Parental Brain 2018

July 13-14th, 2018
Toronto, Canada

Perspectives in Parental Health

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

Parental Brain 2018 Organizing Committee:

- Frances Champagne, University of Texas at Austin (USA)
- Liisa Galea, University of British Columbia (Canada)
- Jodi Pawluski, University of Rennes 1 (France)
- Joseph Lonstein, Michigan State University (USA)

Parental Brain 2018 Program Committee:

- Karen Bales (USA)
- Oliver Bosch (Germany)
- Paula Brunton (UK)
- Arpad Dobolyi (Hungary)
- Liisa Galea (Canada)
- Gabriela Gonzalez-Mariscal (Mexico)
- Pilyoung Kim (USA)
- Kumi Kuroda (Japan)
- Frederic Levy (France)
- Ming Li (USA)
- Joseph Lonstein (USA)
- Benjamin Nephew (USA)
- Jodi Pawluski (France)
- James Rilling (USA)
- Lane Strathearn (USA)
- Simone Vigod (Canada)
- Aron Weller (Israel)

Parental Brain 2018 is very pleased to be supported by the Canadian Institutes of Health Research, Sage Therapeutics, Frontiers in Neuroendocrinology (Elsevier), and the Journal of Neuroendocrinology (Wiley).

Parental Brain 2018:
Biological & Behavioral Perspectives on Parental Health
Toronto, Ontario, Canada

Friday, July 13, 2018

8:15-8:45 am Continental Breakfast

8:45-9:00 Welcome and Introductions

9:00-10:30 ***Symposium 1:*** ***Not just the brain – parental brain interactions with the gut, immune system & placenta***

- Arpad Dobolyi (Semmelweis University, Hungary) - *IGF-1 regulations lactation and maternal responsiveness based on validated systems biological studies*
- Jeffrey Meyer (University of Toronto, Canada) – *From monoamine oxidase A imaging to a novel dietary supplement to reduce postpartum blues*
- Benedetta Leuner (Ohio State University, USA) - *Microglia and motherhood: emerging evidence for immune alterations in the pregnant and postpartum brain*
- Rosalind John (Cardiff University, United Kingdom) - *Placental imprinting modulates maternal care provision: Implications for maternal mood disorders*

10:30-11:00 Coffee Break

11:00-12:30 ***Symposium 2: Threats to mothering – drugs, psychopathology, toxins, stress***

- Lane Strathearn (University of Iowa, USA) - *The neurobiology of maternal addiction: What's attachment got to do with it?*
- Aya Dudin (University of Toronto, Canada) - *Neural response to infant pictures: Comparing depressed and non-depressed mothers and non-mothers*
- Thierry Charlier (University of Rennes 1, France) – *Glyphosate and glyphosate-based herbicide exposure during the peripartum period affects maternal brain plasticity, maternal behavior and microbiome*
- David Slattery (University of Frankfurt, Germany) – *Detrimental impact of stress and diet on peripartum-associated adaptations*

12:30-2:00 pm Lunch on your own

2:00-2:45 ***Keynote Address*****:** John A. Russell (University of Edinburgh, Scotland) - *Giving a good start to a new life via maternal brain adaptations in pregnancy*

2:45-3:45 ***Wiley Young Investigator Symposium:*** Paula Duarte-Guterman (University of British Columbia, Canada), Zachary Grieb (Michigan State University, USA), Sabrina Pose (Universidad de la República, Uruguay),

Kristina O. Smiley (University of Otago, New Zealand), Sarah Winokur (University of Massachusetts, USA), Eva Unternaehrer (University of Konstanz, Germany)

3:45-4:00 Short Break

4:00-4:45 ***Keynote Address*****:** Patricia Tomasi (Huffington Post Canada) - *Leveraging social media and advocacy journalism to connect with mothers and families going through postpartum depression*

4:45-6:15 ***Poster Session/Reception***

Saturday, July 14, 2018

8:15-8:45 am Continental Breakfast

8:45-10:15 ***Symposium 3: Neurobiology of nurturing – parental insights inspired by Craig H. Kinsley***

- Robert Bridges (Tufts University, USA) - *Craig Kinsley: Researcher, enthusiast, and friend*
- Kelly Lambert (University of Richmond, USA) - *Nurturing through adversity: Neurobiological effects of parental challenges*
- Elizabeth Byrnes (Tufts University, USA) - *Opioids, maternal adaptation, and multigenerational effects*
- Jodi Pawluski (University of Rennes 1, France) - *Plasticity in the maternal brain during the perinatal period: Effects of stress and SSRIs*
- Liisa Galea (University of British Columbia, Canada) - *The long and short of it: Hippocampal plasticity after pregnancy and motherhood*
- Luciano Felicio (Universidade Paulista, Brazil) - *Closing remarks*

10:15-10:45 Coffee Break

10:45-12:15 ***Symposium 4: The genetics and epigenetics of parenthood***

- Stephen Gammie (University of Wisconsin, USA) - *Large scale changes in central gene expression across the postpartum period: Relevance to sociality and mental health risks*
- Danielle Stolzenberg (University of California, USA) - *Plasticity in the parental brain: Experience and epigenetics*
- David Ashbrook (University of Tennessee, USA) - *Indirect genetic effects of, and on, maternal care*
- Michelle Arbeitman (Florida State University, USA) – *Gene expression changes associated with mouse maternal behaviors and maternal experience*

12:15-1:30 pm Lunch on your own

1:30-2:15 ***Keynote Address***: - Ruth Feldman (Interdisciplinary Center, Herzliya, Israel) - *Building a human parental brain and why it matters*

2:15-3:45 ***Symposium 5*: Other than mothers – the paternal and alloparental brain**

- James Rilling (Emory University, USA) - *Paternal brain function in human fathers*
- Johanna Bick (University of Houston, USA) – *Variability in foster caregiving from an affective neuroscience perspective*
- Erica Glasper (University of Maryland, USA) - *Neuroendocrine regulation of fatherhood-related hippocampal plasticity in California mice* (*Peromyscus californicus*).
- William Kenkel (Indiana University, USA) - *The babysitters club: Prairie vole alloparents and the role of oxytocin*

3:45-4:30 ***Panel Discussion*: Future Initiatives on Parental Health**

4:30 pm ***Closing Remarks and Adjourn***

KEYNOTE SPEAKER ABSTRACTS

GIVING A GOOD START TO A NEW LIFE VIA MATERNAL BRAIN ADAPTATIONS IN PREGNANCY.

Russell JA; Brunton PJ

Centre for Discovery Brain Sciences, University of Edinburgh, UK (JAR; PJB)

Successful pregnancy requires adjustments to multiple maternal homeostatic mechanisms, governed by the maternal brain to support and enable survival of the growing conceptus and placenta. Such adjustments fit the concept of allostasis and have a cost, allostatic load (e.g. gestational diabetes mellitus). Allostasis is driven by ovarian, anterior pituitary, placental and feto-placental hormones acting on the maternal brain: e.g. relaxin stimulates vasopressin secretion, permitting blood volume expansion; prolactin (and placental lactogen) induces leptin resistance, increasing appetite and positive energy balance; allopregnanolone (5α-reduced neuroactive metabolite of progesterone), reduces hypothalamo-hypophysial-adrenal (HPA) axis responses to stressors, conserving energy and limiting fetal programming. Allopregnanolone, produced and acting in the nucleus tractus solitarii (NTS), where 5α-reductase gene (SRD5A1) expression is increased in pregnancy, induces opioid inhibition of the stress axis, with up- or down-regulation of key neuropeptide and receptor genes. The expression of hundreds more genes is altered in the maternal brain, starting in pregnancy. An emerging issue is whether allostatic changes in gene expression in the brain involve epigenetic mechanisms (e.g. DNA methylation/ demethylation, histone modifications, or micro (mi)RNAs - which can regulate central SRD5A1 expression). There is sparse information about epigenetic changes in the maternal brain in pregnancy, in striking contrast with abundant data about epigenetic changes from early-life experience in offspring brains. Many women carry an existing allostatic load into pregnancy, from socio-economic circumstances, and in ‘developed' countries, also from obesity. These pregnancies have poorer outcomes, suggesting negative interactions between pre-pregnancy and pregnancy allostatic loads: a bad start. The use of animal models, e.g. adult prenatally stressed female offspring with abnormal metabolic and stress response phenotypes, to probe gene expression changes, and epigenetic mechanisms in the maternal brain in adverse pregnancies will be discussed, with the prospect of translating the information to ameliorate poor pregnancy outcomes.

Research supported by: The BBSRC

The authors have no conflicts of interest to declare.

BUILDING A HUMAN PARENTAL BRAIN AND WHY IT MATTERS

Feldman, R

Interdisciplinary Center (IDC), Herzliya, Israel

While research on the neurobiological basis of mammalian mothering is a century-old, studies of the human parental brain are relatively recent. In this talk, I will describe how the subcortical structures underpinning mammalian maternal care evolved to integrate several cortical networks implicated in simulation, mentalization, and emotion regulation into a global human caregiving network that supports the complex, flexible, multi-level, and culture-specific task of human parenting. Mechanisms of biobehavioral synchrony, by which the parent's brain shapes and is shaped by the infant's physiology and behavior during moments of social contact will be discussed. Human studies of mothers and fathers will be presented, detailing similarities and differences between the maternal and paternal brain in relation to parenting behavior, hormones, and degree of father involvement. Longitudinal studies will describe how alterations in the parental brain in the postpartum shape children's social behavior, neuroendocrine systems, and mental health over time. In parallel, studies will show how the parent's hormones and behavior longitudinally shape children's social brain in health and psychopathology. I conclude by addressing the implications of research on the human parental brain for early parenting interventions and for a deeper understanding of the brain-mind polarity.

The author has no conflicts of interest to declare.

LEVERAGING SOCIAL MEDIA AND ADVOCACY JOURNALISM TO CONNECT WITH MOMS GOING THROUGH POSTPARTUM DEPRESSION

Tomasi, P

Huffington Post, Canada

You've done outstanding research but who cares unless you get the word out? And what about when you need people like moms to participate in your research? How do you find them? That's where learning how to effectively use social media and developing relationships with journalists becomes so important. It's time to stop avoiding Twitter and Facebook and get over your fear of talking to the media. But it's not just about cutting and pasting the first few lines of an abstract into a Tweet or a post. There's a right way and a wrong way to get your message out depending on the medium you use and language is everything.

The author has no conflict of interest to declare.

SYMPOSIUM SPEAKER ABSTRACTS

Symposium 1: Not just the brain – parental brain interactions with the gut, immune system & placenta

IGF-1 REGULATES LACTATION AND MATERNAL RESPONSIVENESS BASED ON VALIDATED SYSTEMS BIOLOGICAL STUDIES

Dobolyi A; Udvari E; Leko AH

MTA-ELTE Laboratory of Molecular and Systems Neurobiology, Department of Physiology and Neurobiology, Hungarian Academy of Sciences and Eötvös Loránd University, Budapest, Hungary

We hypothesized that molecular changes in the hypothalamus accompany central maternal adaptations. Therefore, we dissected this brain region to investigate proteomics and genomics changes in rat dams. The control group consisted of mothers, which were deprived of their pups immediately after parturition. There were 21 significant protein changes identified in maternal dams: 7 increases and 14 decreases. A subsequent common regulator analysis using bioinformatics tools suggested that insulin-like growth factor-1 (IGF-1) is a regulator of maternal proteins. In addition, our microarray study revealed that mRNA level of IGF-binding protein-3 (IGFBP-3), the major carrier and inhibitor of IGF-1 was increased in the hypothalamus of mother rats. Therefore, we addressed the role of the IGF1-IGFBP3 system in the control of lactation and maternal behaviours. The increased IGFBP-3 mRNA level of the microarray study was validated with RT-PCR and in situ hybridization histochemistry. IGFBP-3 expression is abundant in the medial preoptic area and the arcuate nucleus, responsible for maternal motivation and regulation of prolactin secretion, respectively. Prolonged intracerebroventricular administration of IGF-1 and an IGFBP-3 ligand inhibitor (NBI-31772) lengthened pup-retrieval time, suggesting specific reduction in maternal motivation, especially because the treatment did not change spontaneous maternal behavior, anxiety and general activity. Suckling-induced prolactin release and weight gain of pups also decreased. IGF-1 elevated the expression of tyrosine-hydroxylase (TH), the rate-limiting enzyme of dopamine synthesis, in tuberoinfundibular dopaminergic neurons. We also found that IGF-1 serum level increased during suckling, which would inhibit maternal adaptation in the central nervous system. IGFBP-3 induced in the MPOA and arcuate nucleus may be able to counteract the action of IGF-1, as far as maternal behavior and prolactin release are concerned, by possibly sequestering IGF-1 from the extracellular space.

Research supported by: NKFIH-4300-1/2017-NKP_17 and OTKA K116538

The authors have no conflicts of interest to declare.

FROM MONOAMINE OXIDASE A IMAGING TO A NOVEL DIETARY SUPPLEMENT TO REDUCE POSTPARTUM BLUES

Meyer JH; Dowlati Y; Steiner M; Stewart D; Ravindran A

Campbell Family Mental Health Research Institute, CAMH and Department of Psychiatry, University of Toronto, Canada

Objective: Given the 13% risk of postpartum depression (PPD), broadly applicable prevention strategies are needed. Greater severity of postpartum blues is associated with greater risk of PPD so reducing severity of postpartum blues is a promising approach to reduce risk of PPD. Monoamine oxidase A (MAO-A) levels are elevated during major depressive episodes (MDE) and high risk/low mood states predisposing to MDE, such as postpartum blues. To compensate for the temporarily elevated MAO-A levels of postpartum blues, a dietary supplement was created. The supplement consists of tryptophan, tyrosine and blueberry extract. Our objectives were to demonstrate that tryptophan and tyrosine do not affect their total concentrations in breast milk since, unlike the blueberry, they are given at supraphysiological amounts; and to demonstrate that this dietary supplement reduces vulnerability to depressed mood during postpartum blues in open trial. Methods: After acute administration of tryptophan and tyrosine at several different doses, concentrations of total and free breast milk tryptophan and tyrosine were assayed (n = 42 subjects; 6 per dose). An open trial of the dietary supplement was assessed evaluating its effect on creating resiliency against depressed mood induction (n = 20 versus 21). Results: Neither tryptophan nor tyrosine influenced their total levels in breast milk. Depressed mood induction shifted the visual analogue scale (VAS) in women who were not receiving the dietary supplement but had no effect in women receiving the supplement (VAS shift in depressed mood: 43mm versus 0.05mm; analysis of variance, effect of group, $F(1,39) = 88.33$, $p<0.001$; effect size 2.9). Conclusions: The strategy of developing a dietary supplement to compensate for highly elevated MAO-A levels in early postpartum is promising. This dietary supplement should be developed further because it has minimal effects on breast milk but prevents vulnerability towards depressed mood during postpartum blues in open trial.

Research supported by: CIHR Research Chair, Leslois Shaw Foundation

Dr. Meyer and CAMH are considering creating a company to provide the dietary supplement.

MICROGLIA AND MOTHERHOOD: EMERGING EVIDENCE FOR IMMUNE ALTERATIONS IN THE PREGNANT AND POSTPARTUM BRAIN

Leuner B

Department of Psychology, The Ohio State University, Columbus, USA

Pregnancy and the postpartum period are characterized by many profound changes in maternal physiology. These include dynamic alterations in the peripheral immune system that are known to be important for a successful pregnancy, the growth and development of the fetus, and for maternal health. The brain is also highly populated with immune cells, called microglia, but to date few studies have considered how the central immune system may be impacted during the peripartum period. This talk will discuss emerging evidence from our studies in rats showing peripartum neuroimmune modifications, in both microglia and immune signaling molecules. Specifically, we have found peripartum reductions in microglial number and increases in potentially neuroprotective cytokines suggesting that the brain may be assuming an inflammatory-resistant state relative to pre-pregnancy levels. Because corticolimbic mood-regulating regions are particularly affected, we hypothesize that these neuroimmune changes may be important for maternal mental health, and if disrupted contribute to peripartum mood disturbance. Our ongoing studies are exploring this possibility using a gestational stress model of postpartum depression. Thus far, our results have revealed that depressive-like behavior during the postpartum period is preceded by an increase in microglia immunostaining, elevated pro-inflammatory cytokine gene expression, as well as increased expression of several phagocytic genes highly expressed by microglia. Further, this neuroimmune profile occurs in association with compromised neuroplasticity suggesting that at least one way postpartum depression might arise is via the effects of central immune dysregulation on neuronal structure and function. Overall, this work extends our understanding of maternal immune system beyond the periphery and has the potential to provide new insights into the causes of, and novel therapeutic targets for, postpartum mental illness.

Research supported by: NICHD 083791-02

The author has no conflicts of interest to declare.

PLACENTAL IMPRINTING MODULATES MATERNAL CARE PROVISION: IMPLICATIONS FOR MATERNAL MOOD DISORDERS

Creeth HDJ; McNamara GI; Tunster SJ; Boque-Sastre R; Allen B; Sumption L; Eddy JB; Isles AR; John RM

Biomedicine Division, School of Biosciences, Cardiff University, CF10 3AX (HDJC, GIM, SJT, RB-S, BA, LS, RM); Centre for Trophoblast Research, Department of Physiology, Development and Neuroscience, University of Cambridge, Physiology Building, Downing Street, Cambridge CB2 3EG (SJT); Behavioural Genetics Group, MRC Centre for Neuropsychiatric Genetics and Genomics, Neuroscience and Mental Health Research Institute, Cardiff University, Cardiff, CF24 4HQ (JBE, ARI), United Kingdom

Genomic imprinting describes the monoallelic expression of genes, depending on parent-of-origin, which are established and maintained by epigenetic marks. Studies in mice reveal a function for imprinted genes in regulating fetal growth, placental development, behaviour and metabolism consistent with dysregulation of these genes in rare human growth disorders such as Beckwith-Wiedemann syndrome and Silver Russell-Syndrome. Using mouse models which specifically address the dosage related function of imprinted genes, we identified a novel role for imprinted genes in regulating the endocrine lineages of the mouse placenta. As the placenta is derived from the fetus, this suggests that the offspring's imprinted genes may influence maternal adaptations to pregnancy. We tested this hypothesis in an animal model in which wild type female mice carried and cared for offspring with three different doses of the maternally expressed Phlda2 gene. The highest dose of Phlda2 resulted in low birth weight of the offspring and a deficit in maternal care whereas the lowest dose increased maternal care provision at the cost of “housekeeping” behaviours such as nest building. Importantly, this enhanced maternal nurturing was maintained in the absence of stimulation from the genetically modified offspring indicative of prenatal programming. We have more recently identified alterations in the expression of imprinted genes in placenta from human pregnancies blighted by depression and anxiety. Together, these data suggest that aberrant placental imprinting may contribute to maternal mood disorders with implications for both the short and longer term health of mothers and their children.

Research supported by: BBSRC grant BB/P002307/1; MRC grant MR/M013960/1; BBSRC grant BB/J015156; BBSRC BB/P008623/1.

The authors have no conflicts of interest to declare.

Symposium 2: Threats to mothering – drugs, psychopathology, toxins, stress

THE NEUROBIOLOGY OF MATERNAL ADDICTION: WHAT'S ATTACHMENT GOT TO DO WITH IT?

Strathearn L; Kim S

Center for Disabilities and Development, University of Iowa Children's Hospital, Iowa City, IA (SL); Departments of Obstetrics and Gynecology, Psychiatry and Behavioral Sciences, and Pediatrics, Baylor College of Medicine, Houston, TX (SK), USA

Maternal addiction constitutes a major public health problem, and is a significant threat to mothering, with high rates of child abuse, neglect, and foster care placement. Our prior studies have shown that infant face cues activate dopamine-associated brain reward regions, similar to drugs of abuse. Mothers with unresolved attachment trauma—a condition seen almost universally in our sample of substance abusing mothers—also have a blunted amygdala response when viewing their own infant's crying face. Our most recent functional MRI study shows that mothers with addictions demonstrate reduced activation of reward regions when shown reward-related cues of their own infants, in both dopamine- and oxytocin-innervated regions including the hypothalamus, ventral striatum, and ventromedial prefrontal cortex. This study is the first to demonstrate that mothers with addictions show reduced activation in these key reward regions of the brain. We hypothesize that early attachment trauma may have an adverse effect on brain reward processing, leading to an increased vulnerability to addiction.

Research supported by: Eunice Kennedy Shriver National Institute of Child Health and Human Development (K23 HD43097, R01 HD065819); the Baylor Child Health Research Center: Pediatrics Mentored Research Program (K12 HD41648); and the National Institute on Drug Abuse (R01 DA026437).

The author has no conflicts of interest to declare.

NEURAL RESPONSES TO INFANT PICTURES: COMPARING DEPRESSED AND NON-DEPRESSED MOTHERS AND NON-MOTHERS

Dudin A; Wonch KE; Davis AD; Steiner M; Fleming AS; Hall GB

McMaster Integrative Neuroscience Discovery & Study (MiNDS) Program, McMaster University, Hamilton, Canada (AD, GBH); Department of Psychology, University of Toronto at Mississauga (KEW, ASF, AD); Department of Psychology, Neuroscience & Behaviour, McMaster University (GBH, ADD); Department of Psychiatry and Behavioural Neurosciences, McMaster University, Hamilton, ON, Canada (MS); Women's Health Concerns Clinic, St. Joseph's Healthcare Hamilton (MS), Canada

Background: In many mammalian species, new mothers show heightened positive responsiveness to infants and their cues when they give birth. Lesioning the amygdala (AMY) differentially affects virgin female rats and new rat mothers, such that virgins show maternal behaviors and new mothers show decreased maternal behaviors. Recent fMRI work from our laboratory shows that, in human mothers, distress and anxiety were significantly related to reduced AMY response to Own smiling infant faces compared to Unfamiliar smiling infant, and that in comparison with nondepressed mothers, depressed mothers show heightened activation in the AMY. These results suggest that, in line with work from other laboratories, infant-related AMY function may be an important factor in maternal anxiety/depression, in quality of mothering, and in individual differences in the motivation to mother. Methods: Focusing on the AMY, the present study examines effects of parity by comparing mothers and nonmothers, and effects of depression by comparing clinically determined PPD and MDD in their neural and subjective responses to positive infant faces and positive non-infant pictures. Separate whole-brain, within-groups fixed-effects analyses (Bonferroni p=0.05). We also undertook analyses of ROIs for certain a priori defined comparisons. Results: In a direct comparison between PPD and non-PPD mothers, non-PPD mothers showed increased functional connectivity between the bilateral AMY and the right insular cortex, whereas PPD mothers show decreased functional connectivity between the two regions in response to own infant images. Conclusions: The results confirm the significance of increased neural sensitivity to own infant stimuli for parenting and the role that the mother's negative mood plays in neural sensitivity. Moreover, we will describe patterns of AMY activity and connectivity patterns in response to contrasts between Unfamiliar infant faces and Noninfant stimuli within and between groups of depressed and nondepressed mothers and non-mothers.

Research supported by: Ontario Mental Health Foundation and Canadian Institutes for Health Research.

The authors have no conflicts of interest to declare.

GLYPHOSATE AND GLYPHOSATE-BASED HERBICIDE EXPOSURE DURING THE PERIPARTUM PERIOD AFFECTS MATERNAL BRAIN PLASTICITY, MATERNAL BEHAVIOR, AND MICROBIOME

Charlier TD

Univ Rennes, Inserm, EHESP, Irset (Institut de Recherche en Santé, Environnement et Travail), UMR_S 1085, F-35000 Rennes, France

Glyphosate is by far the most widely used herbicide, with an annual application reaching up to 125,000 tons of active compound in 2014. Recent work in rodents suggests that glyphosate-based herbicide (GBH) can affect a number of neurotransmitter systems, leading to alterations in behavior. Here, we investigated the effects of peripartum exposure to GBH or glyphosate alone on maternal behavior and neurobiological correlates in the rat dam. Pregnant female Sprague-Dawley rats received water solution (control), glyphosate (5mg/kg/day) or GBH (Round-Up® 5mg/kg/day of glyphosate) by ingestion from gestational day (GD) 9 to post-natal day (PND) 22. This dose corresponds to 1/10 of the “No Observable Adverse Effect Level.” Maternal behavior was investigated in the first week postpartum. We observed a significant increase in time spent licking and grooming offspring on PND1 in control dams compared to glyphosate and GBH dams. However, between PND2-6, GBH-dams spent significantly more time licking and grooming offspring. After weaning, brains from dams were analyzed by immunohistochemistry to characterize neuroplasticity in the hippocampus, cingulate cortex and median preoptic nucleus. There was no effect of treatment on hippocampal neurogenesis. No effect of glyphosate or GBH was evident on measures of synaptic plasticity in the cingulate cortex or median preoptic nucleus. However, the expression of synaptophysin (presynaptic vesicle marker) was significantly increased in the dentate gyrus and CA3 region of the hippocampus in glyphosate treated dams. These changes were not linked to corticosterone levels nor liver toxicity at PND22. However, Glyphosate or GBH treatment at GD20 and PND22 significantly modified the intestinal microbiota of the mother, which was determined using 16S rRNA sequencing methods. These findings reveal that peripartum exposure to glyphosate and GBH affect maternal neuroplasticity, behavior, and microbiome. Further work is needed to determine the extent to which these changes impact offspring development.

Research supported by: in part by the University of Rennes1 "Defi Emergent"

The author has no conflict of interest to declare.

DETRIMENTAL IMPACT OF STRESS AND DIET ON PERIPARTUM-ASSOCIATED ADAPTATIONS

Slattery, DA

Department of Psychiatry, Psychosomatics and Psychotherapy, Gothe University, Frankfurt am Main, Germany

In all mammalian species, the time around birth is associated with profound physiological, emotional and behavioral changes, necessary for normal offspring development and maternal health. Thus, pregnancy and lactation are associated with increased basal glucocorticoid levels (hypercorticism; cortisol in humans; corticosterone in rats and mice) and a concurrent hypo-response to acute stressors. These adaptations are thought to be an evolutionary mechanism to meet the enhanced basal energetic demands of the mother and to protect the offspring from high glucocorticoid levels. Moreover, it is speculated that these adaptations contribute to the increased calmness and decreased anxiety that are characteristic of the period. However, this period is also associated with risk for the development of anxiety and mood disorders, which occur in up to 20-25 % of mothers within the first year after the birth of their child. Although the biological reasons for this remain unclear, a number of risk factors have been identified including a previous history of such disorders. More translatable risks include stress during the peripartum period and obesity, which is a growing public health concern in modern society. However, the mechanisms underlying the increased susceptibility is unclear, but a potential candidate system is the hypothalamic-pituitary-adrenal (HPA) axis since it undergoes substantial plasticity across the peripartum period. In a series of studies, we have investigated the consequences of stress exposure and/or high-fat diet on maternal behavior and HPA axis adaptations in mice and rats. Here, I will describe peripartum-associated adaptations across behavior and the HPA axis, particularly at the level of the adrenal gland, and the detrimental effects of stress and high-fat diet exposure on these alterations.

Research supported by: in part by Deutsche Forschungsgemeinschaft

The author has no conflicts of interest to declare.

Symposium 3: Neurobiology of nurturing – Parental insights inspired by Craig H. Kinsley

NURTURING THROUGH ADVERSITY: NEUROBIOLOGICAL EFFECTS OF PARENTAL CHALLENGES

Lambert KG; Kent M

Department of Psychology, University of Richmond, USA

Although past research has revealed adaptive plasticity in the parental brain, neurobiological responses are complex when parental animals are exposed to various types of stressors. Consequently, our laboratory has explored stress responsiveness and emotional resilience in animals with varying parental experiences. When rats with previous maternal experience (primiparous) were assessed in a swimming task, they exhibited more dive responses than nulliparous animals; further, when assessed in the probe trial of a spatial learning task, primiparous animals exhibited an enhanced search strategy and higher fecal dehydroepiandrosterone (DHEA) to corticosterone (CORT) ratios, responses viewed as markers of emotional resilience. Neurohistological analyses indicated additional putative markers of resilience including increased hippocampal BDNF and lower glucocorticoid-receptor immunoreactivity in primiparous rats. Additionally, maternal responsiveness was examined in rats exposed to mildly restricted resources (MRR; e.g., less bedding and nesting material) or control levels of resources (CR) through lactation. Exposure to MRR resulted in disrupted maternal attentiveness and slower pup retrieval scores in a challenge task. Further, MRR maternal rats exhibited DHEA/CORT ratios and neuropeptide Y profiles that were characteristic of compromised emotional resilience. Corroborating past research, distracted maternal responses in MRR rats had pervasive effects on developing pups, including compromised cognitive, social and physical markers. We have also observed altered DHEA/cortisol ratios in a nonhuman primate parental model (i.e., owl monkeys), an effect that was positively correlated with more efficient foraging. Focusing on paternal-like behavior in long-tail macaques, affiliative interactions between adult males and juveniles were positively correlated with higher DHEA levels. Across species, these studies suggest context-specific stress responsivity in parental animals; whereas adaptive resilience has been observed in animals following parental experience, parental responsiveness is compromised in the MRR maternal model. Thus, both emotional resilience and stress vulnerability have been observed throughout the parental experience continuum.

Research supported by: Schapiro Undergraduate Research Fellowship, Randolph-Macon College; Dept of Psychology, University of Richmond

The authors have no conflicts of interest to declare.

OPIOIDS, MATERNAL ADAPTATION, AND MULTIGENERATIONAL EFFECTS

Vassoler FM; Toorie AM; Schonhoffe CM; Byrnes EM

Section in Neuroscience and Reproductive Biology, Department of Biomedical Sciences, Cummings School of Veterinary Medicine at Tufts University, North Grafton, Massachusetts, USA

Dr. Craig Kinsley conducted numerous studies demonstrating the critical role of endogenous opioids within neural circuits that regulate maternal investment. In the midst of an ongoing opioid epidemic, the number of women exposed to exogenous opioids, often in the form of prescription opioids, has increased dramatically. Adaptations to high circulating levels of opioids have the potential to impact numerous reproductive outcomes beyond maternal behavior, even in the absence of direct fetal exposure. Using the rat as a preclinical model, we have documented a number of significant effects of preconception opioid exposure on offspring outcomes, including effects on substance abuse vulnerability and metabolism. These transgenerational effects are associated with alterations in the endogenous opioid systems in both the exposed female and her future progeny. Overall, these data demonstrate maternally transmitted physiological modifications in response to environmental risk factors and add to the important area of research championed by Dr. Kinsley regarding the critical role of maternal adaptation in offspring health.

Research supported by: NIH R01DA025674

The author has no conflicts of interest to declare.

PLASTICITY IN THE MATERNAL BRAIN DURING THE PERINATAL PERIOD: EFFECTS OF STRESS AND SSRIs

Pawluski JM

Univ Rennes 1, Inserm, EHESP, Irset (Institut de Recherche en Santé, Environnement et Travail), UMR_S 1085, F-35000 Rennes, France

Over the past 20 years, research has begun to show that the female brain has an inherent plasticity expressed during the perinatal period. These changes in the maternal brain are essential for healthy mother-offspring interactions and offspring survival. One such brain area that shows a high degree of plasticity in the mother is the hippocampus and we know from the seminal work of Craig H. Kinsley that changes in the hippocampus of the mother may be related to improved spatial memory during the postpartum period. Apart from spatial memory, the hippocampus also plays an important role in stress and depression. During the perinatal period, one in seven women will suffer from perinatal affective disorders. These stress-related disorders can have significant effects on neural, physiological and behavioural plasticity in the mother. The present talk will focus on how stress affects plasticity in the hippocampus of the mother during gestation and postpartum. Given that the first line of treatment for perinatal mental illnesses is often the selective serotonin reuptake inhibitor medications (SSRIs), further discussion of the effects of these medications on plasticity in the maternal brain will take place. Understanding how brain plasticity is altered in the mother with reproduction as well as perinatal affective disorders will lead to treatments to improve the mental health of the mother and child.

Research Supported by: in part NARSAD Young Investigator Grant from the Brain & Behavior Research Foundation

The author has no conflicts of interest to declare.

THE LONG AND SHORT OF IT: HIPPOCAMPAL PLASTICITY AFTER PREGNANCY AND MOTHERHOOD

Galea LAM; Mahmoud R; Duarte-Guterman P; Lieblich SE

Centre for Brain Health (LAMG,RM, PDG,SEL), Graduate Program in Neuroscience (RM, LAMG) and Department of Psychology (LAMG,RM, PDG,SEL), University of British Columbia, Canada

Pregnancy is an impressive physical feat that requires significant maternal adaptation to a variety of physiological systems (cardiovascular, pulmonary, immune) to ensure the successful development of the fetus. The placenta drives the remarkable levels of steroid and peptide hormones that are seen in extraordinarily high levels during pregnancy, and with the ejection of the placenta these hormones are eliminated and women become hypogonadal during the postpartum, with lactation associated with other endocrine and physiological demands. At the same time, a significant amount of plasticity needs to occur given the repertoire of maternal behaviours that need to be learned to ensure the survival of the offspring. Given these physiological demands both during and after pregnancy it should not come as a huge surprise that there may be a number of long-term changes to the maternal brain. In this talk, I will speak on the range of data examining the influence of reproductive experience on cognitive changes and neuroplasticity in the hippocampus in the short term after weaning and into middle age. Work from our laboratory suggests that past reproductive experience increases hippocampal neuroplasticity, cognition, and alters the trajectory of cytokine profiles in middle-aged rats. Furthermore, our work indicates that the hippocampus responds to estrogens differently in middle-age dependent on past reproductive experience, with multiparous rats showing an upregulation of cell proliferation with estrogens, but no change in nulliparous rats. In response to Premarin treatment, primiparous rats exhibited impaired spatial acquisition but nulliparous rats exhibited facilitated acquisition in middle-age. Given that there is evidence that parity influences cardiovascular disease and cancer as women age, it is important to study how parity may influence the aging female brain, as the aging immune trajectory and response to hormone treatments may differ in aged females with and without reproductive experience.

Research supported by: Canadian Institutes of Health Research and Alzheimer Society of Canada to LAMG

The authors have no conflicts of interest to declare.

Symposium 4: The genetics and epigenetics of parenthood

LARGE-SCALE CHANGES IN CENTRAL GENE EXPRESSION ACROSS THE POSTPARTUM PERIOD: RELEVANCE TO SOCIALITY AND MENTAL HEALTH RISKS

Gammie SC

Department of Integrative Biology, University of Wisconsin, Madison, USA

In mammals, the transition to motherhood involves an unrivaled number of changes in physiology, behavior, and the brain. In humans and rodents, there are over 20,000 protein coding genes and most of these are expressed in the nervous systems. In this talk, I will aim to embrace the whole genome and present data on the postpartum brain based on multiple large scale gene expression studies both from my lab and other labs. The talk will be in four parts. In part 1, I will present an overview on known large-scale changes in gene expression that occur during the transition to motherhood, while also highlighting some enrichment analyses, with a focus on genes involved in reward and addiction. In part 2, I will describe a small scale study that was inspired by large scale data in which we knocked down expression of the gene, Nr1d1, in non-parental females so that it matched levels in postpartum females, and found that treatment improved sociability and decreased anxiety. In the third part, I will present an approach where I combine large-scale maternal brain changes with drug repurposing tools to identify possible new candidate drugs for improving sociability. The premise for this work is that some of the dramatic neural changes that increase sociability of mothers represent fundamental mechanisms that promote sociability across social contexts. Finally, in part 4, I'll present an approach that combines data from the rodent postpartum brain with recent human gene expression datasets from individuals with mental health disorders to provide new insights into where and how vulnerabilities can emerge for postpartum disorders, including postpartum depression, postpartum psychosis, and postpartum bipolar disorder. Together, the talk is aimed to elucidate some of the potential benefits from a large scale analysis of the postpartum brain.

Research supported by: NIH MH109714

The author has no conflicts of interest to declare.

PLASTICITY IN THE PARENTAL BRAIN: EXPERIENCE AND EPIGENETICS

Stolzenberg DS

Department of Psychology, University of California, Davis, USA

Maternal behavior is a defining characteristic of mammals, which is regulated by a core, highly conserved neural circuit. However, mothering behavior is not always a default response to infant conspecifics. For example, initial fearful or fragmented responses toward infants in laboratory rats and mice give way to highly motivated and organized caregiving behaviors following gestational hormone exposure or repeated experience with infants. Therefore a conserved neural substrate for parental care alone is not sufficient to produce maternal behavior; instead hormonal and/or experiential factors must be involved in routing infant stimuli down either an approach or avoidance neural path. Importantly, caregiving behavior is sustained beyond gestational hormone exposure and thus experience with pups likely programs differential sensitivity of these pathways to infant stimuli over time so that infant stimuli come to elicit caregiving behaviors exclusively. However the underlying mechanisms that sustain sensitivity toward offspring long-term remain largely unknown. Using a mouse model, my laboratory has explored the hypothesis that alterations in transcriptional regulation within competing approach and avoidance neural pathways mediate the effects of pup experience on caregiving behavior by potentiating the ability of infant stimuli to reliably activate the neural circuit that regulates parental behavior. In support of this idea, administration of a histone deacetylase (HDAC) inhibitor, which allows for increased expression of primed or poised genes, reduced the amount of experience with pups required to induce long-term changes in caregiving responses. Importantly, the amplification of caregiving behavior in HDAC inhibitor treated mice was linked to altered immediate early gene (IEG) expression in critical nodes of the approach and avoidance pathways. Finally, the extent to which a dysregulation of these mechanisms could be related to maternal neglect/abuse will be discussed.

Research supported by: NICHD R01HD087709.

The author has no conflict of interest to declare.

INDIRECT GENETIC EFFECTS OF, AND ON, MATERNAL CARE

Ashbrook DG; Hager R

Department of Genetics, Genomics and Informatics, University of Tennessee Health Sciences Center, College of Medicine, Memphis, Tennessee, USA (DGA); School of Biological Sciences, Faculty of Biology, Medicine and Health Sciences, University of Manchester, Manchester, UK (RH)

Indirect genetic effects occur when the genotype of one individual influences the phenotype of another individual. The early postnatal period is one of the most important times for these indirect genetic effects, as mammalian offspring are entirely dependent upon their parents. The maternal genetic effect of a mother's genotype on her offspring's phenotype is well studied, however offspring genetic effects, the effect of an offspring's genotype on their parent's phenotype, are not as well-studied. It is predicted that there should be conflicts between the parents and offspring on the level of parental investment, whereby indirect genetic effects may be a mechanism for this. However, few genetic loci causing these indirect genetic effects are known.
To identify these loci we have used a cross-fostering approach in the BXD recombinant inbred mouse strains. We measured the effect of genetically variable foster-family members on genetically uniform foster-family members on postnatal days 7, 10 and 14. We identified several genomic loci underlying maternal, offspring and sibling genetic effects and each contained plausible candidate genes. We showed that indirect genetic effects have a significant impact on phenotype, and in some instances are greater than the direct genetic effects. Contrary to our expectation, sibling genetic effects seemed to have a positive effect, resulting in greater maternal care of siblings. Our results demonstrate that indirect genetic effects can have a large effect on phenotype and therefore should be carefully considered in any genetic studies.

Research supported by: NERC, UK NE/I001395/1. DGA was funded by BBSRC 1088088

The authors have no conflicts of interest to declare.

GENE EXPRESSION CHANGES ASSOCIATED WITH MOUSE MATERNAL BEHAVIORS AND MATERNAL EXPERIENCE

Arbeitman MN

Biomedical Sciences Department, Florida State University, Tallahassee, USA

How the female brain is shaped by maternal experience is not well understood at a molecular or neural circuit level. To contribute to understanding this question, we examined gene expression changes associated with pregnancy and parturition at five time points: two late pregnancy and three post-partum time points. For this study, we examined four brain regions: hypothalamus, hippocampus, neocortex, and cerebellum, to broadly understand the global transcriptional response. The results showed that each brain region had extensive gene expression changes, but each region had a unique repertoire of genes with changed expression. Given the extensive gene expression changes throughout the brain, I was prompted to investigate if these expression changes are long-lasting and if maternal experience impacts the brain beyond the time the female is performing maternal behaviors. To address this question, gene expression was compared between primiparous females that were three weeks post-nursing and virgin age-matched controls. For this study, five brain regions were examined: hypothalamus, amygdala, hippocampus, neocortex, and cerebellum. The differences in gene expression between females post-nursing and virgin controls were fewer than in females actively performing maternal behaviors and virgin controls. The results and comparison of these two analyses will be presented.

Research supported by: College of Medicine and Research Office, Florida State University

The author has no conflicts of interest to declare.

Symposium 5: Other than mothers – the paternal and alloparental brain

PATERNAL BRAIN FUNCTION IN HUMAN FATHERS

Rilling JK

Department of Anthropology and Department of Psychiatry and Behavioral Sciences, Emory University, Atlanta, USA

Humans are cooperative breeders. Mothers usually get help from others in raising their offspring. Fathers are often the most important helper in modern, developed societies and paternal involvement is associated with multiple positive developmental outcomes in these societies. In two studies, we recruited biological fathers of 1 and 2 year old children who were currently cohabitating with the child's mother. Study 1 also included a group of unmarried non-fathers. All men provided blood samples for hormone measurement and received functional MRI scans while they viewed pictures of children and adults. Fathers had lower testosterone and higher oxytocin levels than non-fathers. Fathers also showed stronger activation to unknown child pictures in brain regions involved in reward processing (medial orbitofrontal cortex) and theory of mind (temporo-parietal junction). There was also a positive correlation between paternal involvement in instrumental caregiving (as reported by the mother) and ventral tegmental area (VTA) activation when fathers viewed pictures of their own children. In a second study, fathers of 1 and 2 year old children received either 24 IU intranasal oxytocin before one scan and placebo before the other scan or 20 IU intranasal vasopressin before one scan and placebo before the other scan. Brain function was measured with fMRI as the fathers viewed pictures of their children, unknown children and unknown adults. Intranasal oxytocin, but not vasopressin, significantly increased the response to viewing pictures of their own children within the caudate nucleus, a target of midbrain dopamine projections, as well as the dorsal anterior cingulate and visual cortex, suggesting that intranasal oxytocin augments activation in brain regions involved in reward, empathy and attention in human fathers. These results suggest that increases in oxytocin associated with the transition to fatherhood may motivate sensitive caregiving.

Research supported by: R21HD078778 and John Templeton Foundation

The author has no conflicts of interest to declare.

VARIABILITY IN FOSTER CAREGIVING FROM AN AFFECTIVE NEUROSCIENCE PERSPECTIVE

Bick J; Dozier M

Department of Psychology, University of Houston (JB); Department of Psychological and Brain Sciences, University of Delaware (MD), USA

Alloparenting, or the provision of caregiving by non-biologically related individuals, is an important, yet poorly understood human social behavior. Given its influence on children's social emotional and cognitive outcomes, understanding factors that contribute to its expression are critical. This talk will focus on a special form of alloparenting, foster care, whereby children are removed from their biological families for reasons related to maltreatment. We take an affective neuroscience approach, combining neural and neurohormonal measures with behavioral assessments, to understand caregiving variability over the first months of the foster parent-infant bonding period. We discuss findings in the context of what is known more generally on the neurobiology of parenting and emphasize public health relevance of children who are reared in at-risk alloparental circumstances.

Research supported by: F31MH085423

The authors have no conflicts of interest to declare.

NEUROENDOCRINE REGULATION OF FATHERHOOD-RELATED HIPPOCAMPAL PLASTICITY IN CALIFORNIA MICE (*Peromyscus californicus*)

Glasper ER

Department of Psychology and Program in Neuroscience and Cognitive Sciences. University of Maryland, College Park, Maryland, USA

Our knowledge of fatherhood-related changes to the brain has grown, in large part due to the increased use of mammalian models that express paternal care in the wild. The biparental and monogamous California mouse (*Peromyscus californicus*) is an excellent rodent species in which to explore the relationship between paternal experience and hippocampal plasticity because California mouse fathers provide extensive paternal care and are necessary for offspring survival and normal development. Unlike uniparental maternal rodents that demonstrate a restoration in adult neurogenesis at weaning, California mouse fathers exhibit a reduction in the survival of newborn neurons in the dentate gyrus (DG) of the hippocampus at weaning - an effect also observed in California mouse mothers. Compared to non-fathers, fatherhood also results in increased dendritic plasticity (i.e., spine density, branching) in select subfields of the hippocampus at the time of weaning. Although newborn neuron survival is reduced in fathers at weaning, cells fully incorporated into the pre-existing neuronal circuitry of the hippocampus are enhanced by fatherhood and may be contributing to hippocampus dependent behaviors that are indicative of successful parenting (e.g., reduced anxiety, improved cognition). Importantly, the fatherhood-associated enhancement in dendritic plasticity and adult neurogenesis in the DG, along with the reduction in anxiety-like behavior, is only observed in fathers actively caring for offspring; simply siring a litter does not enhance hippocampal structural plasticity. Estrogen receptor β activation was identified as a putative mechanism supporting enhanced neuroplasticity in California mouse fathers. Non-fathers and fathers were treated with tamoxifen, a selective estrogen receptor modulator, at a time when new neurons are rapidly maturing. Tamoxifen treatment prevented a fatherhood-related increase in adult neurogenesis in the DG without altering cell survival in non-fathers. These data shed new light on a potential neuroendocrine mechanism underlying paternal experience-dependent plasticity in the hippocampus.

Research supported by: in part the National Institute on Aging (F32 AG033461), UNCF-Merck Postdoctoral Science Research Fellowship, University of Maryland Graduate School Research and Service Award, and the University of Maryland Department of Psychology.

The author has no conflicts of interest to declare.

THE BABY-SITTERS CLUB: PRAIRIE VOLE ALLOPARENTS AND THE ROLE OF OXYTOCIN

Kenkel WM

Kinsey Institute, Indiana University, Bloomington, USA

Drawing from work on the neuroendocrinology of maternal behavior, the study of alloparental behavior – parental caregiving provisioned by an individual other than the biological parents - has long focused on the neuropeptide oxytocin. In this talk, I will argue that alloparenting has been a fundamental platform for the evolution of modern humans and remains critically important today. A large reason alloparenting has remained under-studied is its relative absence in traditional laboratory species. Here, I present data on the role of oxytocin in alloparenting from the socially monogamous prairie vole (*Microtus ochrogaster*), a spontaneously alloparental rodent that offers an animal model of cooperative breeding. I originally hypothesized that alloparenting would be characterized by a state of high oxytocin levels and low arousal, analogous to the maternal stress hyporesponsivity described by Slattery and Neumann. Indeed, the first several behavioral and endocrine studies of the alloparental vole seemed to confirm this idea, but the discovery of a relatively ‘hidden' state of dramatically high arousal led this work in a new direction. After exploring this phenomenon and ultimately deriving an explanation for the high arousal levels, I recently returned to studying alloparental behavior as a dependent variable in work relating to the consequences of exposure to oxytocin in the perinatal period, which models the experience of labor induction / augmentation common to contemporary obstetric practice.

Research supported by: P01 HD075750

The author has no conflicts of interest to declare.

POSTER ABSTRACTS

Poster 1

MECP2, AN EPIGENETIC CHROMATIN MODULATOR, REGULATES CORTICAL PLASTICITY UNDERLYING LEARNED MATERNAL BEHAVIOR IN SENSITIZED NULLIPAROUS MICE

Lau BY; Layo D; Fisher D; Krishnan K

Department of Biochemistry & Cellular and Molecular Biology, University of Tennessee at Knoxville, USA

Cohabitation of adult nulliparous mice with pups and mother induces maternal behavior in them in a hormone-independent manner. Such non-hormonal factors are thought to be important in mediating plasticity, likely through chromatin remodeling of specific neural circuitry (Stolzenberg and Champagne, 2016,). We have previously shown that nulliparous mice deficient in Methyl CpG-binding protein 2 (MECP2) display inefficient pup gathering behavior, likely due to atypical auditory processing of ultrasonic vocalizations from pups (Krishnan, Lau et al, 2017). Furthermore, we identified a crucial mechanism involving extracellular matrix structures called perineuronal nets (PNNs) which play a major role in structural plasticity of parvalbumin+ GABAergic networks in the auditory cortex. The auditory cortex of MECP2-deficient females had increased numbers of PNNs, which when removed, improved pup gathering performance. Many questions remain: How do the nulliparous wild types learn and perform the behavior well? What neural circuits are critical for this learning? We use extended audio and video recordings during maternal behavior to dissect the components, and whole brain immunostaining/imaging studies to identify relevant neural circuitry involved in this behavior. Our current results suggest that many cortical regions with nuanced perineuronal net expression and distribution are involved in this circuitry.

Research supported by: University of Tennessee start-up funds.

The authors have no conflicts of interest to declare.

Poster 2

ESTROGEN WITHDRAWAL INCREASES ANXIETY-LIKE BEHAVIOR AND DORSAL RAPHE OXYTOCIN RECEPTORS IN HAMSTERS

Benedetto LE; Heaton EC; Levine MT; Taveras S; Ross AP; Albers HE; Been LE

Department of Psychology, Haverford College (LEB; ECH; MTL; ST; LEB); Neuroscience Institute, Georgia State University, Atlanta (APR; HEA), USA

Peripartum mood disorders are the most common complication associated with childbirth and are associated with negative outcomes for both mothers and children. Despite this, the underlying neurobiological mechanisms remain poorly understood. Previous research suggests that the drop in estrogen at parturition may lead to changes in neurobiology and behavior. Indeed, our laboratory has demonstrated that estrogen withdrawal following a hormone-simulated pregnancy leads to more oxytocin-immunoreactive neurons in the paraventricular nucleus of the hypothalamus (PVN) in female hamsters. We therefore hypothesized that estrogen withdrawal would likewise lead to alterations in oxytocin receptor density in efferents of the PVN and concurrent changes in anxiety-like behavior. To test these hypotheses, we used a hormone-simulated pregnancy model in female Syrian hamsters. In this model, females are ovariectomized and given daily injections to approximate changes in ovarian hormones in the peripartum period. Specifically, ovariectomized females were assigned to one of three groups: an oil control group; a hormone-withdrawn group, which received hormone injections for 17 days before being withdrawn from hormones for five days; and a hormone-sustained group, which received the same hormone regimen as the hormone-withdrawn group for 17 days, then continued to receive estradiol for five subsequent days. On days 18-22, all females underwent testing for anxiety-like behaviors in an open field and an elevated plus maze. Following behavior testing, subjects were sacrificed and their brains were processed for oxytocin receptor autoradiography in the medial amygdala, nucleus accumbens, bed nucleus of the stria terminalis, and dorsal raphe nucleus. We found that hormone-withdrawn females spent significantly more time in the closed arms of an elevated plus maze. In addition, hormone-withdrawn females had a significant increase in oxytocin receptor density in the dorsal raphe. Together, these data indicate that estrogen withdrawal may lead to anxiogenic behavior via oxytocin signaling in the dorsal raphe.

Research supported by: Haverford Faculty Research Grant to LEB

The authors have no conflicts of interest to declare.

Poster 3

THE INDUCTION AND RETENTION OF MATERNAL BEHAVIOR IN NULLIPAROUS, ESTROGEN RECEPTOR ALPHA (ESR1) KNOCKOUT RATS

Gallagher JM; Nephew BC; Poirier GL; King JA; Bridges RS

Department of Biomedical Sciences, Tufts University, Cummings School of Veterinary Medicine, North Grafton, Massachusetts (JMG, BCN, RSB), Center for Comparative NeuroImaging, University of Massachusetts Medical School, Worcester, Massachusetts (GLP, JAK), USA

Many mammals, including rats, show an enhancement of maternal care following a prior maternal experience, termed maternal memory. Other studies report that the quality of maternal care is associated with methylation of the estrogen receptor alpha (Esr1) gene (Champagne et al, 2006), and that parity increases the number of Esr1 positive cells in brains of non-lactating parous rats (Byrnes et al, 2009). Using a new model of Esr1 knockout (KO) rats (Rumi et al, 2014), our study investigated whether deletion of the Esr1 allele affects maternal care and memory in pup-induced, nulliparous rats. Homozygous Esr1 KO and wild type (WT) female rats were induced to respond maternally by placing donor pups in their home cage daily until they displayed maternal responsiveness for two consecutive days. Females that responded during induction testing were tested again for the retention of maternal behavior 30 days after prior pup exposure. Females that reached full responsiveness in the retention test were tested for maternal behavior in a novel cage for 30 minutes (video recorded). Duration, frequencies and latencies for maternal behaviors were recorded. Results indicated no differences in the latencies to induce maternal care between homozygous KO and WT females during the initial induction and retention tests. However, in the home cage retention test, homozygous KO females had shorter pretest latencies to group pups. This suggests that homozygous KO females responded in fewer days to group pups prior to the next testing session, compared to WT females. In the novel cage however, homozygous KO females showed slower latencies to mouth and retrieve the first pup compared to WT females. Overall, the findings suggest that deletion of the Esr1 gene does not significantly affect the establishment of maternal memory in the nulliparous model, but may impact motivational aspects of maternal behaviors.

Acknowledgements of Funding: This research was supported by NIH Grant HD086361 to RSB

Conflict of Interest: The authors of this research disclose no conflicts of interest.

Poster 4

INSULIN-LIKE GROWTH FACTOR (IGF-1) IN MATERNAL ADAPTATIONS OF THE CENTRAL NERVOUS SYSTEM

Leko AH; Udvari EB; Cservenak M; Hanics J; Alpar A; Dobolyi A

MTA-ELTE Laboratory of Molecular and Systems Neurobiology, Department of Physiology and Neurobiology, Hungarian Academy of Sciences and Eötvös Loránd University, Budapest, Hungary (AHL, EBU, MC, AD); Department of Anatomy, Histology and Embryology, Semmelweis University, Budapest, Hungary (AHL, MC, JH, AA, AD)

Adaptation to motherhood includes maternal behaviour and lactation, with major organizing centres located in the hypothalamic medial preoptic area (MPOA) and arcuate nucleus, respectively. We performed proteomics in hypothalamic synaptosomes comparing lactating and pup-deprived rat dams, which suggested that IGF-1 regulates several maternally changing synaptic proteins. Then, we re-evaluated our previous microarray study of the preoptic area and performed its validation with RT-PCR and in situ hybridization histochemistry, which in turn demonstrated that IGF binding protein-3 (IGFBP-3) has higher expression in the MPOA of lactating mothers. Prolonged intracerebroventricular (icv.) administration of IGF-1 and an IGFBP-3 ligand inhibitor (NBI-31772) lengthened the pup-retrieval time. Furthermore, IGF-1 administration decreased suckling-induced prolactin release and consequently the weight gain of pups. The induction of IGFBP-3 expression occurred in tuberoinfundibular (TIDA) neurons of the dorsomedial arcuate nucleus, which control prolactin secretion. IGF-1 elevated the expression of tyrosine-hydroxylase (TH) in TIDA neurons *in vivo* and induced not only expression but also activation of TH by phosphorylation *in vitro*. We also demonstrated that suckling-induced IGF-1 release, which correlates with prolactin, reaches its maximum 30 minutes after the start of suckling and is diminished by prolonged icv. IGF-treatment. In conclusion, we propose a model that IGF-1 serum level is increased during suckling, which would inhibit maternal adaptation in the central nervous system. However, IGFBP-3 induced in the MPOA and arcuate nucleus may be able to counteract this action of IGF-1 by possibly sequestering it from the extracellular space.

Research supported by: ÚNKP-17-3, NKFIH KTIA_NAP_13-2-2015-0003, NKFIH-4300-1/2017-NKP_17, OTKA K116538 research grants.

The authors have no conflicts of interest to declare.

Poster 5

CHARACTERISATION OF PROLACTIN ACTION ON GLUTAMATE AND NNOS NEURONS IN THE FEMALE MOUSE BRAIN DURING LACTATION

Brown RSE, Barad Z, Grattan DR

Department of Anatomy and Centre for Neuroendocrinology, School of Biomedical Sciences, University of Otago (RB, ZB, DG); Maurice Wilkins Centre for Molecular Biodiscovery, New Zealand (DG)

The anterior pituitary hormone, prolactin, acts through the prolactin receptor in the maternal brain to induce numerous critical adaptations during pregnancy and lactation. Although the prolactin receptor is widely expressed throughout the mouse forebrain, the identity (and therefore function) of many of these prolactin-responsive neurons remains unknown. As large populations of glutamatergic and nNos-expressing cells have previously been described in many of these regions, we aimed to identify whether prolactin acts on glutamatergic and nNos neurons in the virgin female mouse brain and whether there are changes in prolactin signaling in these cells during lactation. Using immunohistochemical labeling of prolactin-induced phosphorylated signal transducer and activator of transcription 5 (pSTAT5) as a marker of activated prolactin receptors, we identified populations of prolactin-responsive glutamatergic neurons in the rostral preoptic area, medial preoptic area and ventromedial hypothalamus. Furthermore, many of these prolactin-responsive glutamatergic neurons also expressed nNos. By conditionally deleting prolactin receptors (Prlrlox/lox) exclusively from glutamatergic neurons, using a mouse with Cre recombinase expression restricted to cells that express the vesicular glutamate 2 transporter (VGlut-Cre), we demonstrated that the ventromedial hypothalamic prolactin-responsive neurons consists of a homogenous population of cells that all co-express glutamate and nNos. All pSTAT5 labelling was lost in this nucleus in glutamatergic cell-specific prolactin receptor knockout mice. In contrast, the preoptic area consists of heterogeneous populations of prolactin-responsive cells with subpopulations of cells expressing glutamate, nNos, both glutamate and nNos or neither cellular marker. In response to endogenously-elevated levels of prolactin during lactation, many of these populations showed significantly increased levels of prolactin-induced pSTAT5 labelling. These data provide the first description of populations of glutamatergic and nNos neurons that respond to prolactin, with changes in responses during lactation. We are currently investigating the role of these prolactin-sensitive neuronal populations in aspects of maternal behavior.

Research supported by: Health Research Council of New Zealand

The authors have no conflicts of interest to declare.

Poster 6

KISSPEPTIN NEURONS IN THE PERIVENTRICULAR NUCLEUS PROJECT TO THE PARAVENTRICULAR NUCLEUS IN THE MOUSE

Augustine RA; Jackson M; Brown CH

Brain Health Research Centre, Centre for Neuroendocrinology and Department of Physiology, University of Otago, Dunedin, New Zealand.

Magnocellular oxytocin neurons are found in the hypothalamic paraventricular (PVN) and supraoptic (SON) nuclei. Their cell bodies synthesize oxytocin, which is released into the circulation from the posterior pituitary gland in response to action potential firing. Oxytocin promotes uterine contractions during parturition and milk let-down during lactation. In late-pregnant rats (days 18 – 21 of gestation), central kisspeptin administration increases oxytocin neuron activity, but not in non-pregnant rats. We have unpublished data from late pregnant mice that show kisspeptin projections to the PVN and SON. To identify the origin of these kisspeptin fibres, we injected a retrograde tracer into the PVN of pregnant mice. The fluorescent retrobeads are taken up by axon terminals in the PVN and retrogradely transported along the axon to the cell body. Four days after PVN injection, mice were perfused with 4% paraformaldehyde and brains were processed for immunohistochemistry to identify kisspeptin cell bodies and co-localization of green fluorescent retrobeads. The periventricular nucleus (PeN) of the hypothalamus showed co-expression of green retrobeads in kisspeptin cell bodies. Non-pregnant mice had on average 33.4 ± 12.9 kisspeptin cell bodies in the PeN. Very few cell bodies were detected in the AVPV, which contained mainly fibres, as did the Arc nucleus. Pregnant mice had on average 16.4 ± 8.3 kisspeptin cell bodies ($P \geq 0.001$). In the PeN of non-pregnant mice, 6.5% of kisspeptin neurons co-expressed retrobeads and in pregnant mice 7.4% of kisspeptin neurons contained retrobeads ($P \geq 0.05$). Other kisspeptin neuron populations in the anteroventral periventricular nucleus and arcuate nucleus did not contain retrobeads. Taken together, these results show that periventricular kisspeptin neurons innervate the PVN in the mouse. As yet the functional significance of the increase in kisspeptin fibres during pregnancy is unknown but it appears likely to increase the excitability of oxytocin neurons for birth.

Research supported by: Health Research Council of New Zealand

The authors have no conflicts of interest to declare.

Poster 7

CHRONIC PROLACTIN ADMINISTARTION INCREASES HYPOTHALAMIC KISSPEPTIN EXPRESSION IN VIRGIN MICE

Kumar SS, Augustine RA, Brown CH

Brain Health Research Centre, Centre for Neuroendocrinology and Department of Physiology, School of Biomedical Sciences, University of Otago, Dunedin, New Zealand

Oxytocin is secreted from the posterior pituitary gland by hypothalamic neurons in the supraoptic and paraventricular nuclei (SON and PVN) and is required for normal parturition. Kisspeptin fibre density surrounding oxytocin neurones increases during pregnancy and we have previously demonstrated that kisspeptin excites oxytocin neurones only in late pregnancy. Kisspeptin and oxytocin neurons express prolactin receptors and placental lactogen, which acts on prolactin receptors, is elevated in late pregnancy. Thus, we hypothesised that prolactin receptor activation might increase kisspeptin fibre expression to excite oxytocin neurones in late pregnancy. Here, we determined the effect of prolonged prolactin infusion on kisspeptin and oxytocin neurones in virgin mice. Following subcutaneous infusion of ovine prolactin (1500 µg/day at 1µl/hr for seven days) or vehicle (0.01M $NaHCO_3$), kisspeptin and oxytocin immunohistochemistry (IHC) was carried out. There was no significant difference in the mean number of kisspeptin-labelled cells in the hypothalamic periventricular nucleus (58.6 ± 23.7 vs 49.1 ± 11.7, $P = 0.20$) or in oxytocin-labelled cells in the PVN (139.9 ± 22.8 vs 138.1 ± 19.6, $P = 0.47$) or SON (48.8 ± 8.9 vs 52.1 ± 2.5, $P=0.21$). To determine whether there is a change in the kisspeptin fibre density surrounding the PVN and SON following prolactin infusion, confocal images of brain sections double labelled for oxytocin and kisspeptin are being analysed.

Research supported by: Brain Health Research Centre, New Zealand and Centre for Neuroendocrinology and Department of Physiology, University of Otago, Dunedin, New Zealand

The authors have no conflicts of interest to declare.

Poster 8

PROLACTIN-RESPONSIVE GENES IN THE ADULT MOUSE CHOROID PLEXUS

Phillipps HR; Rand CJ; Brown RSE; Stanton J-A; Grattan DR

Centre for Neuroendocrinology and Department of Anatomy, Otago School of Biomedical Sciences, University of Otago (HRP, RSEB, DRG); Department of Anatomy, Otago School of Biomedical Sciences, University of Otago (CJR, J-AS), New Zealand

Prolactin receptors (PRLR) on the choroid plexus (ChP) are upregulated in lactation. While previously thought to mediate transport of prolactin from blood into cerebrospinal fluid, our work using PRLR-/- mice has proved that PRLR are not required for prolactin to enter the brain. This raises the question of what is the major function of prolactin in the choroid plexus and is this altered in different physiological states? To gain further understanding we used RNA-seq to identify prolactin-responsive transcripts in the ChP under varying prolactin concentrations. Four groups of adult female mice were included at diestrus, diestrus with prolactin (5 mg/kg/i.p. given 4 hours before sacrifice); lactation (days 7-10, with pups continuously suckling) and lactation (days 7-10) treated with bromocriptine (5 mg/kg/s.c., two doses at 18 and 4 hours before sacrifice, pups remained suckling but prolactin secretion and milk production were suppressed). Total RNA from the ChP was extracted and enriched for mRNA then used as template for cDNA library synthesis. Barcoded libraries in each of the four groups were pooled and run 4-5 times on the Ion Proton sequencing platform. Sequence reads were checked in FastQC v 0.113 and filtered for quality and length with FASTX-toolkit. Remaining sequence reads were mapped with Tophat v2.0.12 and transcripts assembled using Cufflinks. Differential expression analysis was undertaken using Cuff diff and a Protein Analysis Through Evolutionary Relationships (PANTHER) gene ontology slim analysis was performed to gain insight into transcript function. Prolactin promotes upregulation of a higher proportion of transcripts in the ChP as compared to downregulation at lactation. Exogenous prolactin treatment during diestrus, however, favours down regulation of transcripts. No obvious differences in overall gene function were found but analysis is still on-going to identify key differences between the data sets.

Research supported by: Marsden Fund from Government funding administered by the Royal Society of New Zealand

The authors have no conflicts of interest to declare.

Poster 9

CENTRAL PROLACTIN RECEPTOR DISTRIBUTION AND PSTAT5 ACTIVATION PATTERNS IN PARENTING AND NON-PARENTING ZEBRA FINCHES

Smiley KO; Dong L; Ramakrishnan S; Adkins-Regan E

Department of Psychology, Cornell University (KOS, EAR); Department of Biomedical Sciences, Cornell University (LD); Department of Biological Science, University of Wisconsin-Milwaukee (SR); Department of Neurobiology and Behavior, Cornell University (EAR), USA

Parental care is a widespread phenomenon observed in many diverse taxa and is an important component of fitness. The hormone prolactin (PRL) has a well-established role in mediating mammalian maternal behavior through its actions on central prolactin receptors (PRLR). We have recently shown that PRL also plays a causal role in the onset of male and female parental care in zebra finches. However, there is a considerable lack of information on the distribution of PRLRs and PRL signaling patterns in the avian CNS to test the hypothesis that parental care is mediated through central PRLRs in birds. In order to advance the research on the role of central PRL in avian parental care, we developed a novel immunohistochemistry (IHC) protocol to visualize the distribution of central PRLRs in parenting and non-parenting zebra finch brains. Additionally, we developed an IHC protocol to visualize pStat5, a transcription factor that is expressed when the PRLR is activated, which is used as a marker for recent PRLR activity. Here we provide the first detailed description of the central PRLR distribution in a songbird brain and the first evidence that PRLRs are upregulated in several brain regions relevant to parental care and other social behaviors in parenting birds. In addition, we are able to show which areas that express PRLRs are activated by PRL during times of parental care, relative to non-parenting birds. Taken together, this work represents an essential first step to facilitate future research that uses central PRL targets to manipulate parental behavior and/or other physiological or behavioral functions of PRL. Additionally, this work will allow for opportunities to begin integrating this important group into comparative analyses to test whether parental brain networks are conserved across species and whether hormones such as PRL have conserved roles in parental care across taxa.

Research supported by: NSF DDIG ISO-501336 (KOS and EAR); NSF ISO- 1146891 (EAR)

The authors have no conflicts of interest to declare.

Poster 10

COMPARISON OF FOS AND pSTAT5 ACTIVATION PATTERNS IN THE BRAIN OF MOUSE DAMS IN RESPONSE TO SUCKLING

Oláh S; Cservenák M; Keller D; Renner É; Fazekas EA; Lőw P; Dobolyi A

MTA-ELTE Laboratory of Molecular and Systems Neurobiology, Department of Physiology and Neurobiology, Eötvös Loránd University and the Hungarian Academy of Sciences (SO, MC,EAF, AD); Department of Anatomy, Histology and Embryology, Semmelweis University (DK, ER); Department of Anatomy, Cell and Developmental Biology, Eötvös Loránd University (PL), Budapest, Hungary

In the postpartum period, stimuli from the pups are known to play a pivotal role in maintaining behavioral and hormonal adaptations of mothers. These adaptations could be driven by prolactin or by direct neuronal inputs from the pups. In an attempt to separate the actions of these different mechanisms, neurons directly activated by prolactin were visualized by pSTAT5 immunohistochemistry in relation to Fos-expressing neurons in suckled mother mice. We first mapped pSTAT5-ir neurons in the maternal mouse brain 2-h after reuniting the dams with their litter following a 22-h separation. Suckling also induced Fos expression in all brain regions, which contained pSTAT5. Then, double labeling of pSTAT5 and Fos was performed with and without pup-exposure, and the colocalization was quantitatively analyzed in all brain regions containing pSTAT5. Additional mouse dams were treated before reunion with the pups with bromocriptine, a dopamine D2 receptor agonist, in order to block prolactin secretion from the pituitary. The treatment indeed resulted in the disappearance of pSTAT5 staining in lactating mice without the litter. Furthermore, bromocriptine treatment also prevented the appearance of pSTAT5-ir neurons in most brain regions in response to suckling. In contrast, Fos induction following suckling remained largely undisturbed in the same bromocriptine-treated suckled mother mice. The results suggest that most neurons responding to suckling in mothers are driven either by prolactin or direct neuronal input from the pups while some neurons are affected by both types of inputs. In addition, the ratio of neurons directly influenced by both routes varies in different brain regions.

Research supported by: OTKA K116538 and NKFIH-4300-1/2017-NKP_17 Research Grants for AD

The authors have no conflicts of interest to declare.

Poster 11

DISASSOCIATION BETWEEN NEURONAL ACTIVATION AND SATIETY EFFECTS OF MTII DURING PREGNANCY IN THE MOUSE

Ladyman SR; Grattan DR

Centre for Neuroendocrinology and Department of Anatomy, University of Otago, New Zealand

Pregnancy is a metabolically challenging state in which the mother undergoes numerous adaptations to create a state of positive energy balance, including increased food intake and a loss of satiety response to leptin. The melanocortin system, in particular the release of alpha-melanocyte stimulating hormone (MSH) from arcuate nucleus POMC neurons in response to leptin and its subsequent downstream actions, mediates leptin's effects on energy homeostasis. The aim of this study was to determine if impaired action of the melanocortin system underlies changes in leptin sensitivity during pregnancy in the mouse. Virgin and pregnant (day 16) C57BL/6J mice were treated with either MTII, an agonist of the melanocortin 3 and 4 receptors, or vehicle. Mice were either monitored for overnight food intake, acute changes in energy expenditure (as measured by indirect calorimetry) or were perfused 90 minutes after i.p. injection and brains processed for c-fos, a marker of neuronal activation. During pregnancy, MTII-induced c-fos expression was suppressed in the PVN and arcuate nucleus compared to non-pregnant mice. However, in response to an acute injection of MTII both pregnant and virgin mice showed a similar reduction in food intake and a similar biphasic response in energy expenditure, although this effect was slightly attenuated in pregnant mice. Overall, the loss of central response to MTII is consistent with the hypothesis that a loss of melanocortin signaling contributes to the leptin resistance seen during pregnancy. The sustained ability of MTII to suppress food intake in the absence of activating these neuronal pathways, however, suggests additional complexity in the system that requires further investigation.

Research supported by: New Zealand Health Research Council

The authors have no conflicts of interest to declare.

Poster 12

EFFECTS OF OXYTOCIN RECEPTOR KNOCKDOWN IN THE DORSAL RAPHE ON POSTPARTUM SOCIOEMOTIONAL BEHAVIORS

Grieb ZA; Manfredsson FP; Lonstein JS

Neuroscience Program, Michigan State University, East Lansing, Michigan, USA

Oxytocin (OT) is well-known for influencing mammalian maternal caregiving. OT acts in many brain sites to affect postpartum behaviors, but midbrain sites sensitive to OT, such as the dorsal raphe (DR; source of most forebrain serotonergic innervation) are rarely studied. Our lab previously found a ~ 60% increase in oxytocin receptor (OTR) autoradiographic binding and ~ 60% higher OT-immunoreactive fiber density in the postpartum DR compared to diestrus. Additionally, we demonstrated that ~ 40% of serotonergic neurons in the female rat DR express OTR immunoreactivity. These postpartum increases in DR OT measures may be functionally relevant, as manipulating the serotonergic system modifies many postpartum behaviors. Here we hypothesized that elevated OT signaling specifically in the DR influences the display of mothers' socioemotional behaviors. To test this hypothesis, we created an adeno-associated virus (AAV) expressing a short hairpin RNA (shRNA) targeted to OTR mRNA (AAV-OTRKO) or a scrambled shRNA control. We predict that mothers treated with the AAV-OTRKO in the DR during pregnancy will later show impairments in aspects of their caregiving behaviors, increased anxiety-like behavior, and decreased maternal aggression compared to scrambled shRNA treated control dams. Preliminary results using these vectors support our predictions. These results would demonstrate that OTR signaling in the DR is necessary for the display of numerous postpartum behaviors in laboratory rats and that OTR-5HT interactions are an understudied mechanism underlying successful motherhood.

Research supported by: RO1HD057962 to J.S. Lonstein

The authors have no conflicts of interest to declare.

Poster 13

CRF-R1 ACTIVATION IN THE MPOA IMPAIRS MATERNAL BEHAVIOR AND TRIGGERS OXYTOCIN RELEASE IN RAT MOTHERS

Klampfl SM; Schramm MM; Gaßner BM; Hübner K; Brunton PJ; Bayerl DS; Bosch OJ

Department of Behavioural and Molecular Neurobiology, University of Regensburg, Regensburg, Germany (KSM; SMM; GBM; HK; BDS; BOJ); Centre for Discovery Brain Sciences, University of Edinburgh, Edinburgh, United Kingdom (PJB)

The brain corticotropin-releasing factor (CRF) system is a potent modulator of maternal behavior and maternal anxiety. Thus, their appropriate appearance postpartum strongly depends on dampened CRF receptor (CRF-R) activity as recently shown for limbic brain regions. Here, we studied the arguably most important brain region for maternal behavior, i.e., the medial preoptic area (MPOA). While expression of CRF receptor subtype 1 mRNA (Crfr1) in the MPOA was higher than for Crfr2, there were no differences between virgin and lactating rats. Subtype-specific activation of CRF-R1 or CRF-R2 in the MPOA decreased arched back nursing and total nursing under non-stress conditions. Following acute stressor exposure, inhibition of CRF-R1, but not CRF-R2, rescued a stress-induced reduction in arched back nursing. Furthermore, inhibition of CRF-R1 heightened maternal aggression towards a virgin female intruder. Surprisingly, maternal motivation, a key maternal behavior regulated within the MPOA, was not affected by any treatment. Interestingly, maternal anxiety on the elevated plus-maze was increased by CRF-R1 activation. Further experiments using local intracerebral microdialysis revealed that activation of CRF-R1, by central as well as by local infusion of CRF in the MPOA, increased local oxytocin release. In conclusion, intra-MPOA CRF-R signaling, particularly of subtype 1, impaired behavioral and emotional postpartum adaptations and, therefore, needs to be dampened during lactation. Furthermore, to counteract the negative impact of CRF-R activation on maternal behavior, oxytocin release in response to CRF-R1 activation may provide a regulatory mechanism.

Research supported by: Deutsche Forschungsgemeinschaft DFG (BO 1958/8-1 to OJB) and the BBSRC (BB/J004332/1 to PJB)

The authors have no conflicts of interest to declare.

Poster 14

HYPOCRETIN AND MATERNAL BEHAVIOR ON MEASURES OF ANXIETY

Lee GH; Kuske J; D'Anna-Hernandez K

Department of Psychology, California State University San Marcos, USA

Anxiety is associated with heightened arousal impairing daily-life functioning and maternal behavior. Although we are unclear of its underlying neuromechanisms, the hypothalamic neuropeptide hypocretin (HCRT) has been implicated in both anxiety and maternal behavior. During the perinatal period, several changes occur in the mother's body including increased arousal and wakefulness linked with lactation. Past literature has shown that HCRT modulates arousal and influences maternal behavior (e.g., nursing and nesting behavior in lactating dams). In the present study, fifteen lactating dams were injected with HCRTR1-antagonist (SB-334867; n=8) or saline (n=7), tested on the elevated zero maze (EZM) for five minutes, and scored on time and latency to head poke and enter open/closed arms. Time spent in open and closed arms in the EZM were not significant, whereas latency to head poke into the open was significant $t(13) = 2.28$, $p = .04$. Dams injected with the HCRT-antagonist had a shorter latency to head poke into the open arms than those injected with saline. This suggests that blocking HCRT decreases arousal and anxiety-like behavior as the dams appeared less fearful to begin exploring the exposed areas. As dams had spent limited time on the open arms, a follow-up study was conducted using pups (on postnatal days 3-4) as a potential motivator on the EZM and another measure of anxiety, the light/dark box (LBD). Transparent boxes were attached on the apparatuses to secure pups and placed in the exposed areas. About 18% and 64% of dams retrieved pups on the EZM and LDB, respectively. Altering anxiety-like tests to include pup retrieval may be more ecologically relevant measures of maternal anxiety. Given that HCRT has been linked to reward and motivation and pups are highly rewarding, HCRT may alter anxiety-like behavior and/or pup retrieval on these modified measures.

Research supported by: CSUPERB GRANT to KDH

The authors have no conflicts of interest to declare.

Poster 15

HORMONAL PROFILE AND MATERNAL EXPERIENCE SHAPE THE MATERNAL EXPRESSION OF FEMALE RATS RAISING OVERLAPPING LITTERS

Ferreño M; Uriarte N

Laboratorio de Neurociencias, Facultad de Ciencias, Universidad de la República, Uruguay

Mothers with overlapping litters (OLM) –resulting from mating during the postpartum estrus (PPE)- take care of newborn and juvenile pups at the same time, however they direct more maternal responses towards newborns. Previous studies suggest that the differential display of maternal behavior towards newborns and juveniles does not only depend on the developmental characteristics of the pups, but also on female's internal factors. Therefore, the objective of this study was to dissect the influence of female's endocrine profile and previous maternal experience on this behavioral adaptation. With this aim we compared the maternal behavior and the relative incentive value of juvenile and newborn pups in a preference test of mothers with overlapping litters (OLM control; n = 10), mothers with sham-overlapping litters with their own juveniles and foster newborns, without going through a new pregnancy and parturition (mating in PPE with a sterile male, OLM Gest- n = 8) and mothers with overlapping litters without previous maternal experience (first litter removed during the PPE, OLM Exp-; n = 10). We found that OLM Exp- and OLM Gest- significantly reduced the maternal behavior directed towards newborn compared to OLM control rats. Accordingly, in the preference test performed following the maternal behavior test, OL control preferred newborns over juveniles, while OLM Exp- did not preferred between both type of pups and OLM Gest- did not preferred the two reinforcing stimuli over the neutral chamber. These results indicate that both endocrine and experience factors are necessary for the behavioral adaptation of mothers raising overlapping litters, however, hormonal exposure associated with second gestation and parturition appears to be essential for an adequate expression of maternal behavior and motivation.

Research supported by: ANII FCE2014_1_104678

The authors have no conflicts of interest to declare.

Poster 16

RAISING OVERLAPPING LITTERS: AN APPROACH TOWARDS UNDERSTANDING MATERNAL FLEXIBILITY AND ITS NEURAL CIRCUITRY

Pose S; Zuluaga MJ; Uriarte N

Laboratorio de Neurociencias, Facultad de Ciencias, Universidad de la República (SP, NU); Sección Fisiología y Nutrición; Facultad de Ciencias, Universidad de la República (MJZ), Uruguay

Maternal behavior (MB) in the rat changes across the postpartum period in response to the needs of its developing pups. This behavioral flexibility involves the active participation of neural substrates, which are modulated by pups' stimuli and the endocrine status of the mother. As a result of mating at the postpartum estrus, mother rats take care of two successive overlapping litters (OL) in different developmental stages. The objective of this study was to explore how the maternal behavior and its neural circuitry adapt to raising overlapping litters. To this aim we evaluated: 1) the relative incentive value of neonates versus juveniles in a Y-shaped preference maze assigned by OL mothers; 2) their MB towards neonates or juveniles during a 15-min maternal test and; 3) the c-FOS expression in the medial preoptic area (MPOA) and medial prefrontal cortex (mPFC) of OL mothers after the MB test. We found that in the preference maze OL mothers spent a similar amount of time near the newborn compared to the juvenile pups, but made more effort to obtain the newborns. When tested only with newborns, OL mothers displayed high levels of MB, whereas when tested only with juveniles the opposite was observed. Despite these differences in behavior, we found a similar c-Fos expression in MPOA, and infralimbic and cingulate portions of the mPFC between OL mother tested with newborns or juveniles. Meanwhile, in the prelimbic portion of the mPFC a higher expression was observed in OL mothers tested with juveniles. These results suggest that during the overlapping of litters, the juveniles have similar incentive value than newborns for the mothers, and therefore the low levels of maternal care displayed towards the juveniles seem to be the result of maternal adjustment to take care of these “less demanding” pups, perhaps mediated by the prelimbic cortex.

Research supported by: ANII - FCE

The authors have no conflicts of interest to declare.

Poster 17

MATERNAL HIGH FAT CONSUMPTION DECREASES MILK EJECTIONS IN LACTATING RATS

Klein MO; Kiss ACI; Bittencourt JC; Felicio LF

Department of Pathology, School of Veterinary Medicine, University of São Paulo (MOK, LFF), Department of Anatomy, Biomedical Science Institute, University of São Paulo (MOK, JCB); Department of Physiology, Botucatu Biosciences Institute, São Paulo State University (ACIK), Brazil

In Western diets, ~40% of its content is made of fat, when ~10% is recommended. This unbalanced intake is especially relevant during pregnancy and lactation, since it may impair mothers' behaviors, also affecting offspring development. This study aimed to evaluate maternal high-fat diet impact on maternal behavior in F0 and F1 generations. Pregnant Wistar rats were assigned either to: high-fat group (HF, 45% of fat from day 0 of pregnancy to weaning) or control group (C, standard chow, same period). After weaning, female offspring were subdivided: half of the litter was kept on the same diet as the mother (CC: standard diet throughout life; HFHF, HF diet throughout life); the other half changed diet type (CHF: standard diet before weaning, HF afterwards; HFC: HF before weaning, control diet post-weaning) resulting in 4 groups for F1 generation. These females were mated at post-natal day 90. Maternal behavior was recorded in lactation day (LD) 5 and 10 for 6 consecutive hours for both generations. Latency to first milk ejection, number of milk ejections and ejection intervals were assessed. F0 HF dams spent more time building the nest and less time crouching than control. There were less milk ejections in HF dams and they presented bigger ejections intervals. Regarding to F1 dams, latency to first milk ejection was bigger in HFHF group in relation to CC in LD5, and compared to all other groups in LD10. All groups that consumed HF diet in any period of their life (i.e. CHF, HFC and HFHF) had less milk ejections than CC. Ejections intervals in HFHF and CHF were bigger than in CC group. Therefore, maternal high-fat intake impairs milk ejection during lactation. Also, the period of high-fat intake in life seems to be important to determine the extension of negative impacts on maternal behavior.

Research supported by: FAPESP (2012/07378-6; 2017/17998-5)

The authors have no conflicts of interest to declare.

Poster 18

EFFECTS OF MATERNAL DIABETES AND SNACK CONSUMPTION ON OFFSPRING BIRTH WEIGHT AND MATERNAL CARE

Martins MG; Cruz AG; Oliveira GP; Horta-Júnior JAC; Kiss ACI

São Paulo State University, Institute of Biosciences, Department of Physiology, Botucatu (MGM, AGC, GPO, ACIK); São Paulo State University, Institute of Biosciences, Department of Anatomy, Botucatu (JACHJ), Brazil

Several studies have demonstrated the effects of maternal diabetes and inappropriate nutrition on a number of maternal and offspring parameters but effects of their combination have not yet been explored. Therefore, the aim of the present study was to evaluate the impact of diabetes and snack consumption during pregnancy and lactation on maternal care and offspring birth weight. In order to do so, control and mild hyperglycemic female Wistar rats (which received streptozotocin (STZ) on the first day of life) were mated and randomly assigned to one of four experimental groups: Control (n=10), STZ (n=10), Control-snack (n=10), and STZ-snack (n=10). Potato chips and 1,5% sucrose solution were offered ad libitum from pregnancy day (PD) 0 to lactation day (LD) 14 to Control-snack and STZ-snack dams. On PD15, dams underwent an oral glucose tolerance test (OGTT). Around PD21, dams delivered naturally and their newborn pups were weighed and classified according to their birth weight as small (SPA), large (LPA), or appropriate for pregnancy age (APA). Maternal behavior was evaluated on LD6 for 30 min. OGTT results showed STZ and STZ-snack dams were intolerant to glucose. STZ-snack dams tended to give birth to smaller litters in relation to Control group. At birth, Control-snack pups weighed less than Control and STZ ones. There were more pups classified as small on mothers that received snacks (Control and STZ) when compared to Control ones. All groups presented a reduced number of appropriate pups compared to Control. Regarding maternal behavior, there were no significant differences between groups, only a trend of Control-snack dams to spend more time without interacting with their pups than STZ dams. Our results show that metabolic impairment caused by diabetes was aggravated by inappropriate nutrition which compromised offspring birth weight with no significant effects on maternal care.

Research supported by: CNPq 141700/2017-3

The authors have no conflicts of interest to declare.

Poster 19

MOTHERHOOD AND OLFACTORY NEUROGENESIS

Corona R ; Meurisse M, Cornilleau F; Moussu C; Keller M; Lévy F

INRA, UMR 85 Physiologie de la Reproduction et des Comportements, 37380 Nouzilly; CNRS, UMR 7247; Université François Rabelais, IFCE, France

Profound behavioral changes occur in the mother at parturition, a time when the maternal brain undergoes extensive remodeling of neural circuits. Adult neurogenesis, a form of brain plasticity, could constitute an adaptive response to motherhood. New neurons are continuously added in the olfactory bulb and the aim of our research is to characterize the importance of olfactory neurogenesis in the establishment of maternal behavior. In sheep, odor cues emitted by newborns are essential to establish maternal behavior at parturition and to provide a basis for individual recognition of the offspring. We characterized the activation of adult-generated olfactory neurons in mothers exposed for 2 hours to either their own lamb, an unfamiliar lamb or a familiar adult sheep, after having 2 days of contact with their lamb. Bromodeoxyuridine, a marker of cell division, was injected 3 months before parturition and revealed through immunocytochemistry in combination with markers of activation or neuronal maturation. Results show that the 3-month-old neuroblasts, are preferentially activated by lamb exposure and not by adult exposure and that the preferential activation is specific to olfactory neurogenesis but not hippocampal neurogenesis. We also hypothesized that chemical disruption of olfactory neurogenesis impair the establishment of maternal behavior. At one month of gestation, ewes received either infusion of the antimitotic drug Ara-C or saline into the lateral ventricles for one-month. Ara-C infusion dramatically decreased olfactory neurogenesis, but spared hippocampal neurogenesis. Mothers exhibiting more than a 70% reduction in olfactory neurogenesis emitted fewer maternal bleats and they were not able to discriminate their own lamb from an alien lamb. These results indicate that adult-born olfactory neurons are to some extent involved in the establishment of maternal behavior by contributing to the processing of offspring odors and reveal the extreme plasticity of the maternal brain.
Acknowledgements to N. Laval, T. Delpuech, UEPAO, platform PIC INRA

Research supported by: Agence Nationale de Recherches (ANR), Programme Blanc.

The authors have no conflicts of interest to declare.

Poster 20

THE SHORT- AND LONG-TERM IMPACT OF MOTHERHOOD ON HIPPOCAMPAL GENE EXPRESSION AND INFLAMMATION

Duarte-Guterman P; Lieblich SE; Mahmoud R; Ibrahim M; Galea LAM

Djavad Mowafaghian Centre for Brain Health and Department of Psychology, University of British Columbia, Vancouver, BC, Canada

Women are more likely to be diagnosed with Alzheimer's disease (AD) and show greater AD neuropathology and cognitive decline than men. Pregnancy and motherhood (parity) play an important role in the aging brain and increased parity is associated with a greater risk of dementia, AD neuropathology, and an earlier age of AD onset. Work from our laboratory suggests that past reproductive experience influences hippocampal neuroplasticity, cognition, and inflammation into middle-age in rats. The goals of this study were to determine how previous parity interacts with aging to influence levels of neuroinflammation in female rats and to explore unknown mechanisms of parity on the brain through RNA sequencing. Female rats were bred once (primiparous), twice (biparous), or not at all (nulliparous) in our animal facility. Maternal behaviours were observed on PND 2, 4, and 6. Tissues were collected 30 days (6-7 months old; adults) and 8 months postpartum (13 months old; middle-aged). Maternal behaviours (i.e. time spent licking, nursing, and off nest) were not different between primiparous and biparous females (including first and second litter). However, biparous females spent significantly less time licking their second litter relative to their first litter. In the younger group, adrenal mass was significantly larger in biparous females relative to nulliparous and primiparous groups but this effect disappeared at middle age. During aging, adrenal mass increased in nulliparous females but not in the mothers. In the short-term, our results suggest that biparity resulted in hyperactivity of the HPA axis that returned to normal in middle age. We are currently analysing brain samples for changes in the transcriptome and inflammatory markers (cytokines). These data will aid in elucidating how reproductive experience influences brain aging.

Research supported by: Canadian Institutes of Health Research to LAMG and the Alzheimer’s Association and Brain Canada to PDG

The authors have no conflicts of interest to declare.

Poster 21

FLUOXETINE INCREASED IL-1BETA IN THE MATERNAL HIPPOCAMPUS AND REVERSED MATERNAL CARE DEFICITS WITH POSTPARTUM CORTICOSTERONE TREATMENT BUT NOT DEPRESSIVE-LIKE BEHAVIOUR

Qiu W; Go K; Mahmoud R; Gobinath AG; Black N; Duarte-Guterman P; Galea LAM

Graduate Program of Neuroscience, Department of Medicine, University of British Columbia (WQ, RM); Department of Psychology, University of British Columbia (KG, ARG, NB, PDG, LAMG); Centre for Brain Health, University of British Columbia (LAMG), Canada

Postpartum depression can affect up to 10-15% of women. Fluoxetine (FLX) is a common antidepressant prescribed to treat postpartum depression. For patients with major depression, there have been reports indicating an increase of the pro-inflammatory cytokines interleukin-6 (IL-6) and tumour necrosis factor-alpha (TNF-a) when compared to healthy controls. Here, we use a rodent model of postpartum depression to determine the effects of maternal stress hormone exposure and depression-like behaviour on cytokine levels within the maternal brain. While there are some reports to indicate a decrease of in pro-inflammatory cytokines when patients are prescribed antidepressants, the effects of FLX on the postpartum maternal brain are unexplored. We hypothesize that with maternal corticosterone (CORT) and maternal FLX exposure, treated dams will have a more inflammatory cytokine profile than non-treated control dams. Dams will be given CORT (40mg/kg) to simulate postpartum depression and FLX (10mg/kg) for 21 days. Dams will then be tested for depressive-like behaviour using the Forced-swim test (FST) and sacrificed for dissection of various brains regions for further analysis. Preliminary data indicate an increase in depressive-like behaviour when dams are treated with CORT. FLX co-treatment was not able to decrease the depressive-like behaviour as measured by FST. Maternal care behaviours were also measured during the first postnatal week. Dams treated with CORT showed a decrease in nursing behaviour; FLX was able to rescue the lost nursing behaviour in dams. Preliminary cytokine data showed a decrease in IL-6 and TNF-a within the hippocampus in CORT-treated dams. FLX treatment increased the levels of interleukin-1beta (IL-1b) within the dam hippocampus. Further analyses will look at the cytokine profile within the prefrontal cortex of the dams to determine any possible effects by brain region.

Research supported by: Funding from CIHR to LAMG (MOP-142308)

The authors have no conflicts of interest to declare.

Poster 22

EARLY AND LATE EFFECTS OF MOTHERHOOD ON HIPPOCAMPAL NEUROGENESIS, MICROGLIA, AND THE CYTOKINE MILIEU

Mahmoud R; Chaiton JA; Lieblich SE; Galea LAM

Graduate Program in Neuroscience, University of British Columbia (RM); Department of Psychology, University of British Columbia (JAC, SEL); Department of Psychology and Djavad Mowafaghian Centre for Brain Health, University of British Columbia (LAMG), Canada

Motherhood is accompanied by a host of physiological and behavioural adaptations. The maternal brain displays considerable plasticity, and motherhood is associated with changes in affective and cognitive function. Emerging evidence also indicates that motherhood can alter the trajectory of brain ageing, including modifications to neuroplasticity and cognition. Here, we investigated the short- and long-term effects of motherhood on hippocampal neurogenesis, microglial morphology, and circulating cytokine levels; domains known to be altered with age and implicated in cognition and mood. Female Sprague-Dawley rats were bred, then euthanized at gestation day 13 (GD13), or postpartum day (PPD) 8, 30, 90, or 180. Nulliparous rats were assigned as age-matched controls to each primiparous condition. We report that hippocampal neurogenesis, assessed via the expression of the immature neuronal marker doublecortin, was significantly suppressed during gestation and the entire postpartum period. Interestingly, while neurogenesis declined significantly in middle-aged nulliparous rats, it increased in primiparous rats across the same period of time. Further, transient postpartum adaptations to the neuroimmune environment of the hippocampus were evidenced, as Iba-1-immunoreactive microglia assumed a de-ramified morphology. Intriguingly, ageing-related changes in cytokine levels were dependent on parity, suggesting that motherhood can modify certain aspects of immunosenescence. Collectively, these data indicate that maternal experience has early and late effects on hippocampal neurogenesis, microglia, and the peripheral cytokine profile. The reported adaptations in neurogenic and immune processes may have ramifications for maternal mood and cognition across the peripartum period and beyond.

Research supported by: Canadian Institute of Health Research (CIHR) grant to LAMG

The authors have no conflicts of interest to declare.

Poster 23

LACTATION AND STRESS ALTER DEPRESSION-LIKE BEHAVIOR AND HIPPOCAMPAL NEUROGENESIS IN POSTPARTUM RATS

Workman JL; De Guzman RM; Medina J; Saulsbery AI; Unger K; Ceballos E

Department of Psychology, University at Albany, State University of New York, USA

Women who do not breastfeed or discontinue breastfeeding early have a higher risk of developing postpartum depression (PPD) compared with women who breastfeed exclusively. Further, stress is a major risk factor for depression. Thus, we sought to determine whether different lactational experiences would alter the susceptibility to stress-induced changes in depression-like behavior and hippocampal neurogenesis. Adult female Sprague-Dawley rats underwent thelectomy (thel; surgical removal of teats), sham surgery, or no surgery (control). Thel and sham rats were yoked and litters were rotated every 12 h postpartum days (PD) 0-26 (thus yielding a higher nursing demand for sham rats). Control litters were rotated between paired control rats. Rats received chronic variable stressors or no stressors PD 2-25. Stressors were presented in a semi-random order without separating dams from litters. Control rats spent less time with offspring compared with sham and thel rats, regardless of stress. Stressed rats spent more time with offspring compared with non-stressed rats, regardless of nursing condition. Nursing and stress interacted to alter immobility in the forced swim test: among non-stressed rats, thel rats spent more time immobile than sham rats. Stress increased immobility in control and sham rats, but unexpectedly, reduced immobility in thel rats. Preliminary data also suggest that lactational experience interacts with stress to alter hippocampal neurogenesis. These data suggest that nursing does not necessarily yield resistance to stress-induced changes in depression-like behavior or neurogenesis. Thus, the relationship between the absence of breastfeeding and PPD could be independent of stress susceptibility in non-breastfeeding women.

Research supported by: in part by a NARSAD Young Investigator Award and startup funds from the University at Albany

The authors have no conflicts of interest to declare.

Poster 24

SERTRALINE (ZOLOFT®), SEROTONIN, AND HIPPOCAMPAL PLASTICITY IN THE PREGNANT FEMALE

Pawluski JL; Even A; Mandhui I; Dechartres J; Cobraiville G; Fillet M; Kokras N; Dalla C; Charlier TD

Univ Rennes 1, Inserm, EHESP, Irset (Institut de Recherche en Santé, Environnement et Travail), Rennes, France; Laboratory for the Analysis of Medicines (LAM), Department of Pharmaceutical Sciences, CIRM, University of Liège, Liège, Belgium; Department of Pharmacology, Medical School, National and Kapodistrian University of Athens, Athens, Greece.

Up to 20% of pregnant women have clinical levels of anxiety or depression. Given the pervasive effects of maternal mental illnesses on the mother, child and family, treatment is needed. The most common treatments for maternal affective disorders during pregnancy are the selective serotonin reuptake inhibitor medications (SSRIs), of which sertraline is one of the most commonly prescribed. SSRIs can help alleviate perinatal mood disorders in many women, however, it is not known how SSRIs affect the neurobiology of the brain during pregnancy. Therefore the aim of this study was to determine how sertraline affects plasticity in the hippocampus of the female during late pregnancy and whether these effects differ from the effects of sertraline in virgin females. To do this pregnant and age-matched virgin female Sprague-Dawley rats were used. For the last half of pregnancy, and at matched points in virgin females, females were orally given sertraline in one of three doses (0mg/kg/day, 2.5mg/kg/day, 10mg/kg/day). Brains were extracted and used for further analysis related to the serotonergic system in the hippocampus and PFC, and neuroplasticity in the hippocampus. Results show that late pregnant females have significantly higher serum levels of sertraline and its active metabolite, norsertraline compared to virgin females at each dose. In the hippocampus significant dose-dependent effects were evident in the 5HIAA:5HT ratio with the lowest ratio being evident with the highest dose of sertraline. Synaptophysin density in the dorsal hippocampus, as a marker of pre-synaptic plasticity, revealed a dose and reproductive state effect in both the CA3 and dentate gyrus. Further work will determine how sertraline affects neurogenesis in the dentate gyrus of the hippocampus. Understanding how SSRIs alter the neurobiology of the maternal brain will aid in effectively treating maternal mood disorders.

Research supported by: Brain & Behavior Research Foundation (JLP); SAD Region Bretagne (JLP, TDC)

The authors have no conflicts of interest to declare.

Poster 25

RNASEQ REVEALS TRANSCRIPTOME CHANGES IN MPOA OF WISTAR-KYOTO RAT MODEL OF POSTPARTUM DEPRESSION

Winokur SB; Pereira M

Department of Psychological and Brain Sciences, University of Massachusetts, Amherst, USA

Postpartum depression (PPD) is a severe mental illness that affects millions of mothers and their babies worldwide. However, the molecular mechanisms of postpartum depression are currently unclear. The present study used the Wistar-Kyoto (WKY) genetic rat model of depression, which demonstrates cognitive, motivational, and parenting dysfunctions that are representative of PPD symptomatology, for identification of altered molecular mechanisms involved in the disease phenotype. Following behavioral phenotyping of WKY and control Sprague-Dawley (SD) mother rats, RNAseq transcriptomic analysis was used to identify differentially expressed genes (DEGs) in the medial preoptic area (mPOA), a region that plays a major role in orchestrating cognitive and motivational aspects of parenting. RNAseq revealed 584 DEGs in the postpartum mPOA that had at least a 2-fold-change in expression between WKY and SD mothers, including oxytocin; mitogen-activated protein kinase; the monoamine signaling genes vesicular monoamine transporter 2 (Vmat2) and tyrosine hydroxylase (Th); and the immediate early genes Fos, FosB, and Egr1. Gene Ontology (GO) and enrichment analyses on DEGs identified signaling pathways associated with cellular metabolic and biological processes, including chromatin organization, synaptic plasticity, and response to stress and hormones. An additional ongoing study is examining the impact of gestational stress (a known risk factor for postpartum depression) on depressive phenotype severity and mPOA transcriptional profile of WKY and SD mothers. Together, these results provide additional insight into the pathophysiology of depression and its impact on parenting.

Research supported by: NARSAD Young Investigator Grant from the Brain & Behavior Research Foundation and a NICHD grant HD073710 awarded to MP

The authors have no conflicts of interest to declare.

Poster 26

THE DISPLAY OF MATERNAL CARE ACTIVATES THE EXPRESSION OF FOS, BUT NOT DOPAMINE, IN THE VENTRAL TEGMENTAL AREA

Caba M, Melo A; Fleming A; Meza E

Centro de Investigaciones Biomédicas, Universidad Veracruzana; CIRA,CINVESTAV-U. Autonoma de Tlaxcala; University of Toronto-Mississauga, Canada.

Classical experiments demonstrated that the ventral tegmental area (VTA), together with the preoptic area (POA), is part of a neural circuit essential for the expression of maternal behavior in the rat. Dopaminergic cells in VTA project via the medial forebrain bundle to several forebrain regions, but their projections to the nucleus accumbens and medial prefrontal cortex are key elements of a network known as the mesolimbic system, involved in maternal behavior. However, in spite of the above evidence, the execution of maternal behavior in lactating rats by pup exposure apparently does not activate VTA cells when using FOS protein as an index of cell activation. In sharp contrast recent works indicates that in other species like rabbits or mice, such pup-induced VTA activation does occur. In order to re-evaluate this apparent discrepancy in the present experiment we explored FOS and double-labelled FOS/Dopamine expression in the VTA of rat mothers that did and did not interact with their pups and of control virgin females. On postpartum day 6 pups were removed from the nest in the evening and were either returned to the mother 12 h later or were not returned to the mothers. After either 90 min of interaction with pups, or no interaction, mothers were sacrificed. Strong FOS induction was observed only in the VTA of mothers that interacted with their pups. However, surprisingly double-labelled FOS/Dopamine cells were found in all groups and there were no differences as a function of whether mothers interacted or not with their pups. We conclude that in the rat, similar to other species, the VTA is also activated by pup interaction. Additional experiments are being designed to further explore the dopaminergic mechanism involved in VTA activation, within the maternal context.

Research supported by: Universidad Veracruzana

The authors have no conflicts of interest to declare.

Poster 27

DOPAMINERGIC ACTIVATION AND CIRCADIAN NURSING IN THE RABBIT

Caba M; Meza E

Universidad Veracruzana, Centro de Investigaciones Biomédicas, Mexico.

Maternal behavior is a motivated behavior and in the rabbit it is restricted to the spontaneous return of the mother to nurse her pups for just a few minutes once a day. Previously we have reported neural activation of brain areas and neuroendocrine cells after nursing. However, this daily spontaneous return suggests that the mother is in a high motivational state to visit the nest and nurse her pups. In the present experiment we hypothesized that during anticipation of nursing there is an activation of dopaminergic neurons (A10 cell group) of the mesolimbic system and in their projected areas. To this aim we explored, by the expression of FOS protein, possible activation of the ventral segmental area, nucleus accumbens and medial prefrontal area as well as dopaminergic cells of the A10 cell group before and after nursing and in control does. We also explored the preoptic area and lateral septum, which are important areas for the control of maternal behavior. We found a significant increase of FOS before nursing, and a further increase after nursing, in the mesolimbic system and dopaminergic cells as well as in the preoptic area and lateral septum. Interestingly, the medial prefrontal area shows an intense activation at the time of anticipation of nursing. Additionally a PER1 protein (product of the Per1 clock gene) rhythm that shifts by time of nursing was found in the preoptic area. We conclude that the intense activation of the mesolimbic system before nursing is related to the high locomotor behavior prior to the next nursing bout. These results support the proposal that the mother is in a high motivational state at the time of returning to the nest and that suckling by pups seems to be important for synchronization of a possible “maternal entrainable circuit” in the rabbit.

Research supported by: Universidad Veracruzana

The authors have no conflicts of interest to declare.

Poster 28

EFFECTS OF PREGNANCY STRESS ON MATERNAL CAREGIVING, ANXIETY, AND MIDBRAIN RAPHE SEROTONIN 2C RECEPTORS

Vitale EM; Lonstein JS

Department of Psychology, Michigan State University (EV; JS); Neuroscience Program, Michigan State University (JS), East Lansing, Michigan, USA

Mammalian mothers show a unique suite of behavioral responses beginning around the time of parturition, including increased offspring caregiving, high maternal aggression, and low anxiety. The neurotransmitter, serotonin (5-HT), is known to influence many socioemotional behaviors, and much of it is synthesized by cells in the midbrain dorsal raphe nucleus (DR). Our lab has shown that the serotonergic DR undergoes structural and neurochemical changes during the peripartum period, and some recent findings also revealed a decrease in serotonin 2C receptor (5-HT2C) mRNA in the DR at parturition and early lactation. This is interesting because others have found that activation of 5-HT2C during early lactation disrupts maternal behaviors, and that central 5-HT2C receptors modulate the behavioral effects of chronic stress. The aim of the current study is to determine whether the normal expression of 5-HT2C in the DR across female reproduction is altered by pregnancy stress. Repeated variable stress is being used during pregnancy, and caregiving, anxiety-like, and depression-like behaviors are observed after parturition. RT-qPCR is being used to analyze 5-HT2C in the DR of stressed and unstressed dams. We predict that pregnancy stress will prevent or even reverse the normal peripartum reduction in DR 5-HT2C mRNA expression, which will be associated with a reduction in caregiving, and increased anxiety. This work could reveal that disruptions in the normative expression of serotonin receptors in the DR across reproduction may contribute to the stress-induced maladaptations in maternal caregiving and socioemotional responses that are often displayed during postpartum depression and anxiety in non-human animals and humans.

Research supported by: RO1HD057962 to JS Lonstein

The authors have no conflicts of interest to declare.

Poster 29

RAT MATERNAL BEHAVIOR IS IMPAIRED BY STIMULATION OF 5-HT1A RECEPTORS

Li M; Li X; Wu R; Gao J; Chen L

Department of Psychology, University of Nebraska-Lincoln, Lincoln, Nebraska, USA

Previous work suggests that 5-HT1A receptors play a special role in rodent maternal aggression, but not in other aspects of maternal care (e.g. pup retrieval and nest building). The present study re-assessed the basic effects of 5-HT1A activation or blockade on various maternal responses in postpartum female rats. We also examined the possible behavioral mechanisms underlying the maternal effects of 5-HT1A. Sprague–Dawley mother rats were injected with a 5-HT1A agonist 8-OH-DPAT (0.1, 0.5 or 1.0 mg/kg, sc), a 5-HT1A antagonist WAY-101405 (0.1, 0.5 or 1.0 mg/kg, sc) or 0.9% saline solution on postpartum days 3, 5, and 7. Maternal behavior was tested 30 min before, 30 min, 120 min, and 240 min after the injection. Acute and repeated 8-OH-DPAT treatment significantly disrupted pup retrieval, pup licking, nursing, and nest building in a dose-dependent fashion, whereas WAY-101405 had no effect at the tested doses. The 5-HT1A receptor specificity of 8-OH-DPAT's action was confirmed as its maternal disruption effect was reversed by pretreatment of WAY-100635 (a highly selective 5-HT1A receptor antagonist). Subsequent pup preference test found that 8-OH-DPAT did not decrease the pup preference over a novel object, thus no inhibition on maternal motivation or maternal affect. The pup separation test and pup retrieval on an elevated plus maze test also failed to find any motivational and motor impairment effect with 8-OH-DPAT. However, 8-OH-DPAT at the maternal disruptive dose did disrupt the prepulse inhibition (a measure of attentional function) of acoustic startle response and enhanced the basal startle response. These findings suggest that stimulation of 5-HT1A receptors by 8-OH-DPAT impairs maternal care by partially interfering with the attentional processing or basal anxiety. More work is needed to further delineate the psychological and neuronal mechanisms underlying the maternal disruptive effect of 5-HT1A receptor activation.

Research supported by: R01MH097718 to M Li

The author has no conflicts of interest to declare.

Poster 30

STRESS RESPONSES AND ORGAN REMODELING IN SINGLE CALIFORNIA MOUSE MOTHERS

Zhao M; Harris BN; Saltzman W

Department of Evolution, Ecology, and Organismal Biology, University of California, Riverside (MZ, WS); Department of Biological Sciences, Texas Tech University (BNH), USA

Being a mother is energetically costly for mammals and is associated with pronounced changes in mothers' physiology, morphology and behavior. In ~5% of mammals, fathers assist their mates with rearing offspring and can enhance pup survival and development. Although these beneficial consequences of paternal care can be mediated by direct effects on offspring, they might also be mediated indirectly, through beneficial effects on mothers. We tested the hypothesis that fathers in the monogamous, biparental California mouse (*Peromyscus californicus*) reduce the burden of parental care in their mates, and therefore that females rearing offspring with and without assistance from their mates will show differences in endocrinology, morphology and behavior, as well as in survival and development of pups. We found that pups' survival and development did not differ between those raised by a single mother and those reared by both mother and father in the lab. Both single and paired mothers had higher lean mass and showed more anxiety-like behavior in open-field tests and tail-suspension tests compared to nonbreeding females. Single mothers had higher body-mass-corrected liver and heart mass, but lower ovary and uterus mass, than both paired mothers and nonbreeding females. These findings suggest that some costs of being single can be overcome by morphological changes in mothers, thereby allowing pup survival and development to be maintained as normal. Ongoing analyses are expected to reveal additional effects of mate absence on mothers' daily corticosterone rhythms and endocrine responses to stress.

Research supported by: NSF IOS 1256572

The authors have no conflicts of interest to declare.

Poster 31

DESERTED PRAIRIE VOLE MOTHERS SHOW NORMAL MATERNAL CARE BUT INCREASED EMOTIONALITY – IMPACT OF THE BRAIN CRF SYSTEM

Bosch OJ; Pohl TT; Neumann IN; Young LJ

Department of Behavioural and Molecular Neurobiology, University of Regensburg, Regensburg, Germany (OJB; TTP; IDN); Center for Translational Social Neuroscience, Department of Psychiatry, Yerkes National Primate Research Center, Emory University, Atlanta, USA (LJY)

When the father leaves the family, the prevalence of depression and anxiety disorders in mothers increases perhaps due to increased childcare responsibilities and reduced social support. Previous work in the biparental, socially monogamous prairie voles showed that separation of the bonded partner causes increased passive stress-coping, indicative of depressive-like behavior, and chronic stress in both females and males. However, the consequences of separation in lactating prairie voles are unknown. Here, after 18 days of cohousing, half of the prairie vole pairs were separated by removing the male. Following parturition, there were no group differences in maternal care. However, anxiety-related behavior as well as passive stress-coping behavior were significantly elevated in separated mothers. Furthermore, CRF mRNA expression in the PVN was increased after separation under basal conditions. In a second cohort of animals, females were acutely infused with vehicle or the nonspecific CRF receptor antagonist D-Phe 10 min prior to behavioral testing. The brief restraining during acute treatment infusion significantly decreased arched back nursing in both paired and separated vehicle-treated groups, whereas in the separated D-Phe-treated group the behavior was unchanged. Furthermore, in the separated females the increased anxiety-related behavior and passive stress-coping was back to normal levels (paired, vehicle-treated) after treatment with D-Phe. In conclusion, maternal investment is robust enough to withstand loss of the partner, whereas the mothers' emotionality is negatively impaired and potentially mediated by a CRF-dependent mechanism. This animal model has potential for mechanistic studies of the behavioural and physiological consequences of partner loss in single mothers.

Research supported by: DFG [BO 1958/8-1 to OJB, NE 465/16-1 and NE 465/27-1 to IDN], the DFG Graduate School GRK 2174, the BMBF [01EE1401A/OptiMD to IDN], and NIH [MH-077776, MH096983 to LJY; OD P51OD011132 to Yerkes National Primate Research Center]

The authors have no conflicts of interest to declare.

Poster 32

EFFECTS OF FAMILY UNIT COMPOSITION ON OFFSPRING BIO-BEHAVIORAL DEVELOPMENT IN THE PRAIRIE VOLE (*MICROTUS OCHROGASTER*)

Rogers FD; Bales KL

Department of Psychology, University of California, Davis (FDR, KLB); California National Primate Research Center (KLB), USA

Mother-offspring interactions are of critical influence to bio-behavioral development in altricial mammalian young. In biparental species, the social network of offspring is expanded to include fathers; and in cooperatively breeding species, this network is further expanded to include alloparents. In species for which this expanded social network is typical, disruption of early bonds between pups and others (e.g. fathers or alloparents) should disrupt typical bio-behavioral development. In the prairie vole (*Microtus ochrogaster*), paternal deprivation affects pup bio-behavioral development. However, it remains unclear what moderates the effect of paternal deprivation, i.e. if any particular quality of paternal care is necessary for typical development, or if disrupted development is the result of a general reduction in parental care. We compared the bio-behavioral development of prairie vole pups reared under conditions of typical biparental (BP), maternal only (MO), and maternal-plus-alloparental (MA; i.e. mother plus older sister) care. Maternal care in the neonatal period was unaffected by family unit composition; however, the composite of care from all caregivers was significantly reduced in the MO condition ($p < .001$), whereas care under the MA condition trended above that of BP conditions ($p = .059$). Birth-to-weaning growth and developmental milestones were unaffected by family unit composition, with the exception of earlier fur growth in MO conditions ($p < .01$). In adulthood, family unit composition did not affect behaviors in an elevated plus maze paradigm. However, both sexes reared under MO conditions failed to demonstrate partner preference after 24-hours of cohabitation with a potential mate; and males, but not females, reared under MA conditions also failed to demonstrate partner preference. Together, our findings replicate previously observed effects of paternal deprivation (sans paternal substitution) on partner preference formation, and we further suggest that paternal care plays a particularly important role in the social development of male offspring.

Research supported by: NIH-HD071998, Bay Area Affective Science Training Program (NIH 5T32MH020006-19)

The authors have no conflicts of interest to declare.

Poster 33

COMPARISON OF METHODS TO ASSESS EARLY-LIFE ADVERSITY AND THEIR ASSOCIATION WITH MATERNAL IMMUNE ACTIVATION DURING PREGNANCY

McCormack C; Champagne F; Liu G; Lee S; Feng T; Monk C

Department of Psychiatry, Columbia University Medical Center (CM, GL, SL, TF); Department of Psychology, University of Texas (FC), USA

Dysregulation of circulating pro-inflammatory cytokines during pregnancy, including interleukin-6 (IL-6), disrupts immune functioning and alters HPA functioning, posing risk to both maternal and fetal health. In adults, including a small number of studies of pregnant women, higher circulating IL-6 levels have been observed among those exposed to early life adversity, and this has been posited as a mechanism by which intergenerational cycles of adversity may be perpetuated. Methodological constraints make these associations difficult to observe; mixed methods approaches may allow a more nuanced documentation of women's experiences of adversity. The aim of this study was to compare reporting of trauma using different instruments to assess trauma history, and to examine associations between maternal trauma exposure and inflammation during pregnancy. Healthy pregnant women (n= 187) were recruited from Columbia University Medical Center. Participants attended lab sessions in second and third trimesters of pregnancy. In Trimester 2 they completed the Childhood Trauma Questionnaire (CTQ), Parental Bonding Index (PBI), and the PTSD Symptom Severity Index (PSSI), including an open-ended question asking for details of any personal trauma history. Blood draws were taken during the 2nd and 3rd trimesters of pregnancy and immunomarkers assayed. Open-ended responses on the PSSI were coded for trauma history, and patterns of responding compared with CTQ responses. Associations between each measure of adversity with IL-6 levels were examined. Including multiple measures of adversity resulted in 42% of women reporting early trauma or neglect. There was partial overlap between those reporting childhood adversity on different measures. Mothers reporting non-optimal bonding with their own parents on the PBI were more likely to report trauma history. In contrast to findings from previous studies, no form of maternal early adversity was associated with altered IL-6 levels during pregnancy in this sample.

Research supported by: NIMH grant R01 MH092580

The authors have no conflicts of interest to declare.

Poster 34

PARENTING STRESS INFLUENCES SLOPE OF CORTISOL RESPONSE IN NEW MOTHERS

Erhart A; Kim P

Department of Psychology, University of Denver, Colorado, USA

New parents report increased feelings of subjective stress, with some stressors stemming directly from being a parent (Deater-Deckard, 1998). While it is known that high levels of parenting stress are negatively associated with mothers' well-being, there is little understanding of associations between parenting stress and the maternal neurobiological system. The present study examines how parenting stress impacts cortisol response in two samples of racially and ethnically diverse mothers. Salivary cortisol samples were collected from first-time mothers across an evening visit from 4pm-7pm in two studies (SHINE, N = 56, 12-24 months postpartum, IDEA, N = 76, 0-8 months postpartum). In both studies, four samples were collected. Multigroup latent growth curve analysis modeling the intercept and slope of cortisol response in the evening determined that there were no significant differences between the two groups of mothers, $X2\ diff(2) = 2.831$, $p = 0.76$ ($N = 132$, M age = 26.31). Mothers had an average starting cortisol value of 3.079 µg/dl at 4pm (time of first sample) and on average decreased linearly across the course of sampling at a rate of -0.514 µg/dl per sample. In order to test the degree to which parenting stress is associated with maternal cortisol response, the parenting stress index (PSI-SF; Abidin, 1995) total score was regressed on cortisol intercepts and slopes generated from the previous latent growth curve model. Parenting stress significantly contributed to variance in only the slope of maternal cortisol response, $\beta = -.007$, $p < .05$. This indicates that while all mothers' cortisol linearly decreases from 4pm to 7pm, increasing parenting stress increases the magnitude of the linear decrease in cortisol. This finding is consistent with studies demonstrating that perceived stress in women is associated with decreased average cortisol levels and extends the literature by showing that parenting stress in particular impacts cortisol response in new mothers.

Research supported by: National Institute of Child Health and Human Development [R01HD090068; R21HD078797]; the Professional Research Opportunity for Faculty (PROF) and Faculty Research Fund (FRF), University of Denver; and the Victoria S. Levin Award For Early Career Success in Young Children's Mental Health Research, Society for Research in Child Development (SRCD)

The authors have no conflicts of interest to declare.

Poster 35

FIRST ONSET POSTPARTUM PSYCHOSIS: SALIVARY ALPHA AMYLASE (sAA) REACTIVITY TO MOTHER-INFANT STIMULUS

Komal S; Thippeswamy H; Binukumar B; Christopher R; Chandra PS

Department of Psychiatry, National Institute of Mental Health and Neuro Sciences, Bengaluru (KS, HT, PSC), Department of Biostatistics, National Institute of Mental Health and Neuro Sciences, Bengaluru (BB), Department of Neurochemistry, National Institute of Mental Health and Neuro Sciences, Bengaluru (RC), India

Introduction: Mother-infant bonding is often disrupted in mothers with postpartum psychosis (PP) and they are likely to perceive the infant signals as a stressful experience. Salivary alpha amylase (sAA) enzyme is known to elevate during stress, reflecting the over activity of sympatho-adrenal medullary system. The maternal sAA levels in response to infant related stimuli among mothers with first onset PP have not been examined. Aim: To estimate the salivary-alpha amylase (sAA) levels in response to an infant related video stimulus in mothers with postpartum psychosis compared to healthy postpartum mothers. Methodology: We studied in 22 cases (postpartum psychosis; onset within 36 weeks of delivery) and 22 controls (healthy mothers; postpartum period matched with cases). A video clipping of 45 seconds of mother-infant interaction was the stimulus. The saliva samples were collected by passive drooling technique and assessed by the modified Caraway Somogyi method. sAA levels measured at three time points viz., T1-baseline, T2-immediately following stressful stimulus, T3-20 minutes after T2. The median values of sAA = A, B and C. Results: Mean age (years) of mothers among cases and controls was (24.2±5.0 and 23.5±3.5) respectively. Postpartum bonding questionnaire showed significant impairment in bonding among cases. F Statistic sAA-A=219.0, sAA-B=235.0, sAA-C=149.0. p Value sAA-A=0.58, sAA-B=0.86, sAA-C=0.029* Discussion and Conclusions:
The immediate drop in levels of sAA among both cases and controls but a later significant elevation in sAA levels only among cases suggests a possible maladaptive affective processing in mothers with postpartum psychosis. Further studies are needed to assess the effects of different components of mother-infant interaction on sAA levels. Also, there is a need to measure sAA over a longer period to observe the response trajectory.

The authors have no conflicts of interest to declare.

Poster 36

SLEEP QUALITY IS ASSOCIATED WITH VASOPRESSIN METHYLATION IN PREGNANT WOMEN WITH HISTORY OF PSYCHOSOCIAL STRESS

Solomonova E; Lee A; Robins S; Feeley N; Gold I; Hayton B; Libman, E; Turecki G; Zelkowitz P

Department of Psychiatry, McGill University (ES, HB, GI, TG, EL, ZP); Lady Davis Institute for Medical Research (ES, LA, RS, EL, ZP); Department of Psychiatry, Jewish General Hospital (ES, RS, HB, EL, ZP); Ingram School of Nursing, McGill University (FN); Department of Philosophy, McGill University (GI), Canada

Background/Objectives: Disordered sleep during pregnancy has been associated with negative outcomes for mother and child. Arginine vasopressin (AVP) is a neuropeptide that plays a role in parental behavior, response to social stressors and circadian sleep regulation. Research shows that psychosocial stress contributes to poor sleep quality and may alter AVP regulation via epigenetic mechanisms of DNA methylation. We investigated the relationship between AVP methylation and sleep quality during pregnancy and postpartum in relation to cumulative psychosocial stress. Methods: 171 mothers were assessed during pregnancy (12-14 weeks gestation, PN2; and 32-34 weeks gestation, PN3) and followed until 2.9 years postpartum (PP). Sleep quality was evaluated by the Sleep Symptom Questionnaire. Cumulative psychosocial stress was assessed by the Antenatal Risk Questionnaire (ANRQ) at PN2. Based on their ANRQ scores, participants were divided into two groups: high (HighPR) and low (LowPR) psychosocial risk. Salivary DNA was collected at 2.9 years postpartum. AVP methylation was measured in AVP receptors 1a, 1b, and Intron1. Results: Independent samples t-tests revealed that sleep quality was worse in the HighPR group than in LowPR group at PN2 ($p=.001$) and at PN3 ($p<.001$). Spearman rank-order correlations revealed that in the HighPR group, worse sleep quality was associated with less methylation of AVP intron 1 at PN2 ($rs=-.390$, $p=.001$), PN3 ($rs=-.384$, $p=.002$), and at PP ($rs=.269$, $p=.032$). In the LowPR group, AVP methylation was not associated with sleep quality. No relationship was observed between sleep quality and methylation patterns for AVPR1a or AVPR1b. Discussion: This is the first study to suggest a relationship between poor sleep quality during pregnancy and hypomethylation of AVP-coding DNA (Intron1) in women with cumulative psychosocial adversity. These results suggest that psychosocial stress and upregulation of the AVP system may exacerbate symptoms of disordered sleep during pregnancy.

Research supported by: CIHR (GTA-91755; MOP-123354) Team Grants to PZ; HBHL (McGill) and the Outstanding Science Award (CSCN) awards to ES

The authors have no conflicts of interest to declare.

Poster 37

DISSECTING MATERNAL CARE: PATTERNS OF MATERNAL PARENTING IN A PROSPECTIVE COHORT STUDY

Unternaehrer E; Cost KT; Bouvette-Turcot AA; Gaudreau H; Massicotte R; Dhir S; O'Donnell KJ; Gordon-Green C; Atkinson L; Levitan RD; Wazana A; Steiner M; Lydon J; Clark R; Fleming AS; Meaney MJ; MAVAN Research Team

Douglas Mental Health Univ Institute, McGill Univ (EU, AAB-T, HG, RM, SD, KJO'D, MJM); Ludmer Centre for Neuroinformatics & Mental Health, McGill Univ (EU, AAB-T, KJO'D, MJM); Dept Psychol., Univ Konstanz (EU); Hospital for Sick Children, Toronto (KTC); Dept Psychol., Univ Toronto Mississauga (KTC, ASF); Maelstrom Research Inst, McGill Univ Health Centre (RM); Jewish General Hospital, McGill Univ (CG-G, AW); Dept Psychol., Ryerson Univ (LA); Centre for Addiction & Mental Health, Univ Toronto (RDL); McMaster Univ (MS); Dept Psychol., McGill Univ (JL); Dept Psychiatry, Univ Wisc School Med & Public Health (RC); Singapore Inst for Clinical Sciences (MJM)

Introduction: Parental care has a strong impact on neurodevelopment and mental health in offspring. While many studies have investigated predictors and outcomes of parenting, particularly by mothers, maternal parenting as a multi-dimensional cognitive-behavioral construct per se and over the course of postnatal development has not been well characterized. Methods: This unique multi-method analysis examined patterns of self-reported and observed parenting from 6-60 months postpartum in a cohort of 496 mothers (maternal age: M=32 yrs). Self-report questionnaires assessed motivational components of mothering, parenting stress, parenting-related mood, maternal investment, maternal style, mother-child relationship satisfaction, and mother-child bonding at multiple time points. Observed parenting variables included the Ainsworth Sensitivity Scales at 6 and 18 months, Behavioral Evaluation Strategies Taxonomies (BEST) at 6 months, Etch-A-Sketch cooperation task (EAS) at 48 months and the Parent-Child Early Relationship Assessment (PCERA) at 60 months. To examine whether different latent constructs underlie these measures of maternal parenting, we conducted exploratory factor analysis. Results: Self-report measures of parenting correlated weakly with behavioral observations. Factor analysis on a subsample (n=197) revealed four latent factors that each explained 7-11% of the data variance (33% total variance explained). Based on the loadings of the instruments, the factors were interpreted as: Cognitive Parenting, Self-oriented Enjoyment of Motherhood & the Child, Overwhelmed Parenting, and Affectionate Parenting. These factor scores showed associations with maternal education and depressive symptoms, and with child outcomes, including maternally reported internalizing and externalizing behaviors, school readiness and child-reported symptoms of mental disorders. Conclusion: These findings suggest that maternal parenting consists of multiple components, each of which is associated with different maternal characteristics and child outcomes.

Research supported by: CIHR Trajectory grant for the Maternal Adversity, Vulnerability and Neurodevelopment Project.
The authors have no conflicts of interest to declare.

Poster 38

THE ROLE OF PERCEIVED STRESS AND CULTURAL VALUES IN MEXICAN-AMERICAN WOMEN ON HAIR CORTISOL

Gonzales S; D'Anna-Hernandez K

Department of Psychology, California State University San Marcos, USA

Mexican-Americans experience high rates of psychosocial stressors during pregnancy linked to physical and mental health problems. These stressors include perceived stress and stress associated to culture adaptation creating an imbalance between enculturative values, traditional content of one's home culture, and acculturative values, beliefs and norms of host culture. Stress is also associated with physiological changes during pregnancy, including alterations in cortisol. Hair cortisol is a reliable non-invasive retrospective measure that accounts for long term stress experienced by the mother throughout pregnancy. This study investigates whether cultural values buffer the effects of perceived stress on hair cortisol. We hypothesized that mothers who identified with high perceived stress and greater enculturative values will be related to blunting in hair cortisol throughout pregnancy. Questionnaires were administered that measured perceived stress and adherence to Mexican or Anglo cultural values early in pregnancy to ninety participants. Hair was collected at the end of every trimester and analyzed for cortisol levels. Adherence to enculturative values were not associated with perceived stress and cortisol for any trimester. However, in the third trimester, mothers who identified more with U.S. mainstream values (acculturation) and high perceived stress showed lower cortisol (R2=0.088, B=-0.071, SE=0.028, t=-2.503, p=0.014). Specifically, the acculturative values of independence and competition moderated the role of stress on cortisol, such that, mothers with higher perceived stress and higher independence, resulted in lower cortisol (R2=0.081, B=-0.020, SE=0.007, t=-2.708, p=0.008). This trend held true for identification of higher competition as well (R2= 0.077, b=-0.049, se=0.019, t= -2.594, p= 0.011). Findings indicate that the third trimester may be a particularly vulnerable stage for the effects of stress during pregnancy and the imbalance between cultural values may play a role.

Research supported by: NIH R15 grant

The authors have no conflicts of interest to declare.

Poster 39

PREGNANCY AND THE BRAIN: TUBINGEN/UPPSALA INTERNATIONAL RESEARCH TRAINING GROUP

Bauer I; Rehbein E; Sörensen F; Krylova M; Walter M; Krägeloh-Mann I; Papadopoulos F; Skalikidou A; Wikström AK; Sundström-Poromaa I; Preissl H; Derntl B

German Center for Diabetes Research (DZD e.V.), Neuherberg, Germany (Preissl H, Bauer I); fMEG Center, Univ Tuebingen, Germany (Bauer I, Preissl H); Institute for Diabetes Research and Metabolic Diseases of the Helmholtz Center Munich, Univ of Tuebingen, (Bauer I, Preissl H); Dept Psychiatry and Psychotherapy, Univ of Tuebingen (Rehbein E, Derntl B, Walter M); Dept Paediatric Neurology and Developmental Medicine, Univ Tuebingen (Sörensen F, Krägeloh-Mann I); Max-Planck Institute for Biological Cybernetics Tuebingen, Germany (Krylova M, Walter M); Dept Neuroscience/ Psychiatry, Univ Uppsala, Sweden (Papadopoulos F); Dept of Women`s and Children`s Health, Univ of Uppsala, Sweden (Skalikidou A, Wikström AK, Sundström-Poromaa I); Werner Reichardt Center for Integrative Neuroscience, Univ of Tübingen, Germany (Preissl H, Walter M, Krägeloh-Mann I, Derntl B); LEAD Graduate School & Research Network, Univ of Tübingen (Derntl B), Germany

Pregnancy is a critical period for women, associated with behavioral and neuronal adaptations presumably preparing them for the protecting and nurturing demands of motherhood. The overall aim of the study is to reveal the impact of pregnancy on socio-cognitive processes, brain structure and function, post-partum mood and mental health as well as its impact on fetal and child development. It is well known that maternal stress during pregnancy can have a long-lasting effect on the mother and the child. In our subproject we aim to investigate the effect of maternal relaxation and stress perception during pregnancy on fetal development (PI Preissl/Wikström). We will record non-invasively fetal brain and heart signals and maternal heart signals by biomagnetic recordings (fetal magnetoencephalography). Besides assessment of chronic stress condition of the mother we will investigate fetal and maternal reactions once while mothers undergo a relaxation induction and during normal rest as a control condition. Both conditions will be measured at two different stages of pregnancy: 29th-33nd gestational week vs. 35th-term. We assume that fetal brain signals will differ between these two gestational ages. The study will include in addition the following subprojects: assessment of brain structure and function in mothers during and after pregnancy by magnetic resonance imaging, development of a prediction model between maternal neuronal, psychophysiological, hormonal and behavioral/psychological parameters and post-partum well-being of the mother (project 3) and how these maternal parameters can predict infant development, well-being and mother-child bonding and the validation of a developmental screening tool (milestone diary) (project 4).

Research supported by: Center of Integrative Neuroscience (CIN), Tübingen, Germany (CIN/EXC 307).

The authors have no conflicts of interest to declare.

Poster 40

LONG-TERM BRAIN CHANGES ASSOCIATED TO HUMAN PREGNANCY

Carmona S; Martínez-García M; Barba-Müller E; Paternina- Die M; Wierenga LM; Beumala L; Pozzobon C; Ballesteros A; Peper J; Crone EA; Vilarroya O; Desco M; Hoekzema E

Centro de Investigación Biomédica en Red de Salud Mental, 28029 Madrid, Spain (SC, MM, MD); Unidad de Medicina y Cirugía Experimental, Instituto de Investigación Sanitaria Gregorio Marañón, 28007 Madrid (SC, MM, MP MD); Faculty of Health Sciences, Universitat Oberta de Catalunya, 08018 Barcelona (SCC); University Institute of Mental Health Vidal i Barraquer, Ramon Llull University, 08022 Barcelona (EB); Leiden Institute for Brain and Cognition, Leiden University, 2300 Leiden, the Netherlands (LMW, JP, EAC, EH); Hospital del Mar Research Institute, 08003 Barcelona (LB, OC); IVI Barcelona, Assisted Medicine Reproduction, 08017 Barcelona, Spain (CP, AB).

In mammalian species, the peripartum period is one of the most sensitive neuroplastic periods of a female's life (1). In contrast to the vast amount of studies that approach the topic of maternal brain through non-human animal models (2), there have been few attempts exploring this topic in humans. There is evidence from longitudinal MRI studies of brain volumetric reductions during human pregnancy (3,4) that persist at least two years after parturition (3). Yet it is still unknown whether these changes are present at longer periods. Using volumetric and surface-based methods we analyzed the structural magnetic resonance imaging (MRI) data of a group of first time mothers at 4 different time points: T1= before pregnancy, T2= during the early postpartum, T3= two years after parturition, and T4= six years after parturition. Our results indicate that some of the brain changes associated to pregnancy are still detectable 6 years after parturition. This is in line with animal literature, which provides compelling evidence that reproduction is associated with alterations in female brain and behavior that are evident past weaning and even in old age (5).

1. Hillerer, et al. The maternal brain: An organ with peripartal plasticity. Neural Plasticity, (2014).
2. Numan, M. Maternal behavior: Neural circuits, stimulus valence, and motivational processes. Parent. Sci. Pract. 12, 105–114 (2012).
3. Hoekzema, E. et al. Pregnancy leads to long-lasting changes in human brain structure. Nat. Neurosci. 20, 287–296 (2017).
4. Oatridge, A. et al. Change in brain size during and after pregnancy: study in healthy women and women with preeclampsia. AJNR. Am. J. Neuroradiol. 23, 19–26 (2002).
5. Kinsley, C. H. et al. Motherhood and the hormones of pregnancy modify concentrations of hippocampal neuronal dendritic spines. Horm. Behav. 49, 131–142 (2006).

Research supported by: Miguel Servet Type I Grant (CP16/00096) of the Spanish Instituto de Salud Carlos III. S.C. was supported by a Miguel Servet Type I Contract (CP16/00096) of the Spanish Instituto de Salud Carlos III and E.H. was supported by an Innovational Research Incentives Scheme grant (Veni, 451-14-036) of the Netherlands Organization for Scientific Research

The authors have no conflicts of interest to declare.

Poster 41

FUNCTIONAL CONNECTIVITY OF THE MATERNAL BRAIN IN THE POSTPARTUM PERIOD: ASSOCIATIONS WITH POSTPARTUM MONTHS

Dufford AJ; Kim P

Department of Psychology, University of Denver, USA

In the postpartum period, the maternal brain undergoes both structural and functional plasticity across the first few months postpartum. However, whether there is an association between later postpartum months and functional connectivity in the human maternal brain remains unclear. Based on previous evidence of the structural changes in specific neural circuits, we hypothesized that the later postpartum period would be associated with greater functional connectivity in regions involved in parental motivation and emotion information processing. Thus, we hypothesized that there would be enhanced functional connectivity between later postpartum months and functional connectivity in salience network (e.g. - amygdala, anterior cingulate, anterior insula), and a reward network including nucleus accumbens. We recruited forty-eight, socioeconomically diverse, first-time mothers with singleton pregnancies (mean age = 25.7 ± 5.2, months postpartum = 4.57 ± 1.8, 60.4% Caucasian). Seed-based connectivity of resting-state fMRI data was conducted using CONN with (left/right) amygdala and (left/right) nucleus accumbens as two separate seed regions. We found that greater postpartum months were associated with greater connectivity between left amygdala and left anterior cingulate cortex, left caudate, right caudate, left insular cortex, and right insular cortex. Later postpartum months were associated with increased functional connectivity between the right amygdala and left putamen and right putamen ($p < 0.001$, FDR corrected). There were no significant results for the nucleus accumbens seeds. Overall, we provide evidence of a relationship between postpartum months and functional connectivity particularly in the regions of the salience network and between the amygdala and regions involved in parental motivation. These findings contribute to our understanding of the relationship between the postpartum period and enhanced functional brain network connectivity. It may further provide information for future studies to examine this association in clinical populations such as women experiencing postpartum depression or anxiety.

Research supported by: National Institute of Child Health and Human Development [R21HD078797; R01 HD090068]; the Professional Research Opportunity for Faculty (PROF) and Faculty Research Fund (FRF), University of Denver; and the Victoria S. Levin Award For Early Career Success in Young Children’s Mental Health Research, Society for Research in Child Development (SRCD)

The authors have no conflicts of interest to declare.

Poster 42

EXECUTIVE FUNCTION IN TEEN AND ADULT WOMEN: ASSOCIATION WITH MATERNAL STATUS AND EARLY ADVERSITY

Almanza-Sepulveda ML; Chico E; Gonzalez A; Hall GB; Steiner M; Fleming AS

Department of Psychology, Neuroscience and Behaviour (MLA-S; GBH); Department of Psychology University of Toronto (ECH; ASF); Department of Psychiatry & Behavioral Neurosciences McMaster University (AG;MG), Canada

The aim of this study was to determine the impact of maternal age on executive function and the moderating effects of women's maternal status and early –life experiences. Four groups of women were assessed as a function of their age (teens vs adults) and maternal status (mothers vs non-mothers). Participants completed executive function tests, including tests of Spatial Working Memory (SWM), Intra-Extra Dimensional Set Shift (IED) and Stockings of Cambridge (SOC). Women also completed the Childhood Trauma Questionnaire to assess their experiences of early adversity. Results showed that for IED attention task, there were main effects of age and maternal status and an interaction between the two; adults performed better than teens, mothers performed better than non-mothers and teen non-mothers performed the least well of all groups; for the SWM task, adults performed better than teens and for the SOC, the opposite pattern was found. Our results indicate that although age is an important factor for proper executive functioning, different tasks are affected differently and other factors such as maternity and adverse childhood experiences moderate this functioning. These differences may help to explain some of the age and some factors associated with (marital status, socioeconomic status, and education) -related differences in maternal behaviour shown by adult and teen mothers. Adaptive mothering necessarily requires the ability to shift attention when necessary, to have good working memory while interacting with infants and to have good self-regulation and impulse control.

Research supported by: Government of Canada > Canadian Institutes of Health Research; Government of Canada > Social Sciences and Humanities Research Council of Canada

The authors have no conflicts of interest to declare.

Poster 43

OPIOIDS AND MATERNAL BRAIN-BEHAVIOR ADAPTATION DURING THE EARLY POSTPARTUM

Swain JE; Ho SS

Department of Psychiatry, Stony Brook University Medical Center, Health Science Center Level 10 Room O6OZ, Stony Brook NY 11794, USA

Introduction: Opioid use is a fast-growing epidemic in the US, affecting a high proportion of child-bearing women. Many suffer comorbid mood disorders, such as postpartum depression, and maladaptive parenting practices that increase costly risks for child maltreatment and foster care utilization. Peripartum women affected by opioids and other substances may receive Medication Assisted Treatment (MAT) with buprenorphine medication (BM) to prevent withdrawal. We are studying the brain-behavior mechanisms among parents under BM. Methods: We studied mothers receiving buprenorphine-medicated MAT (BM, n=7; 4-20 mg daily), as compared to Healthy Controls (HC, n=29) and Depressed Controls (DC, n=7). We applied interview, behavioral analyses and MRI methods at 2-4 weeks (T1) and 3-6 months (T2), including own and other baby-cry stimuli to activate maternal care-giving brain circuits (MCN) that regulate maternal behavior–analyzing with SPM8 and Freesurfer. Results: While BM mothers showed comorbid depressive mood symptoms similar to DC mothers, they exhibited even greater child-oriented worries than DC/HC mothers. Own vs. other's baby cry responses and relative brain volumes in the MCN are consistent with BM>DC/HC mothers brain physiology correlating with maternal worries. However, resting-state functional connectivity between MCN neurocircuits that mediate caregiving vs. defensive behaviors was not antagonistic as in DC/HC. Conclusions: BM mothers' MCN appear susceptible to “hijacking” by exogenous opioids that reinforce the associations between MCN circuits and maternal worries, which may increase their risk of worry-driven intrusive behaviors. On one hand, as the gold standard of addiction treatment, opioids could serve to augment maternal caregiving positive preoccupations. On the other hand, BM may dysregulate maternal care/defense subsystem reciprocal inhibition, explaining why addiction is associated with diminished care or intrusive behaviors under perceived threat or stress in animal models. Results suggest therapeutic augmentation neurocircuit targets for BM mothers.

Research supported by: National Institutes for Health – National Center for Advanced Translational Sciences via the Michigan Institute for Clinical Health Research UL1TR000433

The authors have no conflicts of interest to declare.

Poster 44

DECISION-MAKING ABOUT ANTIDEPRESSANT USE IN PREGNANCY AMONG PRECONCEPTION WOMEN

Barker LC; Hussain-Shamsy N; Dennis CL; Grigoriadis S; Metcalfe K; Oberlander TF; Schram C; Stewart DE; Taylor VH; Vigod SN

Department of Psychiatry, University of Toronto (LCB, CLD, SG, DES, VHT, SNV); Women's College Hospital and Research Institute (LCB, NHS, CS, VHT, SNV); Lawrence S. Bloomberg Faculty of Nursing, University of Toronto (CLD, KM); Li Ka Shing Knowledge Institute, St. Michael's Hospital (CLD); Sunnybrook Health Sciences Centre (SG); Department of Pediatrics, University of British Columbia (TFO); University Health Network (DES), Canada

Background: Decisions about antidepressant medication use in pregnancy are ideally made before conception to optimize maternal and fetal health, however little is known about preconception women making these decisions. We aimed to understand differences between preconception and pregnant women in their decisions regarding antidepressant medication use in pregnancy. Methods: 95 Canadian women with depression were recruited as part of a clinical trial of a decision-making tool for antidepressant use in pregnancy. Using baseline (prior to intervention) data, we compared preconception (planning pregnancy) versus pregnant participants on sociodemographic and clinical characteristics, including decisional conflict. We compared preconception to pregnant women on whether they planned to use (vs. not use) antidepressants in pregnancy using logistic regression, adjusting for other characteristics significantly associated with antidepressant plans. Results: About 57.9% of participants (n=55) were preconception at enrollment. Preconception women were more likely to be currently using antidepressants (85.5% vs. 45.0%), report previous benefits from antidepressants (70.9% vs. 53.5%), and have high Decisional Conflict Scale scores (≥37.5, 83.6% vs. 60.0%). They were less likely to have active depressive symptoms (Edinburgh Postnatal Depression Scale score ≥13, 40.0% vs. 65.0%), and to be under psychiatric care (29.1% vs. 52.5%). About 60% of preconception vs. 32.5% of pregnant women planned to use antidepressants in pregnancy (odds ratio, OR, 3.11, 95% confidence interval, CI 1.33-7.32), however this association attenuated after adjustments (adjusted OR 2.79, 95% CI 0.81-9.62). Conclusions: Among women making decisions about antidepressant use in pregnancy, preconception women were similarly likely to plan to use antidepressants in pregnancy compared to pregnant women, after considering clinical and demographic differences between groups. Preconception women had higher decisional conflict, suggesting a gap in decision-making support for this population.

Research supported by: Canadian Institutes of Health Research (CIHR) grant number FRN-133662

Conflicts of interest – DES is a member of the Scientific Advisory Committee, Duloxetine Pregnancy Registry.

Poster 45

POSTPARTUM DEPRESSION: A CONTENT EVALUATION OF THE INFORMATION AVAILABLE ON THE GOOGLE.CA SEARCH ENGINE

Chénier-Ayotte N; Konkle ATM

School of Psychology, Faculty of Social Sciences, University of Ottawa (NCA ; ATMK); Interdisciplinary School of Health Sciences, Faculty of Health Sciences, University of Ottawa (ATMK); University of Ottawa Brain and Mind Research Institute (ATMK), Canada

Postpartum Depression (PPD) is a disorder very similar to what is considered more "typical" depression, with the addition of the parent's inability to care for his/her child. Because of its status as a mental health disorder and the spreading of sometimes dubious information on the web, it is subject to stigmatization, and this mainly based on stereotypes. Thus, we are (a) qualifying the "type" of the most popular websites consulted in relation to PPD; (b) evaluating the type and quality of information available on Google; and (c) researching what kind of help is available online to individuals with PPD. Our sample is made up of 50 websites. These were selected by isolating the five most popular terms from an initial list of 17 key words related to the PPD. We then evaluated the first 10 websites for each of these five keywords appearing on the Google.ca search engine. The assessment was achieved with the help of an evaluation grid designed in house (not validated but based on existing ones). With this tool, we sought to collect demographic, technical and emotionally related data. Our results show that the websites offering information are mainly "amateur" ones, rather than sources considered reliable or professional, and that the information presented is mostly of a neutral tone, with visual aids being positive rather than negative. This provides a glimpse into (a) the type of information available online; (b) the level of support that can be expected; and (c) the presentation of information that may propagate the stigma associated with this disorder.

The authors have no conflicts of interest to declare.

Poster 46

PREGNANCY AND ADOLESCENCE ENTAIL SIMILAR NEUROANATOMICAL ADAPTATIONS: A COMPARATIVE ANALYSIS OF CEREBRAL MORPHOMETRIC CHANGES

Carmona S; Martínez-García M; Barba-Müller E; Paternina- Die M; Wierenga LM; Beumala L; Pozzobon C; Peper J; Crone EA; Vilarroya O; Desco M; Hoekzema E

Centro de Investigación Biomédica en Red de Salud Mental, 28029 Madrid, Spain (SC, MM, MD); Unidad de Medicina y Cirugía Experimental, Instituto de Investigación Sanitaria Gregorio Marañón, 28007 Madrid, Spain (SC, MM, MP MD); Faculty of Health Sciences, Universitat Oberta de Catalunya, 08018 Barcelona, Spain (SCC); University Institute of Mental Health Vidal i Barraquer, Ramon Llull University, 08022 Barcelona, Spain (EB); Leiden Institute for Brain and Cognition, Leiden University, 2300 Leiden, the Netherlands (LMW, JP, EAC, EH); Hospital del Mar Research Institute, 08003 Barcelona, Spain (LB, OC); IVI Barcelona, Assisted Medicine Reproduction, 08017 Barcelona, Spain (CP, AB).

Mapping the impact of pregnancy on the human brain is essential for understanding the neurobiology of maternal caregiving. Recently, we found that pregnancy leads to a long-lasting reduction in cerebral gray matter volume. However, the morphometric features behind the volumetric reductions remain unexplored. Furthermore, the similarity between these reductions and those occurring during adolescence, another hormonally similar transitional period of life, still needs to be investigated. Here, we used surface-based methods to analyze the longitudinal MRI data of a group of 25 first-time mothers (before and after pregnancy) and compare them to those of a group of 25 female adolescents (during two years of pubertal development). For both first-time mothers and adolescent girls, a monthly rate of volumetric reductions of 0.09 mm3 was observed. In both cases, these reductions were accompanied by decreases in cortical thickness, surface area, local gyrification index, sulcal depth, and sulcal length, as well as by increases in sulcal width. In fact, the changes associated with pregnancy did not differ from those that characterize the transition during adolescence on any of these measures. Our findings are consistent with the notion that the morphological changes associated with pregnancy and adolescence reflect similar hormonally primed maturational processes.

Research supported by: Miguel Servet Type I Grant (CP16/00096) of the Spanish Instituto de Salud Carlos III. S.C. was supported by a Miguel Servet Type I Contract (CP16/00096) of the Spanish Instituto de Salud Carlos III and E.H. was supported by an Innovational Research Incentives Scheme grant (Veni, 451-14-036) of the Netherlands Organization for Scientific Research. We acknowledge the participants for their contribution to this study. In addition, we thank A. Fernández-Pena and L. Marcos-Vidal for advice on the image processing and statistical analysis respectively.

The authors have no conflicts of interest to declare.

Poster 47

MOTHER-INFANT CORTISOL ASSOCIATIONS OVER TIME: EFFECT OF EARLY BREASTFEEDING

Jonas W; Bisceglia R; Meaney MJ; Dudin A; Steiner; Fleming AS on behalf of the MAVAN research team

Department of Psychology, University of Toronto at Mississauga, ON, Canada (AF, BR, WJ); Women's Health Concerns Clinic, St. Joseph's Healthcare, Hamilton, ON, Canada (MS, WJ); Department of Women's and Children's Health, Karolinska Institutet, Stockholm, Sweden (WJ); Ludmer Centre for Neuroinformatics and Mental Health, Douglas Institute, McGill University, Montreal, QC, Canada (MJM); Departments of Psychiatry & Behavioral Neurosciences and Obstetrics & Gynecology, McMaster University, Hamilton, ON, Canada (MS)

Background: Mother-infant dyads often synchronize, both behaviorally and physiologically. Studies show mother-child associations between prenatal, early postnatal and later cortisol levels of both mother and child. However, we know little about what factors regulate these associations and thus, this study explored possible factors that link maternal cortisol to child cortisol over time in human mother-infant dyads. Methods: Participants were 93 new mothers and their infants drawn from the Hamilton sample of the Maternal Adversity, Vulnerability and Neurodevelopment (MAVAN) study, a Canadian longitudinal prospective study following two cohorts of mothers and their infants. Mothers were assessed through assay of salivary samples for cortisol levels at 24 weeks of pregnancy and again at 3, 6, and 12 months postpartum on two consecutive days. Infant cortisol levels were assessed at post-natal 6 and 12 months on two consecutive days. Mothers' breastfeeding status (any and exclusive) was established at 3, 6, and 12 months postpartum. Results: Among breastfeeding dyads, we found positive correlations between maternal cortisol levels during pregnancy and at three months postpartum and infant cortisol at six or 12 months postpartum. Among non-breastfeeding dyads, these same maternal and infant cortisol associations were inverse and less pronounced. Of interest, in breastfeeding mothers, the relationship between maternal prenatal cortisol and infant cortisol at 12 months was mediated through maternal cortisol at 3 months postpartum. Conclusion: Our findings suggest that maternal cortisol levels are positively associated with cortisol levels of the infant, among mothers who breastfeed. This relationship persists over a one-year period, even after breastfeeding has ceased.

Research supported by: Canadian Institutes of Health Research (CIHR) trajectory grant for the MAVAN PIs Michael J. Meaney, Meir Steiner and Alison S. Fleming, and by grants from the Swedish Council for Working Life and Social Research (FORTE), Sällskapet Barnavård and the Erik and Astrid Fernström Foundation at Karolinska Institutet, Sweden, awarded to Wibke Jonas

The authors have no conflicts of interest to declare.

Poster 48

THE FATHER FACTOR: A TALE OF BREASTFEEDING, PARITY, CHILDCARE, CHORES, AND SEX

Tombeau Cost K; Jonas W; Unternaehrer E; Dudin A; Szatmari P; Gaudreau H; Kennedy JL; Atkinson L; Steiner M; Meaney M; Fleming AS

Dept Psychiatry, The Hospital for Sick Children (KTC); Dept Women's and Children's Health, Karolinska Institute (WJ); Konstanz University (EU); Dept Psychology, Neuroscience & Behaviour, McMaster University(AD); Dept Psychiatry, The Hospital for Sick Children (PS); Dept Psychology, McGill University (HG), Dept Psychiatry, Centre for Addiction and Mental Health (JLK), Dept Psychology, Ryerson University (LA); Dept Psychiatry, McMaster University (MS); Dept Psychology, McGill University (MM); Dept Psychology, University of Toronto Mississauga (AF)

Introduction: In the postpartum, mother’s relationship satisfaction with the partner and her interest in sex often decline. One possible explanation is violated expectations surrounding childcare. Our objective was to examine the associations of mother’s satisfaction with father involvement, with relationship satisfaction and interest in sex, in the context of parity and breastfeeding as indicators of increased demand on maternal resources. Methods: Participants (n=222) completed questionnaires at 4 time points, 3-24 months postpartum, in a prospective, multicenter Canadian cohort study (Maternal Adversity, Vulnerability and Neurodevelopment) following mother-child dyads from pregnancy to 14 years postpartum. The main outcomes were mothers’ relationship satisfaction at 6 and 24 months postpartum and mothers’ interest in sex at 6 months postpartum. We used moderated mediation, parallel mediation, and linear regressions models. Results: Breastfeeding at 3 months predicted decreased relationship satisfaction at 6 months, mediated by mothers’ dissatisfaction with father involvement in caretaking. These associations depended on mothers’ parity: multiparous breastfeeding mothers were the most dissatisfied with father involvement ($p<0.05$). Mothers’ satisfaction with father involvement at 6 months also predicted increased relationship satisfaction at 24 months through increased relationship satisfaction at 12 months (Effect = -.182), but not through father involvement at 18 months (Effect = -.022), when father involvement typically increases. Mothers’ satisfaction with fathers’ involvement at 6 months postpartum was a better predictor of mothers’ interest in sex at 6 months (adjusted $R2=0.184$, $p<0.001$) than was their overall relationship satisfaction at 6 months. Conclusion: Multiparous breastfeeding mothers are more dissatisfied with the level of father involvement in caretaking than non-breastfeeding mothers and primiparous breastfeeding mothers. Regardless of parity, mothers’ satisfaction with earlier, rather than later, father involvement is a potent predictor of overall relationship satisfaction and interest in sex, indicating a possible “sensitive period” for satisfaction with father involvement.

Research Supported by: Canadian Institutes of Health Research

The authors have no conflicts of interest to declare.

Poster 49

PREGNANCY RENDERS LONG-LASTING CHANGES IN HUMAN BRAIN STRUCTURE THAT PREDICT MATERNAL ATTACHMENT

Hoekzema E; Barba-Müller E; Pozzobon C; Picado M; Lucco F; García-García D; Soliva JC; Tobeña A; Desco M; Crone EA; Ballesteros A; Carmona S; Vilarroya O

Brain and Development Research Center, Leiden University, the Netherlands (EH, EAC); Institute for Brain and Cognition, Leiden, the Netherlands (EH, EAC); Unitat de Recerca en Neurociència Cognitiva, Departament de Psiquiatria i Medicina Legal. Universitat Autònoma de Barcelona, Barcelona, Spain (EH, EBM, MP, JCS, AT, SC, OV); Instituto Valenciano de Infertilidad, Barcelona, Spain (CP, FL, AB); Departamento de Bioingeniería e Ingeniería Aeroespacial, Universidad Carlos III de Madrid. Instituto de Investigación Sanitaria Gregorio Marañón, Madrid, Spain (DGG, MD, SC); Centro de Investigacion Biomedica en Red de Salud Mental (CIBERSAM), Madrid, Spain (SC); Fundació IMIM, Barcelona, Spain (OV).

Pregnancy involves radical hormone surges and biological adaptations. However, very little is known on the effects of pregnancy on the human brain. Using a prospective ('pre'-'post' pregnancy) study involving first-time mothers and fathers and nulliparous control groups, we showed that pregnancy renders substantial changes in brain structure, primarily reductions in gray matter (GM) volume in regions subserving social cognition.The changes were selective for the mothers and highly consistent, correctly classifying all women as having undergone pregnancy or not in-between sessions. Interestingly, the volume reductions showed a substantial overlap with brain regions responding to the women's babies postpartum. Furthermore, the GM volume changes of pregnancy predicted measures of postpartum maternal attachment, suggestive of an adaptive process serving the transition into motherhood. Another follow-up session showed that the GM reductions endured for at least 2 years post-pregnancy. Preliminary results additionally highlight morphological changes within subcortical brain structures that are crucial for regulating maternal behavior in non-human animals. Taken together, these data show that pregnancy confers long-lasting changes in a woman's brain, highlighting pregnancy as a period of striking neural plasticity, and point to a process of neural adaptation that benefits aspects of maternal caregiving.

Research supported by: EH was supported by a Formación de Profesorado Universitario (FPU) grant by the Ministerio de Educación y Ciencia, and is now supported by an Innovational Research Incentives Scheme grant (Veni, 451-14-036) of the Netherlands Organization for Scientific Research (NWO), EBM. by a grant from the National Council of Science and Technology of Mexico, SC by the Consejería de Educación, Juventud y Deporte of Comunidad de Madrid and the People Programme (Marie Curie Actions) of the European Union’s Seventh Framework Programme (FP7/2007-2013) under REA grant agreement 291820, and MP by an FI grant of the Agencia de Gestió d’Ajuts Universitaris de Recerca, Generalitat de Catalunya

The authors have no conflicts of interest to declare.

Poster 50

THE EFFECTS OF FATHER'S BABY CARRYING ON HORMONE LEVELS AND PARENTAL SENSITIVITY – A STUDY DESIGN

Lotz AM; van Dijk K; Meijer WM; van't Veer AE; Witteman J; van IJzendoorn MH; Bakermans-Kranenburg MJ

Faculty of Social and Behavioral Sciences, Leiden University, Leiden, the Netherlands (AML, KvD, WMM, AEvtV, MHvIJ, MJBK); Leiden Institute for Brain and Cognition, Leiden University Medical Center, Leiden, the Netherlands (AML, KvD, AEvtV, JW, MHvIJ, MJBK); Department of Psychology, Education, and Child Studies, Erasmus University Rotterdam, Rotterdam, the Netherlands (MHvIJ); Leiden University Centre for Linguistics, Leiden University, Leiden, the Netherlands (JW)

Parenting studies mainly focus on mother-child relationships, and on maternal neurological, endocrine, and behavioral factors. As a result, the role of fathers has been largely ignored. The aim of the current randomized controlled trial is to test whether basal hormonal levels, hormone ratios, and observed paternal sensitivity are affected by the use of a soft baby carrier, which induces close physical proximity between father and infant in the first months of the infant's life. In previous research, the use of baby carriers has been related to infant-mother attachment security (Anisfeld et al., 1990). Here we present our design for the current study, in which 140 first-time healthy fathers of full-term healthy infants will participate—70 fathers in the intervention group, using soft baby carriers, and 70 fathers in the control group, using baby seats. The pre-intervention visit takes place when infants are around two months old. Between pre- and post-intervention visits, participants are asked to use either the baby carrier or the baby seat for at least six hours per week, spread over a minimum of four days, for three weeks. During both pre- and post-intervention visits, a test battery including behavioral, neurological and hormonal assessments will be administered, including a 10-minute father-infant free play observation for the rating of paternal sensitivity, with collection of saliva samples 10 minutes before and 10 minutes after free play to measure levels of testosterone, cortisol, oxytocin, and vasopressin. We expect that an increase in close physical contact between father and child induced by using a soft baby carrier will boost basal levels of oxytocin and the release of oxytocin during free play, and will decrease the release of vasopressin, cortisol and testosterone. Moreover, we expect that the use of the soft baby carrier will result in increased paternal sensitivity.

Research supported by: ERC Advanced Grant to MJBK

The authors have no conflicts of interest to declare.

Poster 51

POSTPARTUM DEPRESSIVE SYMPTOMS MEDIATE THE RELATION BETWEEN TESTOSTERONE AND SLEEP PROBLEMS IN NEW FATHERS

Goldenberg D; Khoddam H; Stoycos S; Corner G; Khaled M; Horton K; Saxbe D

Department of Psychology, University of Southern California, Los Angeles (DG, HK, SS, GC, MK, KH, DS), USA

The transition to fatherhood is characterized by alterations in testosterone, marked sleep disruption, and heightened risk for depression. These changes interact in bidirectional and complex ways with potentially profound implications. Prior studies show males with lower testosterone after the birth of their child are more depressed. Additionally, postpartum sleep quality exacerbates depressive symptoms over time in new fathers. However, a clear and mechanistic understanding of how sleep, hormones, and depression interact over the transition to parenthood is currently missing, given a lack of prospective research conducted before and after infant birth. The aim of the current research is to begin to address this gap. Data are drawn from the ongoing HATCH (Hormones Across the Transition to Childrearing) study. Thirty men expecting their first child provided self-reports of depressive symptoms and sleep quality six months into their partners' pregnancy and again six months postpartum. In addition, saliva samples were collected at both time points and assayed for testosterone. Analyses revealed that lower levels of prenatal testosterone were associated with greater postpartum sleep problems, controlling for prenatal sleep. In other words, hormone levels predicted the emergence of sleep problems across the transition to fatherhood. This association was significantly mediated by endorsement of postpartum, but not prenatal, depressive symptoms. Findings have implications for the role of prenatal hormones and postpartum depressive symptoms in the development of sleep problems during the transition to fatherhood. Sleep problems increase irritability and impulsivity. For new parents, this can interfere with activities fundamental for caregiving, such as conjuring the patience to deal with a crying infant. Fathers are currently undergoing postpartum fMRI while performing a task designed to approximate real-world operations for new parents (inhibit impulsive responses during infant cry). Planned analyses will explore how postpartum sleep problems relate to behavior and neural response during task performance.

Research supported by: NSF CAREER (grant number 1552452)

The authors have no conflicts of interest to declare.

Poster 52

STRESSFUL LIFE EVENTS AND WHITE MATTER MICROSTRUCTURE IN EXPECTANT FATHERS

Saxbe DE; Goldenberg D

University of Southern California, Los Angeles, USA

Over the transition to parenthood, a history of life stress and trauma may compromise the adjustment to parenting and increase risk for perinatal mood disorders. Fathers have been understudied within the parenting literature, but it is important to identify predictors and potential neural correlates of paternal well-being. As part of an ongoing, longitudinal study, men expecting their first child were recruited when their partners were in mid-to-late pregnancy and underwent magnetic resonance imaging (MRI) on a 3T Siemens scanner, during which a DTI sequence was collected to evaluate integrity of white matter microstructure. Life stress was assessed with the Life Events Checklist, a self-report measure designed to screen for potentially traumatic events (e.g. assault, death of a loved one, natural disaster) that had occurred within the respondent's lifetime. Analyses using Tract-Based Spatial Statistics (TBSS) identified a significant negative correlation between the number of traumatic events participants had witnessed and fractional anisotropy (FA) values, a measure of fiber organization, in the anterior corona radiata, anterior thalamic radiations, and uncinate fasciculus ($p<.05$). In other words, expectant fathers who have had greater exposure to traumatic experiences throughout their lives have worse structural integrity of white matter tracts connecting cortical and limbic regions. We are now following these fathers into the postpartum period and will examine associations between white matter microstructure and the adjustment to parenthood, including postpartum mood disorder symptoms.

Research supported by: National Science Foundation CAREER Award #1552452

The authors have no conflicts of interest to declare.

Poster 53

EFFECTS OF VASOPRESSIN ON NEURAL PROCESSING OF INFANT CRYING IN EXPECTANT FATHERS

Thijssen S; van't Veer AE; Witteman J; Meijer WM; van IJzendoorn MH; Bakermans-Kranenburg MJ.

Faculty of Social and Behavioral Sciences, Leiden University (ST, AEvtV, WMM, MHvIJ, MJBK); Leiden Institute for Brain and Cognition, Leiden University Medical Center (ST, AEvtV, JW, MHvIJ, MJBK); Department of Psychology, Education, and Child Studies, Erasmus University Rotterdam (ST, MHvIJ); Leiden University Centre for Linguistics, Leiden University (JW), The Netherlands

In a randomized, double blind, placebo-controlled, within-subject magnetic resonance imaging study, we examined the effect of 20 IU intranasal vasopressin on the neural processing of infant crying in 25 fathers-to-be. We explored whether familial background modulates vasopressin effects, and whether vasopressin differentially affects cry processing coupled with neutral or emotional contextual information. Participants listened to cries accompanied by neutral (‘this is an infant') or emotional (‘this infant is sick/bored') contextual information, and neutral control sounds (‘this is a saw'). Additionally, participants reported on their childhood experiences of parental love-withdrawal and abuse. Infant crying (vs control sounds) was associated with increased activation in the bilateral auditory cortex and posterior medial cortex. No effects of vasopressin were found in this ‘cry network'. Exploratory whole-brain analyses suggested that effects of vasopressin in the anterior cingulate cortex, paracingulate gyrus and supplemental motor area were stronger in fathers who experienced lower (vs higher) levels of love-withdrawal. No interaction was observed for abuse. Vasopressin increased activation in response to cries accompanied by emotional vs neutral contextual information in several brain regions, e.g. the cerebellum, brainstem (midbrain), posterior medial cortex, hippocampus, putamen, and insula. Our results suggest that the experience of love-withdrawal may modulate the vasopressin system, influencing effects of vasopressin administration on cry processing. Results further suggest a role for vasopressin in the processing of cry sounds with emotional contextual information.

Research supported by: European Research Council

The authors have no conflicts of interest to declare.

Poster 54

NOT JUST FOR MOMS: INTRANASAL OXYTOCIN ENHANCES FATHERS' BRAIN RESPONSE TO INFANT SMILE

Rajhans P; Goin-Kochel RP; Kim S; Strathearn L

Department of Physiology, University of Texas Stead Family Department of Pediatrics, University of Iowa (PR); Department of Pediatrics-Psychology, Baylor College of Medicine (RP G-K); Department of Obstetrics and Gynecology, Baylor College of Medicine (SK); Stead Family Department of Pediatrics, University of Iowa (LS), USA

Fathers play a significant role in promoting health, development and psychosocial wellbeing of their children. The first 6 months of fatherhood are characterized by elevated plasma oxytocin levels and increases in gray matter volumes of brain regions that are associated with parental motivation and caregiving. Despite burgeoning interest in neuro-hormonal reorganization during fatherhood, the role of oxytocin in father-infant attachment remains unclear. Thus, the current randomized, double-blinded, placebo-controlled, crossover study of intranasal oxytocin (OT) examined paternal brain responses to own and unknown infant cues in first-time fathers. Five fathers of 5 to 7-month-old infants underwent functional MRI (fMRI) scanning, while viewing happy and sad face images of their own infant, along with those of a matched unknown infant. Fathers were given a nasal spray of either OT or placebo prior to one of two fMRI scanning sessions. Effects of intranasal OT were examined in region-of-interest analyses of the striatum and amygdala, with these regions implicated in reward processing and parental motivation. Intranasal OT, compared to placebo, significantly increased activation of the dorsal striatum when fathers viewed their own versus unknown infant's faces ($p<0.005$). This finding was driven by OT-induced increased striatal activation to happy, but not sad, faces of own infants, consistent with OT's role in enhancing social reward-related processing. Intranasal OT similarly augmented activation of the amygdala in response to happy faces of their own infant compared to those of an unknown infant. Taken together, our findings demonstrate that intranasal OT may enhance activation in brain regions associated with reward processing and parental motivation in first-time fathers. Although preliminary, our results highlight the interplay of hormones, neurobiology and infant cues in the transition to fatherhood. These findings need replication in a larger cohort of fathers, but may point to the possible role of intranasal OT in promoting father-infant attachment.

Research supported by: National Institute of Child Health and Human Development

The authors have no conflicts of interest to declare.

POSTER 55

DISCRIMINATION EXPOSURE AND DNA METHYLATION OF STRESS-RELATED GENES IN LATINA MOTHERS

Nephew BC; Murgatroyd C; Bhattacharya A; Tan X; Smith L; Alyamani R; Martin EM; Perreira K; Fry RC; Santos Jr HP

School of Nursing, University of North Carolina at Chapel Hill, North Carolina (AB; XT; RA; EM; KP; RF; HPS); Department of Biomedical Sciences, Tufts University Cummings School of Veterinary Medicine, North Grafton, Massachusetts (BCN); School of Healthcare Science, Manchester Metropolitan University, Manchester, England (CM; LS).

Latina mothers, who have the highest fertility rate among all ethnic groups in the US, are often exposed to discrimination. The biological impacts of this discrimination are unknown. This study is the first to explore the relationship between discrimination, as a psychosocial stressor, and DNA methylation of stress regulatory genes in Latinas. Our sample was Latina women (n = 147) with a mean age of 27.6 years who were assessed at 24-32 weeks' gestation (T1) and 4-6 weeks postpartum (T2). Blood was collected at T1, and the Everyday Discrimination Scale (EDS) was administered at T1 and T2. DNA Methylation at candidate gene regions was determined by bisulphite pyrosequencing. Associations between EDS and DNA methylation were assessed via zero-inflated Poisson models, adjusting for covariates and multiple-test comparisons. Discrimination was associated with decreased methylation at CpG sites within the glucocorticoid receptor (*NR3C1*) and brain-derived neurotrophic factor (*BDNF*) genes that were consistent over time. In addition, discrimination associated with decreased methylation of a CpG in the glucocorticoid binding protein (*FKBP5*) at T1 but not at T2. This study underscores the complex biological pathway associations between discrimination and epigenetic modification in Latina women in the US that warrant further investigation to better understand the genetic and psychopathological impact of discrimination on Latino mothers and their families.

Research supported by: NIH Clinical and Translational Science Award, North Carolina Translational & Clinical Sciences Institute (UL1TR001111; pilot grant #550KR131619) and the University of North Carolina at Chapel Hill School of Nursing to HPS and BCN

The authors have no conflicts of interest to declare.

POSTER 56

INTRANASAL AVP, BUT NOT OXT, PREVENTS THE ADVERSE EFFECTS OF SOCIAL STRESS ON MATERNAL CARE

Nephew BC; Hicks-Nelson, A; Pittet F; Van Caenegem N; Murgatroyd C

Department of Biomedical Sciences, Tufts University Cummings School of Veterinary Medicine, North Grafton, Massachusetts (BCN; AHN; FP; NVC), USA; School of Healthcare Science, Manchester Metropolitan University, Manchester, England (CM), United Kingdom.

Postpartum depression and anxiety, which affect 10-20% of mothers, have negative effects on the health of both mother and offspring through effects on maternal behavior, yet little is known about the etiology of these disorders and specific treatment options are extremely limited. The hormones oxytocin (OXT) and vasopressin (AVP) are both potent mediators of maternal behavior and have been implicated in perinatal depression and anxiety etiology. Furthermore, postpartum OXT is now recommended for all births in the US to prevent postpartum hemorrhage. One of the strongest predictors for depression and anxiety disorders is exposure to early life chronic social stress (ECSS). This project tested the efficacy of intranasal (IN) OXT and AVP in a ECSS based rodent model of postpartum depression and anxiety. The hypothesis was that these IN treatments would prevent ECSS induced depression of maternal care and associated increase in maternal anxiety. Maternal rats exposed to ECSS and non-stressed controls were administered intranasal saline, AVP, or OXT on day 2 of lactation and tested for maternal care and anxiety. Results indicate that IN AVP effectively prevented the ECSS induced depression of maternal care and increased maternal anxiety. In contrast, IN OXT treatment was ineffective at preventing the adverse effects of ECSS. These results are interesting given our recent clinical epidemiology report of a positive association between peripartum Pitocin exposure and depression and anxiety. The data support the hypothesis that intranasal AVP may be an effective preventative measure and/or treatment for postpartum mood disorders, and underscore the need for additional work on the effects of AVP and the current clinical use of perinatal OXT.

Research supported by: Brain and Behavior Research Foundation NARSAD award to BCN

The authors have no conflicts of interest to declare.

Poster 57

EFFECTS OF CHRONIC INTRANASAL OXYTOCIN ON PARENTAL SUCCESS IN BIPARENTAL TITI MONKEYS (*CALLICEBUS CUPREUS*)

Bales KL; Goetze LR; Jacob S; Conley AJ; Berger T; Mendoza SP

Department of Psychology, University of California, Davis, and California National Primate Research Center (KLB, LRG, SPM); Department of Psychiatry, University of Minnesota (SJ); Department of Population Health and Reproduction, UC-Davis (AJC); Department of Animal Science, UC-Davis (TB), USA.

Intranasal oxytocin (OXT) is currently in clinical trials as a treatment for autism spectrum disorders. This potentially chronic use raised the question of how long-term treatment may differ from the acute effects of OXT. In the current study, we used titi monkeys, a socially monogamous and biparental species, to examine long-term effects on a number of variables including parenting behavior. We treated 29 titi monkeys (group n = 7-8) with either intranasal OXT (0.8 IU/kg/day) or intranasal saline, once daily during the peripubertal period (12 months of age to 18 months of age). They were paired at 30 months of age to a reproductively proven mate, and we collected data on reproduction and parental care. 12 out of 14 female subjects and the mates of all male subjects conceived. Time to first conception did not differ significantly for OXT or SAL animals. The first pregnancy ended in live births for all animals except for three miscarriages and one stillbirth, which were not predicted by treatment. However, it was significantly more likely for a first liveborn offspring to survive if its treated parent had received OXT, than if the parent had received SAL. Within offspring that survived to one month, parental care received did not differ based on treatment of the parent. It is therefore most likely that OXT treatment as a juvenile led to increased tolerance or decreased rejection of a first offspring by the treated parent. This study found no negative side effects of long-term OXT treatment on reproduction, while suggesting that adolescent OXT treatment might have beneficial long-term effects on parental behavior.

Research supported by: HD071998, Good Nature Institute, OD011107

The authors have no conflicts of interest to declare.

Poster 58

HISTONE DEACETYLASE INHIBITOR TREATMENT PROMOTES SPONTANEOUS CAREGIVING BEHAVIORS IN C57BL/6J VIRGIN MALE MICE

Mayer HS; Crepeau M; Duque-Wilkens N; Torres LY; Trainor BC; Stolzenberg DS

Department of Psychology, University of California, Davis, USA

Whereas the majority of mammalian species are uni-parental with the mother solely provisioning care for young conspecifics, fathering behaviors can emerge under certain circumstances. For example, a great deal of individual variation in response to young pups has been reported in multiple inbred strains of laboratory male mice. Further, sexual experience and subsequent cohabitation with a female conspecific can induce caregiving responses in otherwise indifferent, fearful or aggressive males. Thus, a highly conserved maternal neural circuit is likely present in both sexes, however the extent to which infant conspecifics are capable of gaining access to this circuit may depend on several factors. In support of this idea, we have recently found that fearful or indifferent responses toward pups in females are linked to greater immediate early gene (IEG) expression in a fear/defensive circuit involving the anterior hypothalamus than to an approach/attraction circuit involving the ventral tegmental area. However, experience with infants, particularly in combination with histone deacetylase (HDAC) inhibitor treatment, can reverse this pattern of neuronal activation and behavior. Thus, we have hypothesized that HDAC inhibitor treatment may increase the transcription of primed or poised genes that play a role in the activation and perhaps long-term selection of a maternal approach circuit in response to pup stimuli. Here, we asked whether HDAC inhibitor treatment would impact behavioral response selection and associated IEG expression changes in virgin male mice that are capable of ignoring, attacking or caring for pups. Our results indicate that systemic HDAC inhibitor treatment induced spontaneous caregiving behavior in non-infanticidal male mice. These data suggest that HDAC inhibitor treatment impacts behavioral response selection by promoting caregiving behavior and eliminating avoidant behavior, thus a similar experience-dependent amplification of caregiving behavior may occur in both male and female mice.

Research supported by: NICHD R01HD087709

The authors have no conflicts of interest to declare.

Poster 59

PARENTAL EXPERIENCE ATTENUATES A NEUROTOXIN-INDUCED NEURODEGENERATION IN THE HIPPOCAMPUS OF MALE MICE

Anagnostou I; Morales T

Department of Cellular and Molecular Neurobiology, Institute for Neurobiology, UNAM, Mexico

It has been shown that the hippocampus (HP) of the lactating dam is less sensitive to excitotoxic damage by kainic acid (KA) than that of virgin rats and part of this effect is attributed to prolactin (PRL) actions. We currently do not know the effects of paternity on such protection. To address this question, male virgin adult CD 1 mice were paired with females and co-housed throughout pregnancy. On the day of parturition (PD0) the animals were randomly assigned to two groups: a) the pregnancy (Pr), (sires placed in an individual cage and injected with KA (100 ng/1 µl SAL) or with saline (SAL-1 µl) i.c.v. on PD1), and b) the paternity group (P) (sires in the home-cage with the lactating dam and the pups until day PD8, when they underwent the i.c.v. injection shortly after the evaluation of parental behavior). The control group consisted of male virgin mice subjected to the i.c.v. injections. All animals were sacrificed 48 h after the i.c.v. injection in order to process for histology and measure neurodegeneration (NeuN, FluoroJade-C), as well as astrogliosis (GFAP) in the CA1, CA3 and CA4 subfields of the HP. Males of the P group had diminished levels of neurodegeneration after KA-lesioning, accompanied by a decrease in astrogliosis, in comparison with the control and Pr group. These results indicate that experiencing the environment of paternity can diminish the neurodegeneration probably via changes in the hormonal profile.

Research supported by: UNAM-DGAPA- PAPIIT-IN202315, and CONACYT Scholarship to I.A. (project number 406166)

The authors have no conflicts of interest to declare.

Poster 60

AGGRESSIVE ENCOUNTERS ALTER CORTICOSTERONE BUT NOT PATERNAL BEHAVIOR IN THE CALIFORNIA MOUSE.

Muller L; Forbes J; Leithead A; Sami A; Slattery K; Becker E. Department of Psychology, Saint Joseph's University, USA

Peromyscus californicus is one of few monogamous and biparental species, which makes it a useful model for characterizing parental behaviors. The father's role is of particular interest given that the father's presence and participation in parenting, particularly through the retrieval behavior, increases offspring testosterone levels and programs future aggressive behavior. For a territorial species such as the California mouse, this plasticity in aggression may be adaptive. The theory of anticipatory parental effects posits that parents increase offspring fitness by shaping the phenotype of their offspring to best match the anticipated environment. This theory is predicated firstly on the assumption that parents change their behavior in response to cues from the environment, and secondly, that through these changes in parental behavior, information is transmitted to offspring in order to increase offspring fitness. In the current study, we tested the first part of the anticipatory parental effect hypothesis, that parental behavior is plastic in response to the environment. We simulated aggressive environments by exposing fathers to 0, 1 or 3 resident-intruder tests and then examined paternal retrieval behavior. Surprisingly, we found no significant effect of exposure to aggression on paternal retrieval behavior. Additionally, we collected baseline (time 1) and post-aggression (time 2) plasma corticosterone samples as a measure of stress and found a significant effect of condition on corticosterone level at time 2, $H(2) = 6.06$, $p = .048$, where increased exposure to aggression resulted in increased corticosterone level, $J = 303.00$, $p = .012$. This is interesting because previous studies in the California mouse have revealed no differences in corticosterone levels between males without offspring exposed to resident-intruder tests and controls not exposed to aggression. Our results suggest that being exposed to territory intrusions while parenting may be more stressful than when males do not have offspring.

Research supported by: Saint Joseph's University Sigma Xi grant; Nicholas and Susan Nicolaides Research Fellowship

The authors have no conflicts of interest to declare.

Poster 61

THE SELECTIVE DOPAMINE β-HYDROXYLASE INHIBITOR NEPICASTAT INHIBITS PUP-DIRECTED BEHAVIOR IN VIRGIN MALE CALIFORNIA MICE

Acosta MC; Saltzman W

Neuroscience Graduate Program & Department of Evolution, Ecology, and Organismal Biology, University of California, Riverside, USA

The neural mechanisms underlying paternal care in biparental mammals are not well understood. The California mouse (*Peromyscus californicus*) is a monogamous rodent in which fathers participate extensively in all of the same parental behaviors as mothers, with the exception of nursing. While virtually all fathers are attracted to pups, virgin male California mice vary widely in their behavior toward unrelated pups upon exposure, ranging from attacking to avoiding to huddling and grooming pups. The difference in pup-directed behavior between virgin males and fathers suggests that the neurochemical control of pup-related behavior changes as males' transition into fatherhood. The current study tested the hypothesis that norepinephrine (NE) facilitates the initiation of nurturant behavior toward pups in virgin male California mice. The selective and potent dopamine β-hydroxylase inhibitor Nepicastat was administered to inhibit NE synthesis. Nepicastat or vehicle solution was injected intraperitoneally 2 hours prior to exposing virgin male mice to a novel pup for 60 min. A second 60-min pup test was performed 24 hours following drug administration. Our results suggest that blocking NE synthesis inhibits interactions with pups in pup-naïve virgin males: only 1 of 7 Nepicastat-treated males approached and interacted with the pup during the first test, whereas all of the 9 vehicle-treated males did so. However, approach behavior did not differ between treatment groups during the second pup test, 24 hours following drug administration. Therefore, our data indicate that NE may play an important role in the initiation of paternal behavior in male California mice.

Research supported by: NSF grant IOS 1256572

The authors have no conflicts of interest to declare.

Poster 62

PATERNAL RETRIEVAL PROGRAMS MATERNAL RETRIEVAL BEHAVIOR IN FEMALE CALIFORNIA MOUSE OFFSPRING

Leithead AB; Becker EA

Department of Psychology, Saint Joseph's University, USA

Early interactions with parents play a significant role in the development of behavioral phenotypes in offspring. In mother-daughter dyads, maternal behavior is transmitted via epigenetic modifications of the DNA. Although the mechanisms of patrilineal transmission remain largely untested because paternal care is rare among mammals, in the California mouse (*Peromyscus californicus*) paternal retrievals influence long-term changes in male offspring behavior and arginine vasopressin (AVP) expression in the brain. Few studies examine opposite-sex parental effects, yet in California mice, AVP expression and aggressive behavior in females is also modulated by paternal retrievals. Since AVP also regulates maternal behavior, we posited that paternal retrievals might also shape female offspring parental behavior in adulthood. In the present study, we sought to establish a relationship between the experience of paternal retrieval and the expression of maternal behavior by exposing female California mouse pups to a paternal retrieval manipulation to create populations of either high paternal care (HPC) or low paternal care (LPC) during a critical period in early development. In adulthood, maternal behavior was observed daily for 7 consecutive days for 20 minutes following a displacement challenge (removing pups from the nest and placing them in the opposite corner of the cage). Blood from focal females was analyzed for concentrations of AVP. Results indicated that HPC females performed more retrievals/grabs in response to the displacement challenge than LPC females. No differences were observed between HPC and LPC females in Huddling, licking, grooming, nursing, nest building, and activity-related behaviors. Interestingly, no differences in plasma AVP were observed between HPC and LPC females. Therefore, the experience of paternal retrievals in development may specifically shape expression of the behavior in adulthood in California mice; however, basal levels of AVP are not reflective of this transmission of behavior.

Research supported by: Sigma Xi Grants-in-Aid of Research

The authors have no conflicts of interest to declare.

Poster 63

WITHIN-LITTER MATERNAL CARE AND GENOTYPE AFFECT DOPAMINERGIC PHENOTYPES IN FEMALE RAT OFFSPRING

Lauby SC; Chatterjee D; Pan P; McGowan PO; Fleming AS

Department of Biological Sciences, University of Toronto Scarborough (SCL & POM); Department of Psychology, University of Toronto (POM); Department of Physiology, University of Toronto (POM); Department of Psychology, University of Toronto Mississauga (ASF); MD Program, Faculty of Medicine, University of Toronto (PP); The Peter Gilgan Centre for Research and Learning, Sickkids Hospital (DC), Canada

In rats, maternal licking/grooming of pups varies between litters and between siblings within a litter. These variations in maternal care, influenced by the dopaminergic system, can be transmitted between generations. Between-litter maternal care is known to be associated with alterations in the dopaminergic system in offspring; however, it is not known whether within-litter maternal care produces similar phenotypes. In addition, genetic variation can affect gene expression and may affect responsiveness to licking/grooming and later-life dopaminergic signaling. We observed maternal care briefly every other day during the first week postpartum and measured duration/frequency of licking of differentially marked female pups. Adult offspring were either tested in a Differential Reinforcement of Lower Rates task (20 seconds; DRL-20), a measure of impulsivity, a behavioural flexibility task that assessed strategy shifting, and a sucrose preference task. Single nucleotide polymorphisms (SNPs) in the dopamine receptor 2 (DRD2) gene were examined. Levels of dopamine (DA) and its metabolite DOPAC were measured by HPLC in the medial prefrontal cortex (mPFC), core and shell of the nucleus accumbens (NAC), medial preoptic area (MPOA), and ventral tegmental area (VTA). Results indicate that DRD2 genotype moderated the effects of average licking bout on behavioural flexibility performance but not DRL-20 or sucrose preference. Maternal care was not associated with baseline dopamine turnover (DOPAC/DA ratio), but the A/G and G/G DRD2 genotype increased dopamine turnover in the NAC in virgin female offspring. Preliminary findings suggest that dopamine turnover in the NAC and VTA in primiparous offspring are higher than in virgins and are also differentially affected by DRD2 genotype. Overall, this study demonstrates the effects of DRD2 genotype on dopaminergic signaling and early-life gene x environment interactions on later-life dopamine-mediated behaviour. However, contrary to our hypothesis, the effects of early-life licking or DRD2 genotype on behavior are not mediated by dopamine turnover.

Research supported by: Natural Sciences and Engineering Research Council of Canada grant to ASF and POM.

The authors have no conflicts of interest to declare.

Poster 64

EARLY-LIFE STRESS INCREASES VULNERABILITY TO DEVELOP COGNITIVE AND METABOLIC DYSFUNCTION: CROSS TALK BETWEEN STRESS, INFLAMMATION AND NUTRITION

Korosi A; Hoijmaker L; Yam K-Y; Kitty R; Silvie R; Abbink M; Kotah J; Naninck E

Brain Plasticity Group, Center For Neuroscience, Swammerdam Institute for Life Sciences, University of Amsterdam, the Netherlands

Early-life stress (ES) is associated with increased vulnerability to cognitive impairments as well as metabolic disorders like obesity later in life. We investigate the role of a synergistic effect of stress, metabolic factors, nutrition and the neuroimmune system in this early-life induced programming. We use an established model of chronic ES and expose mice to limited nesting and bedding material during first postnatal week and study the central and peripheral systems under basal and challenged conditions (i.e. LPS, amyloid accumulation, western style diet (WSD) and exercise) to gain further insight in the functionality of brain plasticity, microglia and adipose tissue. In addition, given the high nutritional demand during development, we propose that early nutrition is critical for programming of brain and body. We focus on essential micronutrients and fatty acids and propose that an early dietary intervention with a diet enriched with these nutrients might protect against ES-induced functional deficits. We show that ES leads to cognitive impairments associated with reduced hippocampal neurogenesis at basal conditions as well as in response to exercise, primed microglia with exaggerated response to LPS or amyloid accumulation. Metabolically, ES mice exhibit a leaner phenotype but they accumulate more fat in response to WSD. Finally, with an early dietary intervention with micronutrient or fatty acid we were able to (at least partly) prevent ES-induced cognitive decline, likely mediated by modulation of microglia, without however affecting the ES-induced metabolic profile. These studies give new insights for the development of targeted dietary interventions for vulnerable populations.

Research supported by: NWO Meervoud, NWO Food Cognition and Behavior, JPI NutriCoG, ISAO

The authors have no conflicts of interest to declare.

Poster 65

PERINATAL BISPHENOL A EXPOSURE: EFFECTS ON CIRCULATING GLUCOCORTICOID LEVEL IN POSTPARTUM DAMS AND NEONATAL OFFSPRING

Fong-McMaster C; Wilson S; Hajjar JM; Phillips KP; Konkle ATM

Biomedical Science, Faculty of Sciences, University of Ottawa (CFM); Interdisciplinary School of Health Sciences, Faculty of Health Sciences, University of Ottawa (SW, JMH, KPP, ATMK); School of Psychology, Faculty of Social Sciences, University of Ottawa (ATMK); University of Ottawa Brain and Mind Research Institute, Canada (ATMK)

Bisphenol A (BPA) is a common xenoestrogen found in plastic consumer products. As a potent endocrine disruptor, BPA has been shown in vivo to modulate physiological functions as both an estrogen receptor agonist and antagonist. However, little is known about the impact of BPA exposure on maternal glucocorticoid levels and development of the stress axis in rodent pups. The aim of this study was to assess circulating levels of corticosterone in BPA-treated dams and rat pups perinatally exposed to BPA. Dam trunk blood was collected on postpartum day 15 and pup samples were collected at either postnatal day 5 (PND5) or PND15. Plasma fractions were removed and stored at -80℃ for later use in quantifying corticosterone levels by enzyme-linked immunosorbent assay. Treatment had no significant effect on dam corticosterone levels (Kruskal-Wallis analysis). While there was no interaction between treatment, age and sex on the levels of circulating corticosterone (ANOVA), or any combination of these factors, plasma corticosterone levels were higher in PND15 compared to PND5 rat pups (ANOVA, $P < 0.05$). Overall, these data contribute to the limited knowledge regarding the effects of environmental perturbations on development of the stress axis.

The authors have no conflicts of interest to declare.

Poster 66

RAISED WITHOUT A FATHER: MONOPARENTAL CARE IMPAIRS THE PREFERENCE FOR MALE ODORS IN FEMALE PRAIRIE VOLES

Valera-Marín G; Díaz N; Young LJ; Camacho FJ; Paredes R; Portillo W

Instituto de Neurobiología, Universidad Nacional Autónoma de México (GVM, JCF,RP,WP); Instituto Nacional de Perinatología, Isidro Espinosa de los Reyes. Mexico (ND); Emory University, Atlanta, Georgia, USA (LJY)

Most modern societies are increasing the engagement of the father in the raise of the children resulting in behavioral, emotional and cognitive benefits for the progeny. However, the neurobiological effects of biparental care are not well understood. *Microtus ochrogaster*, the prairie vole, is a good animal model for studying biparental care (BP) because they build a strong pair bond and share the care of the offspring. Voles raised only by their mother (monoparental, MP) need more time as adults to build a pair bond. We evaluated if the delay in pair bond formation is related with alterations in olfaction and/or sexual behavior. Our results show that BP pups were more frequently licked ($p<0.05$, $F_{1,15}= 4.778$) than MP voles. When adult, both groups of male and female voles were able to discriminate between different odors ($p<0.001$) but MP females did not show preference for male-soiled bedding ($F_{2,18}=1.779$, $p>0.05$) as biparental females did ($F_{2,18} =14.333$, $p<0.001$). Our data showed no differences in the anogenital sniffing or the lordosis quotient between female groups. No differences were found between male groups in their preference for female-soiled bedding or their sexual behavior with receptive females. Our experiments demonstrate that monoparental raising decreases the preference for male odors in the females but does not impair mating in male or female voles.

Research supported by: CONACYT252756,253631; FRONTERAS374; IN203615,202818;210215; INPER212503230-21216-05-15; NIHP51OD11132

The authors have no conflicts of interest to declare.

Poster 67

DEVELOPMENTAL-SENSITIVITY OF ADRENAL GLUCOCORTICOID RECEPTOR EXPRESSION TO PERINATAL BISPHENOL A EXPOSURE IN MALE AND FEMALE RAT PUPS

Hajjar J; Konkle ATM; Phillips KP

Interdisciplinary School of Health Sciences, Faculty of Health Sciences, University of Ottawa (JH, ATMK, KPP); School of Psychology, Faculty of Social Sciences, University of Ottawa (ATMK); University of Ottawa Brain and Mind Research Institute (ATMK), Canada

Background: Bisphenol A (BPA) is an established reproductive and developmental toxicant in animal models. As a xenoestrogen, BPA can dysregulate the hypothalamic-pituitary-adrenal (HPA) axis thereby disrupting stress regulation. Objective: Characterization of molecular effects of perinatal BPA exposure on rat adrenal glucocorticoid receptor (GR) expression. Methods: Long-Evans pregnant dams placed in 5 groups: sucrose vehicle (VEH), positive control (diethylstilbestrol (DES 5µg/kg/day), 3 low doses of BPA (5, 50, 500µg/kg/day). BPA exposure occurred from gestational day 9-11 through postnatal (PND) 4. Adrenals collected PND-5 and PND-15. Adrenal RNA isolated and quantified by qPCR. GR expression normalized to GAPDH by delta delta CT method. Results: BPA exposure did not significantly change normalized GR expression in PND-5 female pups, but did significantly upregulate GR expression in female PND-15 DES, BPA-5 and BPA-500 groups (fold change >2.0). In contrast, BPA exposure in male pups resulted in upregulated GR expression in PND-5 BPA-50 and PND-15 BPA-500 groups (fold change >2.0), while DES consistently downregulated GR expression in both PND-5 and PND-15 male pups (fold change <0.5). Conclusion: Adrenal GR expression in PND-15 female pups was developmentally more sensitive to DES and BPA exposures compared to PND-5 pups. Sex differences were noted in the pattern of DES and BPA-sensitivity between male and female pups.

Research supported by: Faculty of Health Sciences, University of Ottawa

The authors have no conflicts of interest to declare.

Poster 68

PRECOCIOUS FEAR EXPRESSION IN RAT PUPS AND ITS ASSOCIATION WITH EARLY MATURATION OF AREAS RELATED WITH FEAR CONTROL

Zuluaga MJ; Ferreira A

Sección Fisiología y Nutrición, Facultad de Ciencias, Universidad de la República, Uruguay

During early lactation, for neonatal rats, their mother is the main source of stimulation and information from the environment and modulates through its behavior their cognitive and emotional development. Thus, neonatal rats present a stress hyporesponsiveness period (SHRP) whose maintenance depends on maternal stimulation. The SHRP is characterized by an absence of behavioral and endocrine responses of fear towards a social aversive stimulus, like an unfamiliar male, and by a lack activation of neural circuitry related to control of fear. We reported that the prolonged exposure to an unfamiliar male in the home cage provoke in the mother an alteration in it maternal behavior, which accelerate the expression of fear responses in pups during the SHRP. We postulate that the precocious fear expression in pups, caused by the exposure with their mothers to unfamiliar males, is based on the early maturation of neural circuits involved in the control of fear. To this aim we repeatedly exposed the mother-litter dyad to unfamiliar males or an empty cage and subsequently evaluated in 8 and 14-day-old pups their fear responses (reduction on ultrasonic vocalizations and increase on time in immobility) toward an anesthetized male. Finally the expression of c-Fos protein was quantified by immunohistochemistry in amygdala and paraventricular nucleus of the hypothalamus, neural areas related with the control of fear. We observed that the precocious fear response in pups exposed to an unfamiliar male, is associated with the early activation of the amygdala and the nucleus paraventricular. These results suggest that the acceleration in the expression of fear responses is due to an early activation of neural circuits that control these responses.

Research supported by: PEDECIBA, CSIC

The authors have no conflicts of interest to declare.

Poster 69

PRE-ADOLESCENT OXYTOCIN TREATMENT INCREASES SOCIAL INVESTIGATION DEPENDENT NO SEX AND MATERNAL FLUOXETINE EXPOSURE

Qiu W; Minielly NC; Go K; Black N; Splinter J; Duarte-Guterman P; Galea LAM

Department of Psychology, University of British Columbia (WQ, NCM, LAMG,KG,NB,JS, PDG); Graduate Program in Neuroscience, University of British Columbia (LAM, WQ), Canada

Postpartum depression (PPD) affects approximately 15% of women. Selective serotonin reuptake inhibitors (SSRIs) use during pregnancy or the postpartum is often a first-line treatment, yet SSRIs effects on child development are largely unknown. SSRIs can enter breastmilk and cross the placental and blood-brain barrier, exposing the fetus and breastfeeding infant to increased serotonin levels. SSRI exposure during development has been associated with increased rates of autism spectrum disorder (ASD), and anxiety. A key characteristic of ASD is social deficits. Oxytocin is thought to promote prosocial behaviour. Therefore, oxytocin is in trials to mitigate ASD social deficits. However, oxytocin does not readily cross the blood-brain barrier. In this study oxytocin was coupled with TriozanTM, a drug delivery system thought to facilitate large peptides across the blood-brain barrier. This study used a corticosterone-induced rodent model of PPD along with a concurrent SSRI, fluoxetine. The purpose of this study was to determine maternal corticosterone and/or fluoxetine effects on offspring development, and if any social or neurological deficits can be mitigated with pre-adolescent offspring oxytocin administration. We hypothesized fluoxetine would alter offspring anxiety and social behaviour, which would be mitigated by oxytocin. Corticosterone and/or fluoxetine were administered to the dams postpartum day 2-23. Oxytocin and TriozanTM, were administered to the offspring postnatal day (PND) 25-34. Offspring social investigation, and anxiety behaviour testing were conducted on PND 35-37 and PND 70-73. Oxytocin + TriozanTM increased social investigation in females after maternal fluoxetine exposure but decreased social investigation after maternal vehicle exposure. These data suggest TriozanTM facilitates oxytocin's effects when administered peripherally in females. Moreover, oxytocin has sex and context-specific effects. Maternal corticosterone and fluoxetine decreased adolescent offspring anxiety. These results may have implications for PPD and ASD oxytocin treatment.

Research supported by: operating grant to LAMG (CIHR MOP-142308). Support in kind from Ovensa, Inc.

The authors have no conflicts of interest to declare.

Poster 70

THE EFFECTS OF POSTNATAL CLOMIPRAMINE TREATMENT ON LATER POSTPARTUM OBSESSIVE-COMPULSIVE-LIKE BEHAVIOR AND CORTICAL SEROTONIN IN RATS

Ragan CM; Regula B; Shah N

Department of Psychology, Purdue University Northwest (CMR); Department of Psychology, Purdue University Northwest (BR); School of Medicine, St. George's University (NS), USA

Postpartum anxiety disorders affect upwards of 20% of women in the United States. Furthermore, approximately 1 in 10 new mothers experience postpartum obsessive-compulsive disorder (OCD) which is characterized by intrusive thoughts such as accidentally harming the infant, followed by behaviors including repeatedly checking in on infant when he/she sleeps. This disorder can also co-occur with other disorders like postpartum depression. Disruptions in serotonin mechanisms in the orbital frontal cortex of the brain have been implicated in the disorder in male and non-maternal populations, however the regulation of these disruptions is not entirely clear, especially during the postpartum period. To examine the contribution of serotonin to postpartum OCD, our laboratory used a pharmacological model of induced OCD. During postnatal days 9-16, neonates were injected with 15 mg/kg clomipramine which is a tri-cyclic anti-depressant that blocks the serotonin and norepinephrine transporters, or saline as a control twice daily. Then in adulthood, females were mated and their undisturbed maternal behavior and OCD-like behavior on the hole board test were examined during the first postpartum week. On postpartum day 7, dams were sacrificed, brains dissected, and the orbitofrontal cortex was isolated to examine serotonin-related gene expression. We found that dams that were treated with clomipramine as neonates spent significantly less time in an active crouching nursing posture compared to saline mothers. The clomipramine-treated females also showed more OCD-like behavior, measured by repeated hole pokes, on the hole board test during the postpartum period compared to control females. We are currently investigating 5HT2C gene expression in the orbitofrontal cortex of these mothers. Our results suggest that early disruption of monoaminergic systems may be associated with OCD in the postpartum period.

Research supported by: Colgate University Research Council; PNW Undergraduate Research Grant

The authors have no conflicts of interest to declare.

Poster 71

EFFECTS OF A NOVEL METHOD TO INCREASE MATERNAL CARE ON CORTICOSTERONE LEVELS IN RAT PUPS

Roberge CL; Saffar M; Tilson K; Wallin C; Brummelte S

Department of Psychology, Wayne State University, Detroit, Michigan, USA

In human neonates, increased skin-to-skin contact with the mother can improve development and health stability in at-risk infants which may be mediated through decreased levels of infant cortisol. Further, animal models using natural variation in maternal care have shown that increased licking and grooming behavior can significantly influence the offspring's adult phenotype. The goal of the current project is to investigate the acute effects in our novel rodent model of increased maternal care on the offspring's stress response system. For this, half the pups from five litters will be covered in a palpable food (Nutella®), which will entice the dams to lick these pups significantly more compared to their untreated littermates as our previous pilot data has shown. In the current study, pups will be exposed to Nutella® four times a day from postnatal day (PD) 2-5 and maternal care (i.e. licking and grooming behavior) will be observed during each session. Male and female pups will be sacrificed via live decapitation immediately following the last Nutella® session on PD 5. Blood will be collected for ELISA assays for corticosterone levels and brains will be processed with high-pressure liquid chromatography for several neurotransmitter levels. We hypothesize that the increasing licking and grooming will results in lower baseline corticosterone and altered dopamine levels in male and female pups. Increasing maternal care using this translational model can be used in future studies to investigate long-term developmental effects in rat pups exposed to early-life stressors such as neonatal pain.

Research supported by: Start-up funds to SB

The authors have no conflicts of interest to declare.

Poster 72

DO MATERNAL GLUCOCORTICOIDS TRANSMIT THE PROGRAMMING EFFECTS OF MATERNAL STRESS TO THE FETUS?

Sze Y; Fernandes J; Brunton PJ

The Roslin Institute and Centre for Discovery Brain Sciences, University of Edinburgh, United Kingdom

Despite attenuated hypothalamo-pituitary-adrenal (HPA) axis responses to acute stress in pregnancy, chronic maternal stress exerts negative programming effects on the developing offspring. Here we investigated whether excess maternal glucocorticoid transfer to the fetus is the mechanism by which this occurs. Local concentrations of glucocorticoids are modulated by 11β-hydroxysteroid dehydrogenase (11βHSD) enzymes. In the brain, 11βHSD1 reactivates glucocorticoids, regulating glucocorticoid negative feedback of the HPA axis; whilst in the placenta, 11βHSD2 inactivates glucocorticoids, regulating glucocorticoid transfer across the maternal-fetal interface.

Pregnant rats were exposed to 10 min social stress/day from day 16 to 20 of pregnancy. Rats were killed following the final bout of stress and blood/tissues collected. Maternal plasma ACTH concentrations were measured by radioimmunoassay, while corticosterone concentrations were quantified using liquid chromatography-mass spectrometry. In situ hybridisation was performed to quantify mRNA expression for 11βHSD2 in the placenta and 11βHSD1 in the maternal brain and pituitary.

Plasma ACTH and corticosterone concentrations were significantly greater in the stressed dams compared with controls. Corticosterone concentrations were also significantly greater in both male and female placentae from stressed dams compared with controls. However, there was no significant effect of maternal stress on fetal plasma corticosterone concentrations in either sex. 11βHSD2 mRNA expression was greater in male, but not female placenta from stressed dams. In the maternal brain, social stress decreased 11βHSD1 mRNA expression in the paraventricular nucleus, dentate gyrus and CA3 of the hippocampus.

In conclusion, although repeated social stress activates the maternal HPA axis, the placental barrier appears intact and seemingly prevents maternal glucocorticoid transfer to the fetus. The data suggest maternal glucocorticoids are not directly involved in transmitting the programming effects of maternal stress to the foetuses. Whether indirect actions of maternal glucocorticoids are involved requires further investigation.

Research supported by: BBSRC, BSN (PJB). University of Edinburgh Principal’s Career Development PhD Scholarship (SY)

The authors declare no conflicts of interest.

Poster 73

PREVENTION OF BDNF METHYLATION AND ASSOCIATED BEHAVIORAL DEFICITS FOLLOWING EXPOSURE TO ADVERSE MATERNAL CARE

Doherty TS; Roth TL

Department of Psychological and Brain Sciences, University of Delaware, USA

Early, adverse experiences are known to affect typical behavioral trajectories, particularly when these experiences occur within the caregiving relationship. Previous work, including that in our lab, has reported that female rats subjected to poor maternal care in infancy grow up to exhibit deficits in care for their own offspring. The mechanisms underlying this phenomenon have yet to be elucidated, though epigenetic alterations have been identified as promising candidates. One of these epigenetic candidates, DNA methylation, is highly responsive to experience and has been associated with several stress-induced behavioral abnormalities. Using the scarcity-adversity model of low nesting resources, our lab has previously reported increased methylation of Bdnf exon IX in the prefrontal cortex of maltreated infant rats, a mark that persists into adulthood. The aim of this work is to determine if drugs known to modify the epigenome, administered concurrent with maltreatment, are sufficient to prevent this altered epigenetic signature in maltreated rats. Upon identification of an effective drug and dose, we seek to determine if prevention of altered epigenetic patterns can ameliorate adversity-induced behavioral deficits such as altered patterns of maternal care. Infant male and female Long-Evans rats were subjected to either nurturing care (from their biological mother or a foster dam) or maltreatment from a foster dam for 30 minutes daily from postnatal days (PN) 1 to 7. Various doses of either HDAC or DNMT inhibitors were administered daily to each group prior to caregiving manipulations and brains were extracted at PN8 for methylation assays. Results thus far suggest that DNMT inhibition is most promising in terms of prevention of stress-induced Bdnf methylation in maltreated females.

Research supported by: NIGMS 1P20GM103653 and NICHD 1R01HD087509-01 to TLR; University of Delaware Dissertation fellowship to TSD

The authors have no conflicts of interest to declare.

Poster 74

THE RELATIONSHIP BETWEEN PARENTING STYLE AND DENDRITIC MORPHOLOGY

Seelke AMH; Bales KL

Department of Psychology & California National Primate Research Center, University of California, Davis, USA

The amount and type of care that a parent provides to its offspring has a large and lasting effect on all aspects of the developing animal's life, including behavioral patterns, neuroanatomical organization, and gene expression. Indeed, subtle differences in parenting style can result in striking differences in offspring phenotype. We have developed a model of natural variation in parenting using prairie voles, a biparental and monogamous rodent. Prairie voles exhibit natural variation in the amount of physical contact they provide to their offspring. The offspring of high contact (HC) show more exploratory and less anxious behavior than the offspring of low contact (LC) parents. We also found differences in the distribution of neuroanatomical connections between brain regions in the offspring of HC and LC parents. HC offspring have a greater density of intrinsic connections, whereas LC offspring exhibit a wider distribution of connections. We hypothesize that these differences in connectional patterns are a result of alterations in dendritic arborization and dendritic spine density. Here we test that hypothesis by examining the brains of male and female offspring of HC and LC parents. The brains were extracted and underwent golgi staining. We identified neurons in three brain regions of interest: medial preoptic area of the hypothalamus (MPOA), primary somatosensory area in the neocortex (S1), and the CA1 field within the hippocampus. We will compare different cellular characteristics, including soma size, dendritic branching, and spine density, in the brains of the offspring of LC and HC parents. These results will shed light upon the mechanisms underlying the anatomical and behavioral differences generated by natural variation in parental care.

Research supported by: UC Davis Psychology Department Discretionary Funds (KLB)

The authors have no conflicts of interest to declare.

Poster 75

THE WEANING PERIOD PROMOTES ALTERATIONS IN THE OREXIN NEURONAL POPULATION OF RATS IN A SUCKLING-DEPENDENT MANNER

Bittencourt JC; Diniz GB; Candido PL; Klein MO; Alvisi RD; Presse F; Nahon JL; Felicio LF

Institute of Biomedical Sciences, University of São Paulo, Brazil (JCB, GBD, PLC, MOK, RDA); School of Veterinary Medicine, University of São Paulo, Brazil (RDA, LFF); Santa Marcelina Medical School, São Paulo, Brazil (PLC); [4]Institut de Pharmacologie Moléculaire et Cellulaire, France (FP, JLN); Université Côte d'Azur, France (FP); Station de Primatologie, France (PF); Center for Neuroscience and Behavior, Institute of Psychology, University of São Paulo, São Paulo, Brazil (JCB)

The orexin immunoreactive neurons are part of an important orexigenic and arousal promoting hypothalamic population. Several groups have investigated these neurons during the lactation period, when several physiological alterations occur in the dam's body to cope with the newly acquired metabolic needs of the litter. Although several studies have probed this population during the early and intermediate stages of lactation, few works have examined its response to weaning, including the cessation of the tactile suckling stimulus as the litter stops nursing. Using double immunohistochemistry for orexin and FOS combined with three dimensional reconstruction techniques, we investigated the synthesis of orexin and its activation at different times during weaning, in addition to the role played by the suckling stimulus. We report here that weaning promoted a decline in the anterior population of orexin immunoreactive neurons and decreased the number of double orexin-FOS neurons labeled in the central dorsomedial hypothalamus, in addition to reducing the overall number of FOS immunoreactive cells in the whole tuberal hypothalamus. Disruption of the suckling stimulus from the pups impaired the decrease in the number of anteriorly located orexin immunoreactive neurons, attenuated the activation of orexin cells in the dorsomedial hypothalamus and reduced the number of FOS-immunoreactive neurons across the whole tuberal hypothalamus. When taken together, our data suggest that the weaning period is necessary to restore neurochemical pathways altered during the lactation period and that the suckling stimulus plays a significant role in this process.

Research supported by: Fundação de Amparo à Pesquisa do Estado de São Paulo [São Paulo Research Foundation – FAPESP], grants #2010/520680 and #2016/022241 [JCB] and #2016/027480 [GBD]. JCB is also a recipient of a grant from the Coordenação de Aperfeiçoamento de Pessoal de Ensino Superior [Agency for the Advancement of Higher Education] and the Comité Français d'Evaluation de la Coopération Universitaire avec le Brésil [French Committee for the Evaluation of Academic and Scientific Cooperation with Brazil], CAPES-COFECUB grant #848/15. JCB is an Investigator with the Conselho Nacional de Desenvolvimento Científico e Tecnológico [National Council for Scientific and Technological Development – CNPq, Brazil], recipient of grant #426378/20164.

The authors have no conflicts of interest to declare.

LIST OF CONFERENCE REGISTRANTS
(as of 6/18/18)

Melina Acosta, University of California, Riverside, United States, macos010@ucr.edu

Daniella Agrati, Facultad de Ciencias, Universidad de la Republica, Uruguay, agrati@fcien.edu.uy

Mayra Almanza, McMaster University, Canada, Almanzam@mcmaster.ca

Mayra Linné Almanza-Sepúlveda, McMaster University, Canada, almanzam@mcmaster.ca

Ilektra, Anagnostou, Institute For Neurobiology, UNAM, Mexico, eta2608@gmail.com

Michelle Arbeitman, Florida State University, United States,michelle.arbeitman@med.fsu.edu

David Ashbrook, Univ of Tennessee Health Science Center, United States, dashbroo@uthsc.edu

Rachael Augustine, University of Otago, New Zealand, rachael.augustine@otago.ac.nz

Malik Asad Awan, Benazir Bhutto Hospital, Rawalpindi Pakistan, malikasad11100@gmail.com

Tracy Bale, University of Maryland School of Medicine, United States, tbale@som.umaryland.edu

Karen Bales, University of California, Davis, United States, klbales@ucdavis.edu

Ilena Bauer, Institute for Diabetes Research and Metabolic Diseases, FMEG Center, Germany, ilena.bauer@uni-tuebingen.de

Laura Been, Haverford College, United States, lbeen@haverford.edu

Denise Belsham, University of Toronto, Canada, d.belsham@utoronto.ca

Ruth Bettelheim, Fresh Ideas, Inc., Virgin Islands (U.S.), freshideasinc.us@gmail.com

Johanna Bick, University of Houston,United States, jrbick@uh.edu

Jackson Bittencourt, University of Sao Paulo, Brazil, jcbitten@icb.usp.br

April Booth, University of California, Davis, United States, abooth@ucdavis.edu

Oliver Bosch, University of Regensburg, Germany, oliver.bosch@ur.de

Robert Bridges, Tufts University, United States, robert.bridges@tufts.edu

Rosie Brown, University of Otago, New Zealand, rosemary.brown@otago.ac.nz

Colin Brown, University of Otago, New Zealand, colin.brown@otago.ac.nz

Susanne Brummelte, Wayne State University, United States, sbrummelte@wayne.edu

Paula Brunton, University of Edinburgh, United Kingdom, p.j.brunton@ed.ac.uk

Elizabeth Byrnes, Tufts University, United States, elizabeth.byrnes@tufts.edu

Mario Caba, Universidad Veracruzana, Mexico, mcaba@uv.mx

Rebecca Calisi, University of California, Davis, United States, rmcalisi@ucdavis.edu

Ioana Carcea, New York University School of Medicine, United States, carcea.ioana@gmail.com

Susanna Carmona, Fundacion Investigacion Biomedica Hospital Gregorio Maranon, Spain, scarmona@hggm.es

Frances Champagne, University of Texas at Austin, United States, fchampagne@utexas.edu

Thierry Charlier, University Rennes1, France, thierry.charlier@univ-rennes1.fr

Debora Christensen, Drake University, United States, debora.christensen@drake.edu

Christine Clemson, Sage Therapeutics, United States, christine.clemson@sagerx.com

James Curley, University of Texas at Austin, United States, curley@utexas.edu

Kimberly D'Anna-Hernandez, California State University San Marcos, United States, kdanna@csusm.edu

Arpad Dobolyi, Eötvös Loránd University, Hungary, dobolyi.arpad@ttk.elte.hu

Tiffany Doherty, University of Delaware, United States, tdoherty@psych.udel.edu

Didac Domenech, Andorra, didac@cevents.es

Paula Duarte-Guterman, University of British Columbia, Canada, paula.duarte@psych.ubc.ca

Aya Dudin, Mcmaster University, Canada, aya.dudin@gmail.com

Ruth Feldman, Interdisciplinary Center (IDC) Herzliya, Israel, feldman.ruth@gmail.com

Luciano Felicio, University of Sao Paulo, Brazil, lfelicio@usp.br

Marcela Ferreño, Facultad de Ciencias, Universidad de la República, Uruguay, marcelaferreno@gmail.com

Alison Fleming, University of Toronto, Canada, alison.fleming@utoronto.ca

Claire Fong-McMaster, University of Ottawa, Canada, cfong006@uottawa.ca

Julia Forbes, Saint Joseph's University, United States, jf644963@sju.edu

Ileana Fuentes, Rutgers The State University Of New Jersey, United States, if110@dls.rutgers.edu

Liisa Galea, University of British Columbia, Canada, liisa.galea@ubc.ca

Jillian Gallagher, Cummings School of Veterinary Medicine at Tufts University, United States, jillian.gallagher@tufts.edu

Stephen Gammie, University of Wisconsin, United States, scgammie@wisc.edu

Teodora Georgescu, University of Otago, New Zealand, teodora.georgescu@otago.ac.nz

Erica Glasper, University of Maryland, United States, eglasper@umd.edu

Diane Goldenberg, University of Southern California, United States, diane.goldenberg2@gmail.com

Selina Gonzales, California State Univeristy San Marcos, United States, gonza423@cougars.csusm.edu

Gabriela Gonzalez-Mariscal, Cinvestav, Mexico, gabygmm@gmail.com

Dave Grattan, University of Otago, New Zealand, dave.grattan@otago.ac.nz

Zachary Grieb, Michigan State University, United States, zgrieb@gmail.com

Julia Hajjar, University of Ottawa, Canada, jhajj058@uottawa.ca

Elseline Hoekzema, Leiden University, Netherlands, e.a.hoekzema@fsw.leidenuniv.nl

Rosalind John, Cardiff University, United Kingdom, JohnRM@cf.ac.uk

Wibke Jonas, Karolinska Institutet, Sweden, wibke.jonas@ki.se

Noriyuki Kawamura, KCGP, GMC, Japan, nkawamura@g-clinic.net

William Kenkel, Indiana University, United States, wkenkel@indiana.edu

Zin Khant Aung, Centre for Neuroendocrinology, University of Otago, New Zealand, zinkhantaung@gmail.com

Pilyoung Kim, University of Denver, United States, pilyoung.kim@du.edu

Sai Komal, National Institute of Mental Health and Neurosciences, India, drkomalsai@gmail.com

Anne Konkle, University of Ottawa, Canada, Anne.Konkle@uOttawa.ca

Aniko Korosi, University of Amsterdam, the Netherlands, a.korosi@uva.nl

KeerthiKrishnan, University of Tennessee, United States, krishnan@utk.edu

Shalini Kumar, University of Otago, New Zealand, shalinipalathinkal@gmail.com

SharonLadyman, University of Otago, New Zealand, sharon.ladyman@otago.ac.nz

Kelly Lambert, University of Richmond, United States, klambert@richmond.edu

Samantha Lauby, University of Toronto Scarborough, Canada, samantha.lauby@mail.utoronto.ca

Grace Lee, California State University San Marcos, United States, lee210@cougars.csusm.edu

Amanda Leithead, Saint Joseph's University, United States, al598901@sju.edu

Andras Hugo Leko, Eötvös Loránd University, Hungary, lekandras@gmail.com

Benedetta Leuner, The Ohio State University, United States, leuner.1@osu.edu

Frederic Levy, Inra Centre Val De Loire, France, frederic.levy@inra.fr

Ming Li, University of Nebraska-Lincoln, United States, mli@unl.edu

Joan Liebermann, George Washington University School of Medicine, United States, joan.liebermann@gmail.com

Joe Lonstein, Michigan State University, United States, lonstein@msu.edu

David Lopez Rodriguez, Liege University, Belgium, dlopez@uliege.be

Anna Lotz, Leiden University, Netherlands, a.m.lotz@fsw.leidenuniv.nl

Rand Mahmoud, University of British Columbia, Canada, rand.mahmoud@psych.ubc.ca

Phyllis Mann, Cummings School of Veterinary Medicine at Tufts University, United States, phyllis.mann@tufts.edu

Magdalena Martinez Garcia, Ciber, Spain, ciber@bcdtravel.es

Marina Martins, UNESP, Brazil, marina.gmartins@gmail.com

Heather Mayer, University of California, Davis, United States, hsmayer@ucdavis.edu

Patrick McGowan, University of Toronto, Canada, patrick.mcgowan@utoronto.ca

Julian Mercer, Rowett Institute, University of Aberdeen, United Kingdom, j.mercer@abdn.ac.uk

Teresa Morales, Instituto de Neurobiologia – UNAM, Mexico, marter@unam.mx

Yoshikazu Morishita, Rutgers University, United States, morishita@dls.rutgers.edu

Linda Muller, Saint Joseph's University, United States, lindamuller@outlook.com

Ben Nephew, Tufts University Cummings School Of Veterinary Medicine, United States, bcnephew@aol.com

Cristie Noschang, UFRGS, Brazil, cristiegn@gmail.com

Szilvia Olah, Eötvös Loránd University, Hungary, olahszilvi@yahoo.com

Alexander Ophir, Cornell University, United States, ophir@cornell.edu

Jodi Pawluski, University of Rennes 1, France, jodi-lynn.pawluski@univ-rennes1.fr

Mariana Pereira, University of Massachusetts Amherst, United States, pereiram@psych.umass.edu

Holly Phillipps, University of Otago, New Zealand, hollian.phillipps@anatomy.otago.ac.nz

Sabrina Pose, School of Science, University of the Republic, Uruguay, spose.c@gmail.com

Wansu Qiu, University of British Columbia, Canada, wansuq805@gmail.com

Christina Ragan, Purdue University Northwest, United States, christina.ragan@gmail.com

Purva Rajhans, University of Iowa, United States, purva-rajhans@uiowa.edu

James Rilling, Emory University, United States, jrillin@emory.edu

Angélica Rivarola, National University of Cordoba, Argentina, arivarola@unc.edu.ar

Forrest Rogers, University of California, Davis, United States, fdrogers@ucdavis.edu

John Russell, University of Edinburgh, United Kingdom, j.a.russell@ed.ac.uk

Helena Rutherford, Yale University, United States, helena.rutherford@yale.edu

Wendy Saltzman, University of California, Riverside, United States, saltzman@ucr.edu

Angie Seech, Maternal Brain Education, United States, angieseechphd@gmail.com

Adele Seelke, University of California, Davis, United States, amseelke@ucdavis.edu

Alexander Seymour, University of Otago, New Zealand, xander.seymour@otago.ac.nz

Gleb Shumyatsky, Rutgers University, United States, gleb@dls.rutgers.edu

Valerie Simonneaux, Centre National de la Recherche Scientifique & University of Strasbourg, France, simonneaux@inci-cnrs.unistra.fr

David Slattery, University Hospital Frankfurt, Germany, david.slattery@kgu.de

Kristina Smiley, University of Otago, New Zealand, kristina.smiley@otago.ac.nz

Danielle Stolzenberg, University of California, Davis, United States, dstolzenberg@ucdavis.edu

Lane Strathearn, University of Iowa, United States, lane-strathearn@uiowa.edu

Ying Sze, University of Edinburgh, United Kingdom, s1564527@sms.ed.ac.uk

Patricia Tomasi, Huffington Post Canada, Canada, tomasi.patricia@gmail.com

Eva Unternaehrer, University of Konstanz, Germany, eunternaehrer@gmail.com

Natalia Uriarte, Facultad De Ciencias, Universidad De La República, Uruguay, natiuria@gmail.com

Guillermo Valera-Marin, Universidad Nacional Autónoma De México, Mexico, guivama@comunidad.unam.mx

Kim van Dijk, Leiden University, Netherlands, k.van.dijk@fsw.leidenuniv.nl

Rechelle Viernes, University of California, Davis, United States, rcviernes@ucdavis.edu

Erika Vitale, Michigan State University, United States, vitalee1@msu.edu

Claire-Dominique Walker, McGill University, Canada, dominique.walker@douglas.mcgill.ca

Zuoxin Wang, Florida State University, United States, zwang@psy.fsu.edu

Nazish Waqas, Holy Family Hospital, Pakistan, nazishwaqas195@gmail.com

Sarah Winokur, University of Massachusetts, Amherst, United States, swinokur@umass.edu

Katherine Wisner, Northwestern University, United States, katherine.wisner@northwestern.edu

Barbara Woodside, Concordia University, Canada, barbara.woodside@concordia.ca

Joanna Workman, University at Albany, United States, jworkman@albany.edu

Maria Jose Zuluaga, Facultad De Ciencias, UDELAR, Uruguay, majosezuluaga@gmail.com