how much influence one had on future offers) and initial norm (i.e., offer amount participants expected to receive prior to any interactions); participants also self-reported perceived control after the game. We found no group difference in estimated control (P = .66) or initial norm (P = .60), but a reduced sense of control in ED group (t (53) = - 2.18, p = .03). In healthy adolescents, perceived control was driven by model-estimated control (r = .62, p = .0004), but not initial norm (r = - .04, p = .85). Strikingly, adolescents with ED showed a completely reversed pattern in that their perceived control was primarily correlated with initial norm expectation (r = .47, p = .01) instead of model-estimated control (r = .05, p = .80). These findings suggest that a stable relationship between subjective awareness of controllability and one's actual behavioral influence protects against disordered eating, while altered social norm expectation contributes to a diminished sense of control in adolescents with ED.

Keywords: social control, eating disorder, developmental

A3. O. C. Meisner, O. Dal Monte, N. Fagan, P. Putnam, S. W. Chang, "Oxytocin promotes prosocial behavior via amygdala-mediated alterations in ACC neural activity," Yale University, University of Turin, Kavli Institute for Neuroscience, Wu Tsai Institute.

Abstract: Prosocial decisions are integral to human's social lives, yet the specific neural mechanisms underlying these behaviors remain under-explored. The primate basolateral amygdala (BLA) and anterior cingulate cortex (ACC) are two reciprocally connected brain regions1 implicated in prosocial behaviors. Notably, neurons in the BLA and the ACCg selectively enhance spike-field coherence for expressing prosocial preferences in this social decision-making context2. Recent work in humans has found that oxytocin, a neuropeptide strongly implicated in a wide range of social behaviors across species3, helps sustain prosocial learning over time by increasing fMRI functional connectivity involving the ACC4. Here, we hypothesize that oxytocin helps mediate BLA-ACC communication to help sustain prosocial preference during social decision-making. To test this, we examined if and how oxytocin alters the communication between BLA and ACCg by focally infusing either oxytocin or saline into the BLA

while recording local field potentials (LFP) from the ACC during a social reward allocation task. In this task, actor monkeys made decisions to deliver juice rewards between a conspecific monkey and an empty juice bottle (Other/Bottle context) and between oneself and both monkeys (Self/Both context). Behaviorally, oxytocin infusion in the BLA, compared to saline, resulted in a more sustained preference over time for delivering juice rewards to the conspecific over the bottle in the Other/Bottle context. By contrast, it had no behavioral effect in the Self/Both context, when the monkeys' decisions involved reward delivery to themselves. Neurally, oxytocin infusion in the BLA increased low-frequency (< 30 Hz) LFP power in the ACC associated with the reward outcome for both the actor and conspecific monkeys (Self, Other, Both) but not for the bottle (Bottle). Further, these effects on the ACC LFP signals from infusing oxytocin in the BLA were only present when the monkeys actively made the choices, but not when the same choices were forced on the monkeys. These results support the notion that oxytocin processing in the BLA promotes BLA-ACC communication through low-frequency bands, and that these interregional effects are associated with processing reward outcomes arising from social decisions.

Keywords: prosocial decisions, oxytocin, non-human primates, basolateral amygdala, anterior cingulate cortex, electrophysiology

A4. M. Barbier, K. Thirtamara Rajamani1, S. Netser, S. Wagner, H. Harony-Nicolas, "Studying the impact of Shank3-deficiency on the mesoaccumbens pathway of reward," Seaver Autism Center, Icahn School of Medicine at Mount Sinai, New York, University of Haifa.

Abstract: Social deficits are a core symptom of autism spectrum disorder (ASD). Clinical studies have implicated the mesoaccumbens reward circuit in autism spectrum disorder. However, the causality between alterations in this system and social deficits has not been established. The ventral tegmental area (VTA), a core node of the mesolimbic pathway, is interconnected with the nucleus accumbens (NAc) via the VTA dopaminergic projections. Despite the role of the reward system in social interaction, little is known about the impact of ASD associated mutations on processing social reward and on the functional integrity of this pathway. In this work, we study the effect of a mutation in an ASD high-risk gene, Shank3, on the mesoaccumbens pathway in rats. We hypothesize that Shank3 mutation impacts neural activity in the mesoaccumbens pathway, causing abnormalities in accumbal dopamine transmission and leading to impairments in processing social reward. To identify abnormalities in dopamine transmission in Shank3-deficient rats that correlate with deficits in processing social reward, we used fiber photometry to record in the VTA in combination with a dopamine sensor in the NAc during a social reward paradigm (n = 15 per genotype, WT, HET and Shank3-KO; and for the behavioral experiment, n = 40 per genotype). In this paradigm we introduced two rewarding stimuli, social and food, during satiety and food deprivation and examined investigation time for each reward during the two conditions ($p < 0.001$ between WT and Shank3-KO at food deprivation). To control for attentional deficits, we used the same paradigm, but replaced the social stimuli with a moving toy rat (behavioral experiment, n = 30 per genotype). To rule out reduced motivation to food or impairment in food consumption, we assessed food consumption (n = 20 per genotype). We found that Shank3-deficient rats have deficits in processing reward that are associated with perturbation in VTA neural activity and an intact attention and food consumption. Our study demonstrates that Shank3-deficient rats have deficit in processing reward and provides a first step toward understanding the role of Shank3 in the reward system, and how Shank3-deficiency may lead to social deficits.

Keywords: Reward, Shank3, ventral tegmental area, dopamine

A5. W. Zajkowski, Ryan Badman, Masahiko Haruno and Rei Akaishi, "Neural correlates of emergent prosocial behavior during dynamic human group formation," RIKEN Institute.

Abstract: Probing the emergent changes in cognition as group sizes increase is vital for understanding the evolution of large cooperative societies. Larger group sizes often require complex self-versus-other trade-offs, as well as possibly greater mental capacity to process than smaller groups or dyads—issues which have been rarely studied in social neuroscience. Specifically, to date, there has been few studies exploring how dynamic cognitive changes associated with group size increases and decreases affect cooperation within economic decision making experiments, as group size is typically fixed rather than modulated within-session. We thus deploy a novel, social network-embedded-dyad version of the classic iterative prisoner's dilemma (PD) task to study how preference for cooperation changes, within-subject, as a function of group size (N=87 for behaviour, N=26 for fMRI). Each trial consisted of a two-way PD game with one randomly chosen group member. New group members were added every ~5-10 trials in 180-trial session (up to a group size of 5 partners), but both the subject and current partner could unilaterally break ties on select trials. Being in larger groups is assumed to affect both memory and social behavior, which are examined by behavioral and neural analyses. Subjects consistently followed a well-performing decision policy (tit-for-tat, TFT), in which players imitate the prior choice of the current partner from their previous interaction, suggesting subjects could strategically track and respond to multiple partners even in larger groups and over multi-trial timescales. However, subjects became more forgiving as group size increased. with higher cooperation rates that resulted in larger group sizes being maintained from partners breaking social ties less (despite defection being more optimal for score). Response time (RT) also increased with group size, suggesting larger group sizes required more mental capacity to process, while there was a default preference shift from faster RT for defect in dyads to faster RT for cooperate in larger groups. Larger group size was associated with deactivation in the precuneus, a complex brain region with both social and memory functions, as well as components of the dorsal attention network. Choice (e.g. TFT) and new partners each correlated with changes in possibly memory-related hippocampal activation and functional connectivity within social and salience networks. Overall, humans seem to default to more cooperative strategies partly due to intrinsic preference for larger group sizes, and this prosocial behaviour transition may be governed by the brain's social memory systems

Keywords: cooperation, social dynamics, group formation, fMRI

A6. J. Kim, S-W. Kim, MS. Kim, JH. Baek, C. Latchoumane, G. Gangadharan, YW. Yoon, D-S. Kim, and H-S. Shin**, "**Hemispherically lateralized rhythmic oscillations in the cingulate-amygdala circuit drive affective empathy in the mouse," Institute for Basic Science (IBS), Manipal Academy of Higher Education, Soonchunhyang University, SL Bigen.

Abstract: Observational fear, a form of emotional contagion, is thought to be a basic form of affective empathy. However, the neural process engaged at the specific moment when socially acquired information provokes an emotional response remains elusive. Here, we show that reciprocal projections between the anterior cingulate cortex (ACC) and basolateral amygdala (BLA) in the right hemisphere are essential for observational fear and 5-7 Hz neural oscillations were selectively increased in those areas

at the onset of observational freezing. A closed-loop disruption demonstrated the causal relationship between 5-7 Hz oscillations in the cingulo-amygdala circuit and observational fear responses. The increase/decrease in theta power induced by optogenetic manipulation of the hippocampal theta rhythm bi-directionally modulated observational fear. Together, these results indicate that hippocampus-dependent 5-7 Hz oscillations in the cingulo-amygdala circuit in the right hemisphere are the essential component of the cognitive process that drives empathic fear, but not freezing in general.

Keywords: Observational fear, ACC, BLA, empathy

A7. N. Rigney, S. Belkasim, S. Singh, R. Beaumont, G.J. de Vries, A. Petrulis, "Optogenetic activation and inhibition of extended amygdala vasopressin neurons modulates sex-specific social approach and communication in mice," Georgia State University.

Abstract: The neuropeptide arginine-vasopressin (AVP) has long been implicated in the regulation of social behavior and communication, often sex-specifically, but the source of AVP release relevant for behavior has not been precisely determined. AVP cells in the bed nucleus of the stria terminalis (BNST) are a major source of sex-different AVP expression in brain regions associated with social behavior. Consequently, to define the behavior-relevant sources, we bilaterally injected AAVs that express Cre-dependent channelrhodopsin-2 (EF1a-DIO-hChR2(H134R)-YFP) for cell excitation, Cre-dependent soma-targeted Guillardia theta anion-conducting channelrhodopsin (hSyn1-SIO-stGtACR2-FusionRed) for cell inhibition, or Cre-dependent fluorescent label only (YFP; EF1a-DIO-YFP) as a control, into the BNST of adult AVP-iCre+ male and female mice. We next tested BNST AVP projections to the lateral septum (LS) by targeting BNST-LS AVP terminals. After recovery, subjects underwent a total of four tests for social communication (scent marking, ultrasonic vocalizations) and social investigation in a three-chamber apparatus. Each subject received two test days with light stimulation and two test days without light stimulation with each stimulus type (male and female conspecifics). We also tested whether BNST AVP neurons affect reward or aversion with a real-time place preference (RTPP) assay. Finally, mice were tested on an elevated-zero maze (EZM) for anxiety-like behavior. Preliminary results indicate that, in male mice, stimulation of BNST AVP-expressing neurons increases social investigation of male and female conspecifics, while inhibition of these neurons decreases social investigation to males, specifically. In females, stimulation of BNST AVP-expressing neurons increases social investigation of male conspecifics. When BNST AVP neurons were inhibited, only females displayed significant photostimulation-side preference during the RTPP relative to controls. Lastly, we stimulated the BNST AVP to lateral septum pathway, which caused males to increase their overall social investigation time, along with anxiety-like behavior in the elevated zero maze. Overall, these results point to differential involvement of BNST AVP neurons in social behavior, communication, and anxiety. Similar sex differences in the neurochemical underpinnings of behavior may contribute to sex differences in disorders of social behavior and communication.

Keywords: Social behavior, vasopressin, sex differences, mice

A8. M.R. Jones, H. Engelbrektsson, C. Haggarty, I. Morrison, M. Heilig and L.M. Mayo, "Exploring the relationship between the perception of affective touch and endocannabinoid function in trauma and non-trauma-exposed humans," Linköping University.

Abstract: Touch serves an important role in social interactions, as well as regulating our stress response. In particular, C-tactile CT afferent nerve fibres facilitate the pleasant characteristics of touch and are thus thought to serve an important function as a stress buffer. However, individuals with trauma may respond differently to touch. Emerging evidence suggests that the endocannabinoid (eCB) system is involved in both stress processing and social functioning. Thus, the goal was to evaluate how the eCB system may influence touch processing. In study one, we looked at preferences for affective touch in individuals with documented childhood trauma (N=52) or no trauma history (N=49). We also assessed variations of the endocannabinoid ligand anandamide (AEA). In a separate study with healthy participants (N=46), we examined whether pharmacological enhancement of AEA had an impact on affective touch processing. In study one, trauma exposure was associated with marginally higher AEA levels. However, we found no significant interactions between affective touch preference and the trauma group. We observed an interaction between affective touch and AEA such that decreased preference for CT-touch was associated with higher levels of AEA. In study two, we similarly found an interaction between preference for CT-optimal touch and AEA, where the high AEA group displayed less preference for affective touch. These findings suggest that both AEA and affective touch may play a role in stress buffering. Further studies using clinical populations or conducted during stress could be informative going forward.

Keywords: Affective touch, endocannabinoids, anandamide, trauma, stress

A9. J. Santiago Perez, M. Cum, N. Lopez, R. Iwata, E. Wangia, E. Wright, A. Li, C. Garcia Restrepo, N. Padilla-Coreano, "Dominance behaviors differ across strains of mice," University of Florida.

Abstract: The neural mechanisms for dominance hierarchies remain unknown and an important first step towards understanding them is to reliably measure dominance behavior. Previous research has validated the tube test to determine the social rank of C57Bl/6 (C57) male mice, with the dominant mouse pushing the subordinate out of the tube. However, this correlation has not been shown in other strains of mice, such as outbred CD-1 mice. No study to date has systematically compared dominance behaviors and behavioral assay correlations across strains. We aimed to compare the social dominance behaviors of C57 mice to CD-1 mice through multiple dominance-based behavioral assays. For each strain we studied 32 mice. We performed the following assays: tube tests, urine marking assay, reward competitions and observed homecage agonistic behaviors. We analyzed the pairwise and group relationship of dominance behavior across assays and strains. Behavior in the tube test, urine marking and during agonistic interactions showed significant differences across strains. In C57 mice, as expected from previous literature, we see that dominance outcomes in the tube test, urine marking and agonistic interactions, correlates positively (tube vs urine $r=0.32$, $p<0.01$ tube vs agonistic $r=0.71$, $p<0.05$). However, in CD-1 mice, although urine marking patterns and agonistic interactions correlated positively with each other ($r=0.57$, $p<.01$), the tube test outcome was negatively correlated to the others (tube vs urine $r=-0.48$, $p<0.01$; tube vs agonistic $r=-0.37$, $p<0.05$). Our data suggests that while tube test winning reflects dominance for C57 mice, it may not reflect it for CD-1 mice. Urine marking behavior may provide a common dominance assay that is ethologically relevant across mouse strains.

Keywords: Social dominance

A10. P. Gangopadhyay, S. Fan, O. Dal Monte*, N. A. Fagan, and S. W. Chang**, "**Subtle differences in social gaze target discriminability by broad-spiking and narrow-spiking neurons in the primate prefrontal-amygdala circuits," Yale University, University of Turin.

Abstract: Gaze interactions among conspecifics make up an important part of social communication. Neurons in the primate prefrontal-amygdala circuits have been shown to encode multiple interactive social gaze-related variables (Dal Monte, Fan, et al., 2022, Neuron). However, the specificity of social gaze processing by different cell types remains unexplored. Here we examined if putative excitatory and inhibitory neurons in the primate prefrontal cortex and the amygdala signal social gaze variables differently during real-life social gaze interaction between pairs of macaques. We recorded single-neuron activity from the basolateral amygdala (BLA) and three prefrontal areas - the rostral gyrus of the anterior cingulate cortex (ACCg), orbitofrontal cortex (OFC), and dorsomedial prefrontal cortex (dmPFC). Based on the peak-to-valley distance of mean waveforms, we classified individual neurons into three clusters - broad-spiking (putative excitatory), narrow-spiking (putative inhibitory), and others that did not belong to either distribution. We then contrasted the spiking activity of neurons pertaining to gaze fixations to the face of the partner monkey with gaze fixations to a non-social object. Although the activity from many neurons distinguished social from non-social stimuli in the BLA (n = 201/454), OFC (n = 27/96), ACCg (n = 56/191), and dmPFC (n = 45/151), only the BLA and ACCg showed subtle differences in the proportions of broad-spiking and narrow-spiking neurons for differentiating social from non-social fixations. In the BLA, compared to narrow-spiking neurons, a larger fraction of broad-spiking neurons discriminated social from non-social fixations (140/293 [47.8%] broad-spiking vs. 61/161 [37.9%] narrow spiking, p = 0.042, chi-sq prop. test). Among the significantly discriminating BLA cells, most broad-spiking neurons had higher activity when the monkeys looked at the face compared to the object, but this proportion was equivalent for narrow-spiking neurons. By contrast, a larger fraction of narrow-spiking neurons in the ACCg differentiated social from non-social fixations compared to broad-spiking neurons (13/63 [20.6%] broad-spiking vs. 43/128 [33.6%] narrow-spiking, p = 0.064, chi-sq prop. test). A fraction of narrow-spiking (n = 12/43), but not broad-spiking (n = 0/13), neurons also discriminated looking at the eyes versus the non-eye region of the face. Taken together, these results suggest that there are only subtle differences in social gaze target discriminability between putative excitatory and inhibitory neurons in the investigated regions in the primate brain.

Keywords: Social gaze, Electrophysiology, Monkey

A11. N. DiCola, "Code breaking cognition: The history and philosophy of information theory's use in neuroscience," University of Florida.

Abstract: Information theory is widely used in many disciplines of neuroscience and psychology, particularly in studies of the visual system, hippocampal neurons with spatially selective firing (i.e, "place cells"), and communication. Many of the assumptions necessary for the use of these information theory tools, however, have not been discussed by modern neuroscientists despite their broad implementation, potentially questioning the validity of these tools for understanding brain dynamics. Here we will discuss the history of how information theory made its way from the code breakers of World War II to the theoretical models of the nervous system and artificial intelligence. Furthermore, I

will summarize how these tools influenced our first insights into the visual system as well as its modern usage in hippocampal neurophysiology. Each step of this transition was accompanied by assumptions and simplifications, stated or not, that are still hotly debated today. Particular focus will be placed on the use of firing rates as the syntactical code of the nervous system, and that the same neural syntax is assumed to exist for all brain regions despite vast differences in degrees of recurrent connections, neuronal function, neurotransmitter presence, etc. Such factors, at least those known of at the time, were carefully considered in the first attempts to use an "information theoretic approach", yet this discourse is largely missing from modern publications. It is my hope that by highlighting the history of deep philosophical thought that surrounds information theory we can encourage the neuroscience community to rigorously examine how this tool is used and the conclusions that can be drawn from its implementation.

Keywords: Information Theory, Philosophy, History

A12. N. Bass, M. Leclair, E. Choleris, "The role of dihydrotestosterone in dorsal hippocampal D2-type dopamine receptor regulated social learning in male mice," University of Guelph.

Abstract: Social learning is a critical form of learning and may be defined as "learning that occurs via the observation of, or interaction with, a conspecific or it's products" (Heyes, 1994; Galef, 1998). The neurobiological mechanisms underlying social learning are poorly understood, but in animals may be studied using the social transmission of food preference (STFP) paradigm. By utilizing the STFP, the dopaminergic system, the dorsal hippocampus (DH), estrogens, progesterone and androgens have been implicated in social learning. Our previous work revealed that DH D2-type dopamine (DA) receptor antagonism blocked social learning in castrated male mice, but not gonadally intact males. In the male brain, gonadal hormones may act either directly at androgen receptors, or indirectly at estrogen receptors following aromatization. Our recent findings revealed that long-term estradiol and progesterone treatment protected against the impairing effects of DH D2-type DA receptor antagonism on social learning in castrated male mice. The purpose of this study was to elucidate whether DH D2-type DA receptors interplay with androgens to regulate social learning in castrated male mice. To test this, adult castrated male "observers" (OBS) are implanted with long-term subcutaneous slow releasing dihydrotestosterone (DHT), a potent androgen, or vehicle silastic capsules. OBS then received acute bilateral infusions of the D2-type DA receptor antagonist raclopride (20 μg/μL) into the DH 10-minutes before a 30-minute social interaction with a recently fed, same-sex, familiar "demonstrator" (DEM). Immediately following the social interaction, OBSs undergo an 8-hour choice test where they have free access to two novel flavored food diets. If social learning occurs, the OBS prefers the DEM diet. Because our preliminary findings showed that estrogens and progesterone protected against the impairing effects of intra-DH D2-type DA receptor antagonism on social learning in castrated males, perhaps all hormones can influence the effects of DH D2-type DA receptor antagonism on social learning. Thus, it is predicted that we will see similar results in the present study. Funded by NSERC.

Keywords: Social learning, dihydrotestosterone, dorsal hippocampus, dopamine

A13. H. Engelbrektsson, M.R. Jones, M. Heilig, & L.M. Mayo, "Endocannabinoid and neuroendocrine contributions to fear learning in humans with or without chronic stress exposure histories," Linköping University, University of Calgary.

Abstract: Traumatic childhood experiences can lead to dysregulation of social and emotional processing, which can subsequently contribute to the development of stress-related psychiatric disorders, such as substance use disorders (SUDs). Repeated stress exposure can in turn lead to impairments in fear learning, an implicit form of emotion regulation essential for survival. Here, our goal was to determine how chronic stress exposure, in the form of childhood trauma exposure and/or development of an SUD, impacts the function of critical stress systems (the neuroendocrine and endocannabinoid systems) and in turn fear learning. In a 2x2 factorial design, adult participants (total n=100) with or without histories of childhood trauma and/or SUD completed a laboratory session to assess fear conditioning and extinction. Blood samples were collected to quantify peripheral levels of endocannabinoids and cortisol. Overall, individuals with lower levels of 2-arachidonoyl glycerol (2AG), an endocannabinoid important for the termination of the stress response, self-reported more anxiety and greater impairments in emotion regulation. Although there were no main effects of group on different aspects of fear learning, baseline levels of cortisol and endocannabinoids influenced fear learning in the sample overall. Specifically, higher baseline cortisol levels were associated with better acquisition of conditioned fear. Furthermore, baseline 2AG levels were related to the early extinction of conditioned fear such that higher levels of 2AG were coupled with greater distinction between the reinforced conditioned stimulus (CS+) and the non-reinforced conditioned stimulus (CS-). While additional analyses are ongoing, these results provide valuable insight into the neurobiology of fear learning and highlight potential molecular targets that could have therapeutic potential. This therapeutic approach may be particularly advantageous to improve social and emotional functioning following trauma exposure.

Keywords: fear learning, endocannabinoid system, neuroendocrine system, trauma

A14. E. Rodriguez, C. Adeyemi, D. Salzman, "Dissecting the circuit mechanisms underlying olfactory-driven social behavior," Columbia University.

Abstract: Organisms must learn to evaluate and respond to environmental stimuli that indicate appetitive or aversive events. These decisions are influenced by dynamic and complex social interactions. Social interactions rely on a subject's ability to represent sensory information about social agents, to assign social meaning to these neural representations, and to guide emotionally motivated behavioral responses. How social information directs behavior and emotions remains poorly understood, as we lack mechanistic insight into the neural pathways mediating the conversion of sensory representations to socially driven behavior. To approach this issue, we focused on how the hierarchical rank of individuals influences emotional behavior. We first created social groups of male and female mice so that they form stable hierarchies. To obtain experimental control of social stimuli that drive behavior, we assessed how urine sample odors from dominant and submissive mice influenced the behavior of intermediate ranked mice in the groups. We found that male mice investigated dominant urine more than submissive, and the inverse was seen in females implicating that this olfactory-guided emotional behavior is both rank-dependent and sex-specific. These findings provide a springboard for deciphering the role of the anterior cingulate cortex and basolateral amygdala in contributing to sex-dimorphic olfactory-guided emotional/social behaviors.

Keywords: social, emotional, olfactory, mice, sex-dimorphic, hierarchy, amygdala, cingulate cortex

A15. K. Thirtamara Rajamani, M. Barbier, A. Lefevre, K. Niblo, N. Cordero, S.Netser, V. Grinevich, S Wagner, H. Harony-Nicolas, "Oxytocin activity in the paraventricular and supramammillary nuclei of the hypothalamus is essential for social recognition memory in rats," Icahn School of Medicine at Mount Sinai, USA, University of Heidelberg, Germany, University of Haifa, Israel.

Abstract: Social cognition in mammals is fundamental for several conserved behaviors including distinguishing prey from a conspecific, identification of mating partners and for kinship maintenance. Social recognition memory is a form of social cognition that requires the discrimination of a novel from a familiar conspecific. Deficits in social recognition have been reported in several psychiatric disorders including Autism spectrum disorder and Schizophrenia. Thus, identifying the neural and biological correlates of social recognition memory (SRM) can spur a greater underlying of these behaviors in disease. Oxytocin (OXT) is a neuropeptide that is synthesized and released by neurons in the paraventricular (PVH), supraoptic (SON) and accessory nuclei of the hypothalamus. It is implicated in social behaviors including maternal care, social bonding, and SRM. Despite a clear role for OXT in SRM, it is still unclear which of the three nuclei within the hypothalamus is necessary for the formation of this form of memory. Furthermore, little is known about the role of downstream neural substrates, targeted by OXT axonal projections, in SRM. We hypothesized that PVN-OXT neurons are necessary for both short- and long-term SRM. To address this, we used designer receptors activated by design drugs (DREADDs) to specifically silence OXT neurons (OXT-hM4DGi) in the PVH of Sprague Dawley rats (n=14/Males) and assessed their performance on both short and long term SRM. We found that silencing PVH-OXT neurons significantly impaired both long (**P=0.003) and short-term SRM (**P=0.005). In order to determine which of the downstream targets of PVH-OXT axonal projection regions may contribute to SRM, we focused on the supramammillary nucleus (SuM), as it plays an important role in hippocampal-dependent learning and memory. We first demonstrated that the SuM contains OXT fibers using OXT specific antibodies. We then injected an OXT promoter driven specific anterograde (AAV-OXTp-Venus) or OXT promoter driven synaptophysin GFP (OXTp-Synaptophysin-GFP) in the PVH and found that OXT fibers in the SuM originate in the PVH but not SON. Using in situ fluorescent hybridization, we confirmed that OXT receptors are found predominantly on glutamatergic neurons in the SuM. Finally, we found that blocking OXT receptors in the SuM inhibits and long-term SRM (n=12, ***P=0.0008), suggesting that the PVH-SuM may be a novel neural circuit necessary for this form of memory. Taken, together these findings attribute a novel role for PVH-OXT neurons and PVH-SuM neural circuitry in social recognition memory.

Keywords: Social recognition memory, Oxytocin, Paraventricular nucleus, Supramammillary Nucleus

A16. S. Peng, O. Kachmarchuk, M. Wilson and E. Choleris, "Estrogens in the medial Prefrontal Cortex of ovariectomized female mice rapidly facilitate social recognition but not object recognition or object placement," Department of Psychology and Neuroscience, University of Guelph, Guelph, Canada.

Abstract: Estrogen, in the form of 17β-estradiol (E2), rapidly facilitate short-term memories of various social and non-social tasks in mice, when infused into the dorsal hippocampus, a brain region critical for memory formation. Medial Prefrontal Cortex (mPFC) receives extensive dorsal hippocampal projections and has high estrogen receptors expression. However, whether E2 in mPFC rapidly facilitate short-term

memory remains unclear. In this study, adult ovariectomized female mice were infused bilaterally into mPFC with either vehicle or one of the three doses (25, 50, 100μM) of E2, then tested 15-min post-infusion in either of social recognition (SR), object recognition (OR), or object placement (OP) short-term memory tasks, all in 'difficult' version, in which control ovariectomized mice]show no short-term memory. Results show that E2 in mPFC rapidly facilitated SR but not OR or OP short-term memory, suggesting a possible prioritization of E2's rapid action in mPFC, towards social cognition. Therefore, one additional social cognitive task, the social transmission of food preferences (STFP), is currently being tested. Altogether, this study helps elucidate estrogens' role on rapid short-term memory facilitation in mPFC of female mice and determine whether, differently from the dorsal hippocampus, in the mPFC they preferentially facilitate social over non-social cognition.

Keywords: Social cognition, medial Prefrontal Cortex, estrogens

A17. S. Omyan, I. Nolan, J.K. Leong, "Pupil dilation can bias observers' pain perception intensity while empathizing with painful facial expressions," University of Arkansas.

Abstract: Can emotional contagion promote altruism? Previous research suggests that people might mimic other people's changes in pupil size, and further that individual differences in empathy relate to tighter pupil mimicry. However, no research has linked trial-to-trial pupil mimicry to enhanced perception of another's emotional intensity to altruistic giving. In this pre-registered study, we propose to test this mechanistic link within subjects. Subjects will see a target face expressing pain; observe the target's eyes either dilate, constrict, or remain static; rate the amount of pain the target is experiencing; then decide how much money from their $20 endowment to donate to a medical center to help chronic pain patients. To ensure incentive compatibility, one trial will be selected at random to deduct from the subject's endowment and donated to a real medical center. The face stimuli will be 10 photos (5 females), controlled for attractiveness and ethnically representative of the study region's population. Each face will be manipulated for pain intensity in 4 conditions (0%, 33%, 66%, 100%), and fully crossed with 3 pupil change conditions (dilating, static, constricting). An eyetracker will measure the subject's pupil size and ensure center fixation during the task. We predict a main effect of the target's pupil dilating on subjects rating greater pain intensity and larger monetary donation. We further predict that the degree of the subject's pupil mimicry of the target's pupils will statistically mediate the association between the pupil dilation condition and increased pain rating. Together, this evidence would suggest that emotional contagion in the form of pupil mimicry can enhance perception of another's emotions and increase altruism.

Keywords: Pupil dilation, Pain, Altruism

A18. D. Aspesi, S. Matta, S. Sethuraman, T. Manning, E. Choleris, "The role of Estrogen Receptor alpha and beta in the BNST in social recognition and aggression in male mice," University of Guelph.

Abstract: Social recognition (SR) allows to identify previously investigated conspecifics and to emit appropriate pro-social or -aggressive behaviors. Both androgens and estrogens in the bed nucleus of the stria terminalis (BNST) can rapidly facilitate social recognition and enhance dominance in male mice.

Both Testosterone and 17β-estradiol can rapidly facilitate SR and increase dominance, suggesting that the estrogen receptors (ERs) may be the main regulators of SR and dominant behaviours. However, the specific role of the different ERs in SR and aggression is yet to be established. To elucidate the role of ERα and ERß in SR and aggression, adult castrated (CX) male mice were intracerebrally infused with one of four different doses of the specific ERα agonist PPT (50, 100, 150, 200nM of PPT in 0.5µl of aCSF/alcohol) or with one of three different doses of the specific ERß agonist DPN (50, 100, 150nM of DPN in 0.5µl of aCSF/alcohol). Mice were then exposed to a 'difficult' SR paradigm, in which CX mice show an impairment. To assess aggression, mice were tested in a resident-intruder (RI) paradigm. Results revealed that infusing PPT or DPN in the BNST rapidly facilitated SR, with treated CX mice spending more time investigating a novel over a familiar CX mouse. In addition, PPT increased the dominance score at 35-min, but not at 120-min. The expected results on DPN will reveal a similar behavioral outcome to that of PPT with a facilitation of SR and increased dominance. These results will help understanding the regulation of social and aggressive behavior by E2 through interacting with different receptors.

Keywords: Social recognition, aggression, estrogen receptors, testosterone

POSTER SESSION B, Friday, November 11, 5:00pm-6:00pm

B1. J. Tripp, D. Zheng and S.M. Phelps, "Song production is sexually dimorphic and song circuit neurons are androgen-sensitive in Alston's singing mouse," University of Texas at Austin, Cornell University.

Abstract: Vocal displays are among the most conspicuous and diverse animal behaviors. Production of these displays often varies across sex, reproductive state, and social context, all factors tied to the expression of gonadal steroid hormones. To better understand the neurohormonal mechanisms regulating social vocal behavior, we work with Alston's singing mice (Scotinomys teguina), small diurnal rodents named for their distinctive vocalizations. Prior observational studies report that mice of both sexes sing, but males sing more frequently and produce longer songs than females. Additionally, male song production is regulated by androgens and many of the regions involved in regulating S. teguina vocalization have dense expression of androgen receptors. To better understand sex differences in singing mouse vocal behavior, we first recorded male and female mice in silence and in response to playback of conspecific male song. We found that males sang more than females, and that animals of both sexes increased their song rate in response to song playback. Next, to better understand the role of androgen signaling in regulating song production, we used a combination of tract tracing by pseudorabies virus (PRV) and labeling of androgen receptor (AR) to determine whether neurons in the circuit controlling singing mouse vocalization were androgen sensitive. Mice were injected with PRV encoding either green or red fluorescent proteins (GFP, RFP) in two vocally active muscles. We then used immunohistochemistry to triple label brain tissue for GFP, RFP, and AR in six regions previously identified as part of the singing mouse vocal circuit. We found that five of six regions contained neurons triple labeled for AR, GFP, and RFP. Our results show that neurons regulating sexually dimorphic vocal display behavior are directly androgen sensitive and provide a better understanding of how steroid signaling contributes to the regulation of vocalization.

Keywords: Vocal behavior, sex differences, neuroendocrinology

B2. I. Ahmed, J Liu, K. Gieniec, C. Bair-Marshall, A. Adewakun, B. Hetzler, C. Arp, L. Khatri, G. Vanwalleghem, A. Seidenberg, P. Cowin, D. Trauner, M. Chao, F. Davis, R. Tsien, R. Froemke, "Optopharmacological tools for precise spatiotemporal control of oxytocin signaling in the central nervous system and periphery," New York University, University of New South Wales, Aarhus University, University of Pennsylvania.

Abstract: Oxytocin is a neuropeptide critical for maternal physiology and social behavior, and is thought to be dysregulated in several neuropsychiatric disorders. Despite the biological and neurocognitive importance of oxytocin signaling, methods are lacking to activate oxytocin receptors with high spatiotemporal precision in the brain and peripheral mammalian tissues. Here we developed and validated caged analogs of oxytocin which are functionally inert until triggered cage release is triggered by ultraviolet light. We examined how focal versus global oxytocin application affected oxytocin-driven Ca2+ wave propagation in mouse mammary tissue. We also validated the application of caged oxytocin in the hippocampus and auditory cortex with electrophysiological recordings in vitro, and demonstrated that oxytocin uncaging can accelerate the onset of mouse maternal behavior in vivo. Together, these results demonstrate that optopharmacological control of caged peptides is a robust tool for modulating neuropeptide signaling throughout the brain and body.

Keywords: social, behavior, maternal, oxytocin, opto, pharmacology ,optogenetics, nursing

B3. R. Báez-Mendoza, E. P. Mastrobattista, A. J. Wang, Z. M. Williams, "Frontopolar mechanisms for driving social and economic decisions in primate groups," German Primate Center, Harvard Medical School, Massachusetts General Hospital.

Abstract: Primate group behavior allows individuals to build affiliations and benefit from the reciprocation with others but also poses the unique challenge of tracking others' behavior across multiple distinct interactions. These interactions can often also be highly dynamical and change rapidly based on the reputation or wealth distribution of others. The single-cellular mechanisms that precisely underlie these decisions or that drive the social-economic behavior of groups, however, remain poorly understood. Here, we obtained multiple-neuronal recordings from the dorsomedial prefrontal cortex (dmPFC) and frontopolar (FP) cortex of Rhesus macaques as they performed a structured reciprocity-based social task. In this task three individuals interacted with each other over multiple rounds by offering each other reward and which could allow us to dissociate computations associated with interactive behavior, social preference, and group dynamics. Behaviorally, we find that the monkeys demonstrated a strategic preference for other individuals and favored rewarding those who reciprocated. The rate at which individuals reciprocated within and across sessions was reflected in distinct levels of reputation. At the single-cellular level, we have previously shown that different subpopulations of dmPFC neurons tracked the identity of the current actor and reward recipient. Here, we show that the activity of a subpopulation of FP neurons correlated with the current actor's own reputation for reciprocity. These findings reveal neurons in the primate prefrontal cortex that encode information about specific individuals within social groups and which could help optimize economic benefit during interactive group dynamics. Future work in Macaques and Marmosets will expand on how social ties impinge on these economic behaviors and their neuronal mechanisms.

Keywords: social interactions, neurophysiology, non-human primates, prefrontal cortex

B4. E. Caldbick, N. Watson, "Distinct sex steroid responses to social and nonsocial decisions under risk," Simon Fraser University.

Abstract: A substantial amount of research demonstrates the existence of sex differences in economic and social risk-taking. Sex steroids are known to play a role in moderating aspects of social cognition (e.g., trust) in economic games. While research suggests that sex steroids are engaged for decision-making in the social domain, no direct comparison has yet been made of the effects that social and non-social risk-taking have on sex steroid release. In the current experiment we compared economic decisions under risk through a gambling task in which the wins and losses on bets were framed as generated from either another person (social) or a computer algorithm (non-social). Saliva samples were collected for hormone analysis to compare how baseline sex steroids affect risk-taking, and how the social and non-social framing of payoffs for bets might influence the release of sex steroids. Results demonstrated a sex difference in betting behaviour in the social condition in which females made fewer high bets (i.e., lower risk-taking) than males. Baseline sex steroid levels did not predict measures of risk-taking, but there was a significant effect of condition on the percent change in sex steroids. No change in sex steroids was observed for either sex in the social condition, but there was a decrease in both female estradiol and male testosterone in the non-social condition. We speculate that sex steroids levels are sustained to promote aspects of social cognition relevant for decisions under social risk, and are relaxed for decisions under non-social risk

Keywords: sex steroids, estradiol, testosterone, risk-taking

B5. M. Kim, M. Barbier, K. Thirtamara Rajamani, H. Harony-Nicolas, "The impact of social isolation on social reward behavior and mesoaccumbens circuitry," Icahn School of Medicine at Mount Sinai.

Abstract: Social interactions during development are crucial for establishing adult social behavior. An important facet of social behavior is the rewarding properties of social interaction, and in both humans and animals, social reward undergoes a shift in salience during adolescence. However, there is a gap in understanding how juvenile social isolation (jSI) may impact social reward processing in adulthood as well as neural circuitry mediating reward. At weaning age, rats are assigned to either jSI or group-housing for 3 weeks. At P42, rats are re-housed and re-socialized with a novel age and sex-matched rat until adulthood (P60). Once rats reach adulthood, we use a battery of behavioral assays to assess locomotor activity, anxiety-like behavior, social recognition memory, and social reward processing and motivation. We investigate social reward processing and assess the rewarding value of social interaction through a task presenting a rat with both a novel social stimulus along with a competing non-social reward (food). During this task, we also record in vivo neural activity of dopaminergic neurons in the ventral tegmental area (VTA), one of the core nodes of the mesoaccumbens pathway, which is comprised of dopaminergic neurons projecting from the VTA to the nucleus accumbens (NAc), and is a main pathway known to mediate reward-seeking and processing behavior. We found male rats raised in jSI (n = 13) show a lower preference for social interaction compared to group-housed male rats (n = 12) but only when a social stimulus was presented along with a competing non-social reward (unpaired t-test, p = 0.06). Our results show impaired social reward-seeking in male rats raised in jSI when presented with competing stimuli, suggesting a possible link between jSI and impaired social reward behavior, and

more precisely, impairments in processing the value of social interaction when presented with a competing stimulus. Ongoing in vivo fiber photometry recording experiments during social interaction will also shed light on the impact of jSI on neural activity of VTA-DA neurons and DA neurotransmission in the NAc and how changes in neural activity may underlie impairments in processing social reward.

Keywords: social isolation, behavior, reward, dopamine, fiber photometry

B6. A. Leithead, A. Godino, H. Harony-Nicolas, "Social stimuli elicit glutamatergic neuronal activity in the posterior intralaminar complex of the thalamus in male and female mice," Icahn School of Medicine at Mount Sinai.

Abstract: The posterior intralaminar (PIL) complex of the thalamus is considered a neural relay center by which sensory stimuli are perceived and communicated to downstream regions for the generation of social behaviors. The PIL has previously been implicated in maternal social behaviors in female rodents; however, it remains unknown whether the PIL is involved more broadly in other social interactions in both males and females. To address this question, we first used viral retrograde tracing and RNAscope in situ hybridization in male and female mice to demonstrate that the PIL sends monosynaptic glutamatergic inputs to the paraventricular nucleus of the hypothalamus, which is highly involved in social behaviors. Next, we exposed adult male and female mice to either a novel same-sex juvenile social stimulus or a novel object stimulus for 1 hour of free interaction then collected brains and analyzed for immunohistochemical staining of the immediate early gene c-fos. We observed significantly more c-fos+ cells in the PIL of mice exposed to social stimuli versus object stimuli. To confirm these results in real-time, we used fiber photometry to record neural activity of glutamatergic neurons in the PIL during interactions with social and non-social stimuli. The neural activity of PIL glutamatergic neurons of males and females was increased when mice were engaged in social interaction with a same-sex juvenile or opposite-sex adult but not an object toy rat. Interestingly, glutamatergic neural activity was also increased in females when interacting with an opposite-sex adult odor (urine sample); however, this pattern of increased activity was not observed in males. Together, these findings suggest that glutamatergic PIL neurons respond to social stimuli in both male and female mice, but activity may vary depending on sex and sensory modality. Ongoing experiments using chemogenetic tools will inhibit the activity of glutamatergic neurons in the PIL to measure the impact of this inhibition on the perception of social stimuli and behavior. We expect our findings to identify novel roles for the PIL which may further contribute to our understanding of neural mechanisms involved in social behaviors.

Keywords: Social perception, thalamus, sex differences

B7. M. Eikemo, GE Løseth, G Ernst, M Carlyle, C Pazmandi, M Thompson, C Vezzani, IM Meier, M Trøstheim, T Johnstone, M Heilig, G Biele, S Leknes, "Social stress enhanced opioid self-administration in healthy men," Univ. of Oslo, Norway, Kongsberg Hosp., Norway, Oslo Univ. Hosp., Norway, Swinburne Univ. of Technol., Australia, Linköping Univ., Sweden, Norwegian Inst. of Publ. Hlth., Oslo, Norway

Abstract: Most people will receive an opioid drug during their lifetime. The rate of addiction following prescription opioid use is alarming. Non-human animal research links addiction with the powerful relief

opioids can offer to animals in distress. In humans, epidemiological and clinical studies converge upon stress as a key risk factor for addiction. Despite this, the mechanisms through which stress alters opioid abuse liability in humans remain poorly understood. Here, we used a pre-drug social stress induction before opioid infusion in healthy men and women. The study was preregistered (OSF.io/bcxv8). Healthy volunteers participated in a double-blind placebo-controlled pseudo-randomized repeated-measures study; 63 completed all four 3-hour sessions (32 women, mean age 30 years, BMI 24). Two potent stress tasks and two non-stressful control tasks were performed immediately before dose 1 of oxycodone (i.v. 3mg/70kg) or saline. The dose was piloted to yield noticeable subjective effects, with few adverse effects. 15 minutes later, participants performed an effort-based self-administration task in which they could work to obtain 0-125% of the first dose effect. Dose 2 was given ~45 minutes later. Subjective state ratings, heart rate and blood samples were collected repeatedly. Self-administration data were analyzed using hierarchical Bayesian ordinal logistic regression. Overall, pre-drug stress increased oxycodone self-administration by 5.8% (OR=2.2 [0.91, 4.02], BF=22). The increase was driven by the men, who on average self-administered 15% more drug after stress (OR = 4.6 [1.07, 13.46] per 5%, BF = 48). Men exhibited significantly larger stress-enhanced abuse liability than the women, despite lower subjective and physiological stress indices. We found no direct stress relief from oxycodone in men or women. This study reveals a mechanism through which acute stress can alter opioid abuse liability. We find that men may preferentially turn to opioid drugs in response to stress.

Keywords: Social stress, TSST, opioids, psychopharmacology, abuse liability

B8. S. W. Li, P. Gabrieli, M. Suzuki, O. Zeliger, J. Demaree, R. Cauchon, N. Occidental, and Z. Williams, "Insular-prefrontal circuit driving compassionate social behavior," Massachusetts General Hospital.

Abstract: Compassionate behavior, or the ability to help others in need, is a cornerstone of prosocial interactions. To benefit others, it is necessary for individuals not only to perceive the internal states or emotions of others but also to take appropriate actions. Yet, how mammalian neurons precisely link social-specific information with adaptive behavior has been a major challenge to understand. Here, we developed a place-preference assay that allowed mice to directly control in real-time the experience of a nearby conspecific partner while also allowing the animal's own actions to be dissociated from the other's identity. Behaviorally, we found that wild-type male mice consistently chose to reduce aversive experiences of familiar but not unfamiliar partners, actions not observed when visual and olfactory cues were blocked. By recording from anterior insular (AI) neurons, we identified cells that encoded task relevant information, including the social identity of the animal's partners and their specific experience. Dorsal anterior cingulate (dACC) neurons, by contrast, preferentially encoded information about the act of helping their partners, displaying changes in activity prior to making their decisions. Further, whereas information about the experience of others could be predominantly decoded from AI activity, information about the animal's prosocial actions could be predominantly decoded from dACC activity; demonstrating a partitioning of information within the insular-prefrontal circuit. Finally, chemogenetic excitation of AI-to-dACC projectors but not dACC-to-AI projections increased compassionate behavior while inhibitions of both dACC to AI as well as AI to dACC projectors, on the other hand, decreased this behavior with familiar partners. Taken together, these findings identify a putative insular-prefrontal circuit for driving compassionate behavior and a mechanism that could allow insular neurons to instruct social-specific actions through prefrontal control.

Keywords: Compassionate behavior, insula, cingulate, electrophysiology, decoding, dreadds, mice

B9. M. L. Gustison, R. Muñoz-Castañeda, P. Osten, S. M. Phelps, "Sexual coordination in a whole-brain map of pair-bonding," University of Texas at Austin, Cold Spring Harbor Laboratory, Certerra, Inc., Certego Therapeutics.

Abstract: Social bonds are central to the human experience, and monogamous prairie voles enable investigation of the neurobiology of attachments. We developed a whole-brain imaging and computational pipeline to identify circuits involved in prairie-vole pair-bonding. Subjects were paired with either a same-sex sibling or a novel opposite-sex mating partner for up to 22h while we continuously tracked their movements and USVs. We extracted brain tissue at four time points (0h, 2.5h, 6h, 22h) and used iDisco immunolabeling to quantify the brain-wide distribution of the immediate-early gene c-Fos, a proxy for neuronal activity. The brain-wide distribution of the immediate-early gene c-Fos implicated 68 brain regions in pair-bonding, with little evidence for sexual dimorphism. Bonding pairs exhibited profound mating-induced male-female correlations across regions, a pattern predicted by ejaculation rates. The bed nucleus of the stria terminalis (BST) emerged as a central node in the pathway translating sexual experience into attachment; novel regions such as the preoptic area and medial amygdala, recently implicated in social reward, responded strongly to bonding and were coordinated across pairs even after bonds formed. These data offer novel systems-level insights into sociosexual attachments.

Keywords: pair-bond, sexual behavior, iDISCO, c-fos

B10. M. Cum, J. Santiago-Perez, R. Iwata, E. Wright, E. Wangia, N. Lopez, A. Li, A. Chambers, N. Padilla-Coreano, "Mind the social history gap: A Systematic review of social memory neuroscience studies," University of Florida.

Abstract: Social recognition is crucial for survival in social species. Without it, selective reproduction, territory and offspring protection, dominance hierarchies, and community cohesion would be impossible. Over the past two decades, much has been learned about the neural mechanisms of social memory using mice and rat models. To assess what types of social memory, and thus what neural mechanisms, have been investigated, we conducted a systematic review of the literature assessing social memory. We analyzed 669 articles published since 2000 for methodological variables regarding subject and social agent identities and the social memory experimental set-up. A vast majority of studies investigate short-term familiarity memories; 95% of the experiments conducted used "familiar" social agents that had a prior exposure to the subject of two hours or less, 60% of all experiments used five minutes or less. From the experiments reported, 99% did not consider social rank. Although many papers report subject variables, many fail to report the same for the social agent, with 19-59% of papers lacking specifications on housing history, age, sex, and strain, making reproducibility difficult. Of those reported, 53% of experiments used juvenile social agents, and 36% of experiments used male juveniles specifically. Thus, social memory has been studied in a very narrow lens that has minimal ethological relevance given the lack of familiarity. The neural mechanisms involved in short-term familiarity memories may differ from the mechanisms of long-term familiarity. Similarly, kin or hierarchy may

influence which mechanisms are used but there is a lack of consideration for these factors in the literature. This review highlights that neuroscience research needs to consider a wider variety of social memory types to uncover a nuanced understanding of the mechanisms that encode ethologically relevant social memories.

Keywords: literature, social memory, social recognition, review, memory

B11. G. Løseth, M. Trøstheim, M. Eikemo, & S. Leknes, "Opioid modulation of social bonds in humans – a meta-analysis," University of Oslo.

Abstract: Social motivation and bonding processes in non-human animals rely on and are modulated by opioid signalling (e.g. Moles et al. 2004, Science; Løseth et al. 2014, Front. Behav. Neurosci.). An emerging body of literature suggests opioid modulation of social connectedness also in humans. We conducted a preregistered random-effects meta-analysis of randomized double-blind studies comparing the effects of a centrally active mu-opioid antagonist and an inert substance (placebo) on social connectedness in healthy humans (see osf.io/x5wmq for preregistered methods). Data from eight publications reporting a total of fifteen outcomes from six different studies were included (N = 379). The studies all used naltrexone (25-100mg) to block the endogenous opioid system. Outcomes were self-reported measures of social connectedness. On average, naltrexone slightly reduced feelings of social connectedness (Hedges' g [95% CI) = -0.24 [-0.36, -0.11]. Results were highly consistent within and between studies (I2 = 16%), but there was some indication of publication bias in favour of larger negative effects (Egger's test: B = -2.48, SE = 0.99, z = -2.51, p = 0.01). These results indicate that the endogenous opioids system does plays a role in modulating or fine-tuning human feelings of social connectedness. However, the findings clearly demonstrate that the human experience of social connectedness is not dependent on intact opioid signalling, with robust ratings of social connectedness even during pharmacological opioid blockade. The small effect size observed in human studies compared to non-human animal findings could relate to the nature of the measure (subjective versus behavioural/motivation-related) or to differences in the neural representation of social connections in humans compared to e.g. macaques or rodents.

Keywords: social connectedness, social bonding, opioid

B12. R. Kee, K. Jantzen, J. Frederick, Z. Royer and A. Hahn, "Does cleft palate repair restore normal visual scanning and neural processing for infant faces?" California Polytechnic Institute Humboldt, Western Washington University.

Abstract: Infant faces readily capture adult attention and elicit enhanced neural processing, likely due to their importance evolutionarily in facilitating bonds with caregivers. However, facial malformations such as cleft lip/palate negatively impact interactions with caregivers, possibly due to altered perceptual processing of these faces compared to normal infant faces. Previous research has shown evidence of increased neural processing effort for these faces. Importantly, it is not yet known how surgical repair impacts responses to these faces. The current study used electroencephalography (EEG) to investigate adults' processing of infant faces with cleft lip/palate before and after surgical repair. We found

enhanced N170 responses for faces pre-repair surgery compared to post-repair surgery, suggesting that cleft lip/palate repair surgery may restore a more "normal" N170 response. Additionally, the P200 was smaller for the pre-repair surgery faces compared to post-repair surgery, which likely reflects the P200 responding to "typicality" for face stimuli as the post-repair surgery faces would appear more face-typical. Given that processing differences for infants with facial malformations may contribute to a number of important aspects of development (e.g., joint attention) and may play a key role in the previously observed difficulties in mother-infant interactions, this study provides an important first step in determining the effectiveness of surgical interventions on the neural mechanisms of infant face processing.

Keywords: Parenting, ERP, N170, cleft lip/palate, face processing

B13. K. Duskin and A. Hahn, "Does having siblings affect the reward value of infant faces?" California Polytechnic Institute Humboldt.

Abstract: "Baby schema" refers to infant characteristics, such as facial cues, that positively influence cuteness perceptions and trigger caregiving and protective behaviors in adults. Previous neuroimaging work has demonstrated that this "baby schema" activates reward-related regions in the brain. The factors that contribute to individual differences in the reward value of cute infant facial characteristics are poorly understood. These effects have primarily been explored as they relate to parental care, however infants receive care from others who are not their parents and it would be important for any caregiver, regardless of parental status, to respond to infant cues effectively. Because siblings often fulfill a caregiver role in the home, this study investigated whether having siblings, and younger siblings in particular, impacted the reward value of and perceptual sensitivity to the baby schema. Contrary to our hypothesis, having siblings did not influence the reward value of baby schema or perceptual sensitivity to baby schema in infant faces. Additional analyses exploring the potential impact of experience with younger siblings in particular also failed to show that responses to infant cues were sensitive to this type of alloparental care. Future research may consider investigating if the age difference between siblings affects responses to infant cues.

Keywords: Siblings, kinship, alloparental care, cuteness, reward

B14. B. Lau, M. Mykins, B. Kartal, B. Bridges, J. Elrod and K. Krishnan, "Role of perineuronal nets in the primary somatosensory cortex of adult female mouse model for Rett syndrome," University of Tennessee at Knoxville.

Abstract: Methyl-CpG-binding protein 2 (MECP2) is a known regulator of synaptic plasticity in sensory critical periods during early postnatal development. Previously, we have shown that MECP2 also regulates inhibitory synaptic plasticity in adult auditory and somatosensory cortices, in the adult female mouse model for Rett syndrome (Mecp2-heterozygote, Het). MECP2 appears to regulate inhibition through parvalbumin+ GABAergic neurons, which are surrounded by specialized extracellular matrix structures called perineuronal nets (PNNs). We have found atypical increased PNN expression in the Het primary somatosensory cortex (S1), a brain region responsible for processing somatosensory

information. We hypothesize that this atypical increased PNN expression leads to atypical tactile sensory perception in Het during single modality and complex social behaviors. To test this hypothesis, we manipulate cortical PNN expression in Het S1 and assess their social (alloparental; consecutive 6-day trials) and tactile (texture discrimination; 2-day trials) behaviors. We use DeepLabCut to analyze pose and trajectory of freely moving female mice while retrieving pups, and DataVyu to analyze whisker interactions during texture discrimination. We show that PNN reduction in S1 'rescues' tactile sensory phenotypes in Het, in a time-dependent manner. Analysis of trial- and day-dependent changes in behaviors suggests that S1 PNNs do not significantly affect tactile sensory perception in early days of the trials, but have significant impact on later days. These findings allow us to speculate about the roles for S1 PNNs in sensorimotor integration over days, and set the stage for testing with direct optogenetic manipulations and electroencephalogram recordings.

Keywords: Rett syndrome, alloparental social behavior, perineuronal net plasticity

B15. L. Schuster, R. Henderson, D. Ananth, A. Mar and R. Froemke, "A novel, open-source, high-throughput monitoring system for maternal behavior in mice," New York University, North East Ohio Medical University, NYU Langone.

Abstract: Understanding the neural basis of maternal behavior requires a comprehensive analysis of the repertoire that parents express, under conditions that enable high-resolution monitoring of most if not all behaviors 24 hours/day for weeks to months. To achieve this, we designed a semi-automated habitat for mice using open-source tools, where behavioral data can be collected and saved near-continuously over 4+ months. Our system is soundproofed, temperature- and humidity-controlled, and supports neural recordings and gain-of-function and loss-of-function interventions. Our overall goal is comprehensive behavioral phenotyping throughout life and over generations. We have monitored 11 wild type (WT) dams across 2-4 litters apiece, examining changes across different aspects of maternal care from litter to litter. While infanticide is quite common in first-time mothers, the incidence decreases in most dams with the subsequent litters. We found that even before birth of the first litter, quality of nest-making predicted degree and perseverance of infanticide. Dams that continued to be infanticidal stopped this behavior when co-housed with experienced dams that were not infanticidal, but persevered if cohoused with a male, a female virgin, or if left alone. Our study provides insights into the developmental trajectory of maternal behavior over time and across consecutive litters, the impact of the nest and its insulating capacity on pup mortality, and the role of socially transmitted parental behavior through cohousing in future litter success of dams showing suboptimal caregiving.

Keywords: maternal behavior, open source, caregiving, parent, dam, mouse, pups, accesibility

B16. P. Paletta, A. Palmateer and E. Choleris, "Interplay between estrogens in the supraoptic nucleus and the oxytocin receptor in the medial amygdala on the rapid mediation of social recognition," University of Guelph.

Abstract: Social recognition (SR) is mediated by both estrogens and oxytocin (OT), as shown in studies in which knocking out the genes for the estrogen receptors, OT, and the OT receptor (OTR) impaired SR. Also, studies in which 17b-estradiol (E2), estrogen receptor agonists, or OT are administered facilitated SR. Since estrogens and OT are needed for SR, it has been hypothesized they may interact. A model has

been suggested that estrogens will bind to their receptors in the paraventricular and/or the supraoptic nuclei (PVN and SON) of the hypothalamus, where the majority of OT production occurs, and facilitate the production and release of OT. The OT will then reach the medial amygdala (MeA) and bind to the OTR. The MeA also receives direct projections from the olfactory bulbs, so olfactory information about individuals that are encountered is also sent to the MeA. The model suggests that it is the OT facilitated by estrogens, binding to the OTR in the MeA that allows the incoming olfactory information to be used to recognize a familiar individual. We have previously shown evidence for this interplay through estrogens' rapid mechanisms by finding that E2 infused into the PVN of female mice rapidly facilitates SR and this facilitation can be blocked by simultaneously infusing a subeffective dose of an OTR antagonist (OTRA) into the MeA. These findings support the proposed interaction between estrogens and OT as well as the PVN and MeA in the rapid facilitation of SR. Currently, we are investigating whether this interaction also occurs with estrogens in the SON. We have shown that E2 infused into the SON can rapidly facilitate SR, and the current experiment is investigating whether the same subeffective dose of the OTRA, a dose that doesn't block SR by itself, can block this facilitation by E2 in the SON. Following the infusions, the mice are run through the "difficult" rapid SR paradigm. The paradigm takes place within 40 minutes to test the rapid mechanisms of estrogens and was designed to be difficult, meaning the vehicle group will not show SR and therefore facilitating effects of the treatments can be observed. If it is found that the OTRA in the MeA blocks the rapid facilitation of SR by E2 in the SON, it would show support for the idea that estrogens in the SON also interact with OT to rapidly facilitate SR in the MeA, similar to the PVN results. Funded by NSERC.

Keywords: Social recognition, estrogens, oxytocimn

POSTER SESSION C, Saturday, November 12, 11:00am-12:00pm

(online, includes posters B5-B16)

C1. C.J. Haggarty, C. Murray, I. Tare, R. Lee and H. de Wit, "Dose dependent effects of acute methamphetamine on EEG alpha power, self-reported stimulation and blood pressure in healthy adults," University of Chicago, Chicago, IL, USA.

Abstract: Methamphetamine (MA) is a stimulant drug characterized by increased feelings of stimulation, cardiovascular effects, and changes in electrophysiological function. In particular, previous studies indicate that stimulants decrease alpha power in EEG studies, consistent with increased wakefulness. In the present study, the subjective, physiological and cortical effects of acute MA (10 and 20 mg) were measured in healthy volunteers to examine relationships between its effects on alpha power and other measures. Healthy volunteers (N=29), aged 18-35, participated in a within-subject, double blind procedure in which they received placebo, 10mg and 20mg MA in 4-hour sessions at least four days apart. During the sessions, they completed subjective effects questionnaires and heart rate and blood pressure measurements were obtained. One hour after ingesting the capsule, resting state EEG measures were obtained to determine power at five frequencies bands, with eyes open. Data were analyzed from electrodes representing the default mode network. MA (10 and 20 mg) dose-dependently increased ratings of drug liking and vigor, and increased mean arterial pressure, compared to placebo. MA (10 and 20 mg) significantly decreased alpha power in a linear fashion, without significantly affecting other frequencies. The decrease in alpha power after MA (20 mg) significantly correlated with increases in feelings of vigor, but it was not correlated with increases in blood pressure. These data support the

association between increased feelings of arousal and decreased alpha frequency power. Single doses of MA increased both subjective stimulation and blood pressure and decreased alpha power, but only the subjective effects were related to the EEG measure. This supports the EEG measure as an index of cortical processing relating to acute drug effects.

Keywords: Methamphetamine, EEG, subjective effects

C2. M. Jin Yee Neoh, A. Bizzego, J. Hui Teng, G. Gabrieli, and G. Esposito, "Neural correlates of sexist criticism: Associations between perceptions of sexism and prefrontal activity," Nanyang Technological University, University of Trento, Italian Institute of Technology.

Abstract: Sexism is a widespread form of gender discrimination which includes remarks based on gender stereotypes. However, little is known about the neural basis underlying the experience of sexist-related criticism and how perceptions of sexism are related to these neural processes. The present study investigated whether perceptions of sexism influence neural processing of receiving sexist-related criticism. Participants (N = 67) read experimental vignettes describing scenarios of criticism from different sources while near-infrared spectroscopy recordings were made to measure the hemodynamic changes in the prefrontal cortex. Results found a significant correlation between participants' perceptions of sexism and brain activation in a brain cluster including the right dorsolateral prefrontal cortex and inferior frontal gyrus. There was a significant gender difference where female participants showed a stronger negative correlation compared to male participants. Future research can expand on these initial findings by looking at subcortical structures involved in emotional processing and gender stereotype application as well as examining cultural differences in perceptions of gender stereotypes and sexism.

Keywords: perceived sexism, criticism, neuroimaging

C3. B. de Souza, R. Lyra Romero, A. Alves and P. Boggio, "Modulation of perceived gratitude using Transcranial Direct Current Stimulation on Medial Prefrontal Cortex: A research project," Mackenzie Presbyterian University.

Abstract: Gratitude is a complex emotion and also a major psychological trait. Over the years, literature has shown that gratitude can have a significant role in perceived levels of well-being, as well as build interpersonal relationships and influence our moral decision making. In the last decade, the neural correlates of gratitude processes have been investigated using neuroimaging techniques such as functional magnetic resonance imaging (fMRI). The results point to the medial prefrontal cortex (mPFC) as having increased activity while participants engage in gratitude expression. Recent investigations are beginning to explore this specific area while applying transcranial direct current stimulation (TDCS) but the effects are yet to be further investigated. To better shed light on this topic, we designed an experiment in which the TDCS is used to stimulate the mPFC while the participants will be submitted to an emotional vignette evaluation task (40 vignettes). We will apply a direct low-level (1.5mA) intensity current on the mentioned area for approximately 15 minutes. According to the International 10-20 EEG System, the anode will be placed near Nz (between the eyebrows) while the cathode will be placed at Fz

using a 2 $cm^2 \times 3$ $cm4^2$ physiological saline-soaked sponge, respectively. The task can be completed on a computer at the laboratory and all the participants will receive both active and sham stimulation within a week's interval. Participants will be able to indicate which emotion (between anger, fear, sadness, happiness, gratitude, guilt, and neutral) is present while reading the vignette and also the valence and intensity of said emotion, followed by the Gratitude Questionnaire (GQ-6).

Keywords: Gratitude, TDCS, emotional vignettes, social emotion, neuromodulation

C4. C. Harp and A.Hahn, "Does postpartum depression reduce the reward value of infant stimuli?" California Polytechnic Institute Humboldt.

Abstract: This preregistered study aims to determine whether: (1) the anhedonia associated with postpartum depression reduces the reward value of baby-relevant stimuli to a greater degree than other social stimuli, and (2) whether postpartum depression reduces the reward value of infant cuteness. In order to answer these questions, women who have given birth in the past 12 months will be asked to complete the Edinburgh Postnatal Depression Scale (EPDS). This screening tool encompasses three sub-categories: depression, anhedonia, and anxiety and is widely used by practitioners at the 6-week postpartum checkup. The mothers will also complete two versions of a behavioral keypress task that assesses the reward value of stimuli. In the first task, they will see images of baby-relevant stimuli along with other social stimuli (adults, animals, etc). In the second task they will see baby faces that have been manipulated to appear more or less cute. These tasks and image manipulation techniques have been used widely in the literature. Regression analyses will be conducted to determine if levels of postpartum depression predict these reward-related responses (regardless of whether the clinical threshold for postpartum depression is met). Additional analyses will be conducted for the individual subscales to determine which elements of postpartum symptomology have the greatest impact on these social reward related responses.

Keywords: Social reward, postnatal depression, baby, infant

C5. A. Hahn, Z. Royer, J. Frederick, R. Kee, R. Crimmins, B. Huber, D. Harris and K. Jantzen, "Effects of cleft lip on visual scanning and neural processing of infant faces," California Polytechnic Institute Humboldt, Western Washington University.

Abstract: Infant faces readily capture adult attention and elicit enhanced neural processing, likely due to their importance evolutionarily in facilitating bonds with caregivers. Facial malformations have been shown to negatively impact early infant-caregiver interactions, however it remains unclear how early visual processing may be impacted by such facial malformations. The current study used a combination of eye tracking and electroencephalography (EEG) to investigate adults' early visual processing of infant faces with cleft lip/palate as compared to normal infant faces as well as the impact cleft palate has on perceived cuteness. The results demonstrate a significant decrease in early visual attention to the eye region for infants with cleft palate, while increased visual attention is registered on the mouth region. Increased neural processing of cleft palate was evident at the N170 and LPP, suggesting differences in configural processing and affective responses to the faces. Infants with cleft palate were also rated as

significantly less cute than their healthy counterparts. These results suggest that the faces of infants suffering from cleft lip/palate are processed differently at early visual perception. These processing differences may contribute to a number of important aspects of development (e.g., joint attention) and may play a key role in the previously observed difficulties in mother-infant interactions.

Keywords: ERP, N170, LPP, face processing, parental behavior

C6. Z. Royer, A. Hahn, K. Jantzen, J. McCabe and A. Gaffney, "Does threat to maternal identity impact neural responses to emotional faces?" California Polytechnic Institute Humboldt, Western Washington University.

Abstract: Pregnancy is a period of increased perceptual sensitivity to threats in one's environment, including the emotional expressions of others. Evolutionary theories posit that pregnancy necessitates cognitive restructuring, helping ensure survival during a period of vulnerability. Pregnancy is not only a time of biological change but social change, too, reflecting cultural attitudes about motherhood and child-rearing. Intensive mothering ideology (IMI; Hayes, 1996) dominates the United States parenting discourse, defining the expectations, emotions, and behaviors a "good" mother should have. The perfectionistic standards outlined by IMI place an oversized burden on mothers to adopt a new identity by being solely responsible for their child's development. The proposed study aims to determine whether maternal identity influences threat perception during pregnancy by using EEG to measure neural responses to threat-relevant stimuli. Pregnant women will read a passage about motherhood and be asked to reflect on their future role as a mother. Half of the women will read about the challenges of becoming a mother and be asked to reflect on ways they feel uncertain about their future role (threat to maternal identity condition). The other half will read a positive piece about the transition to motherhood and be asked to reflect on ways they feel prepared for their future role (non-threat condition). They will then view angry, happy, and neutral male faces. Our analyses will focus on the EPN and LPP components, both of which are related to attention to emotionally salient stimuli. We predict that threat to maternal identity will cause an increase in perceptual sensitivity towards interpersonal threat (i.e., enhanced neural processing of the angry faces).

Keywords: Pregnancy, threat detection, maternal identity

C7. T.C. Marcal, **E.F. Albregard**, I. Rezende, M.B. de Almeida, P.S. Boggio, "Racially biased decisions in facing injustice modulated by transcranial magnetic stimulation in Ultimatum Game," University of São Paulo.

Abstract: Racial bias interacts directly with the justice system, as many are punished more because of their skin color than their actions. The Ultimate Game (UG) is a tool to assess the aversion to inequality and altruistic punishment. Neuroimaging studies revealed a positive correlation between the supplementary motor area (SMA) and the rejection of offers in the UG. In addition, some studies have pointed to the role of the ventromedial prefrontal cortex (VMPFC) in UG tasks with social distance manipulation. However, few studies integrate economic games with racial bias and ways to influence behavior by experimental manipulation. This study aims to analyze whether transcranial magnetic

stimulation (TMS) affects decision-making when the proponent's skin color varies. Black and white participants will play the UG in a version with racial manipulation of the proposers. Fair and unfair offers will be equally made by black and white proponents. In each offer screen, will be applied a pulse of TMS. The SMA and VMPFC will be stimulated in addition to placebo stimulation. Considering the disruptive effect and targeting this neural network of TMS at each pulse, we expect that TMS in the SMA will reduce the rejection rate of offers regardless of the proposer. On the other hand, TMS in the VMPFC will decrease the rejection rates set on out-group aversion based on the proponent's skin color.

Keywords: Ultimatum game, transcranial magnetic stimulation, racial bias

C8. H. Kim, J. Jang and **H.-Y. Koh**, "Abnormal maternal behavior in mice lacking phospholipase Cβ1," Korea Institute of Science & Technology (KIST) Brain Science Institute (BSI).

Abstract: Motherhood goes through preparation, onset and maintenance phases until the natural weaning. A variety of changes in hormonal/neurohormonal systems and brain circuits are involved in the maternal behavior. Hormones, neuropeptides, and neurotransmitters involved in maternal behavior act via G-protein-coupled receptors, many of which in turn activate plasma membrane enzymes including phospholipase C (PLC) β isoforms. In this study, we examined the effect of PLCβ1 knockout (KO) on maternal behavior. There was little difference between PLCβ1-KO and wild-type (WT) dams in the relative time spent in maternal behavior during the period between 24 h prepartum and 12 h postpartum (-24 h ~ PPH 12). After PPH 18, however, PLCβ1-KO dams neglected their pups so that they all died in 2-3 days. In pup retrieval test, latency was not different during the period within PPH 12, but after PPH 18, PLCβ1-KO dams could not finish pup retrieval in a given time. During both periods, FosB expression in the nucleus accumbens (NAcc) of PLCβ1-KO dams was significantly lower than WT, but not different in the medial preoptic area (mPOA). Given that mPOA activity is required for initiation of maternal behavior, and that NAcc is known to be involved in maternal motivation and maintenance of maternal behavior, our results suggest that PLCβ1 signaling is essential for transition from the onset to maintenance phase of maternal behavior.

Keywords: maternal neglect, maternal motivation, maintenance of maternal behavior, Phospholipase Cβ1, mice

APPENDIX: MAP AND DIRECTIONS TO MARINA BALLROOM E

Marina Ballroom E is in the South Tower, Level 3.

Directions: The South Tower is closest to the convention center.
From the main entry, you are on the Lobby Level (level two). You will need to head left toward the South Tower and take the escalator or elevator to Level 3. Once on Level 3, *Marina Ballroom E* will be on your left (indicated by the star on the diagram).