Parental Brain 2022

The 7th International Meeting on the Neuroscience of Parenting

May 16-18th, 2022
St Malo, France

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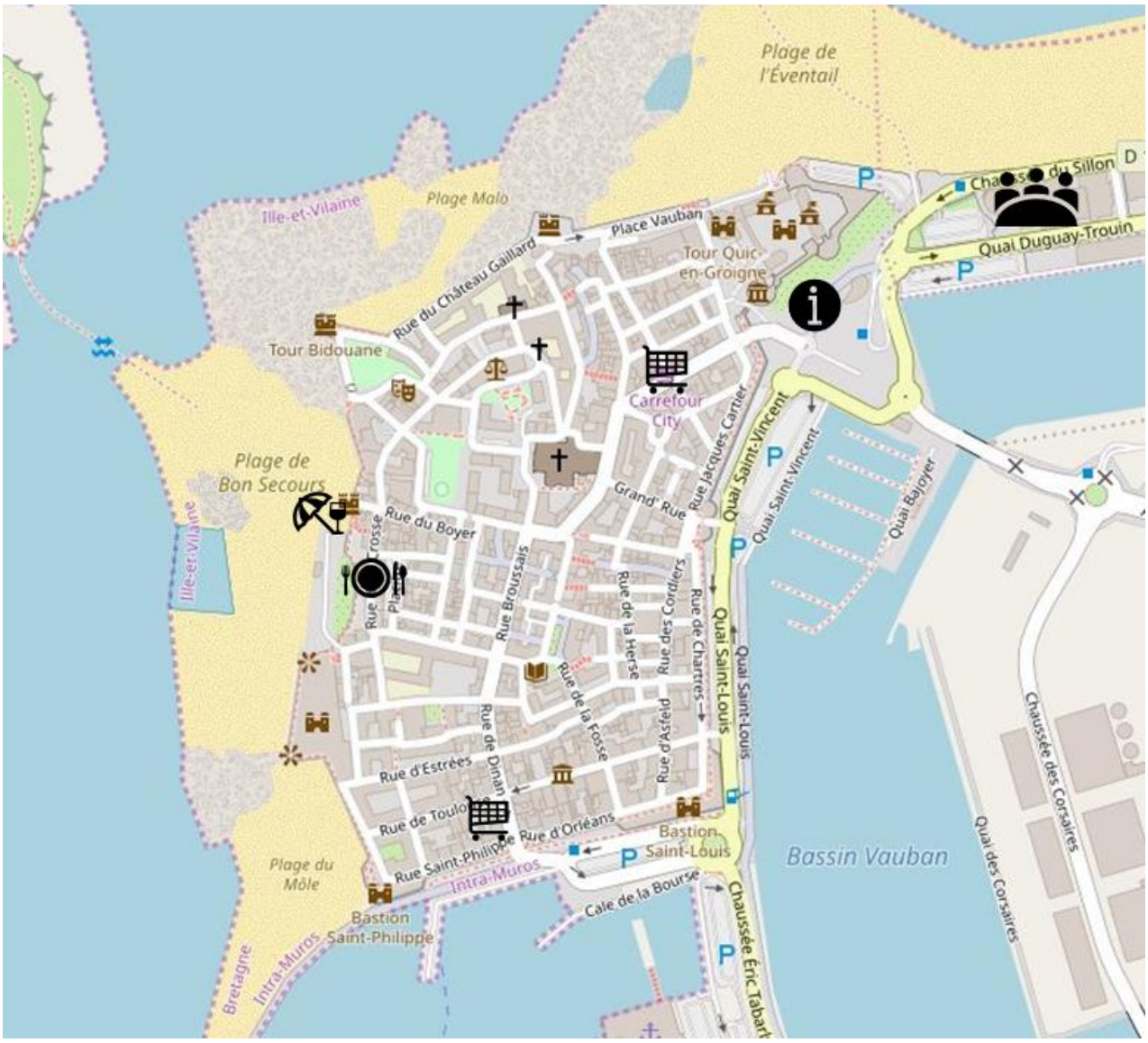

- • Conference centre - Palais du Grand Large
- • Tourist information
- • Trainee Social – L'Embraque
- • Dinner – Restaurant Les Chiens du Guet
- • Markets (Carrefour / Casino)

Parental Brain 2022

7th International Meeting on the Neuroscience of Parenting

Monday, May 16th, 2022

3:30pm to 4:30pm **Registration**

4:30pm to 5:30pm **Pre-meeting Workshop:**
Using Social Media for Science Communication and Outreach
Dr. Cindy Hovington, Curious Neuron (www.curiousneuron.com)
Chair: Dr. Jodi Pawluski (Univ Rennes 1, France)

Tuesday, May 17th, 2022

8:00am to 8:45am **Registration**

8:45am to 9:00am **Welcome**

9:00am to 10:30am **Symposium 1: Maternal Brain Across the Lifespan**
Chair: Dr Kimberly D'Anna-Hernandez (Marquette University, USA)

A longitudinal magnetic resonance imaging study to assess the plasticity of the maternal brain in mice
Dr. Matthieu Keller (Centre INRA Val-de-Loire, France)

Mapping the impact of pregnancy and motherhood on a woman's brain
Dr. Elseline Hoekzema (Amsterdam University Medical Center, NL)

Population-based neuroimaging reveals traces of childbirth in the maternal brain
Dr. Ann-Marie de Lange (Le Centre Hospitalier Universitaire Vaudois, Switzerland)

Neurocognitive Adaptations to Motherhood Across the Lifespan
Dr. Winnie Orchard (Monash University, Australia / Yale University, USA)

10:30am to 11:00am **Coffee Break**

11:00am to 12:30am **Symposium 2: Neural Mechanisms mediating Parental Behavior**
Chair: Dr. France Champagne (UTAustin, USA)

A Brain Switch for Maternal Aggression
Dr. Christian Broberger (Stockholm University, Sweden)

Parenting Control in Mice: From Cell Types to Circuit Function
Dr. Catherine Dulac (Harvard, USA)

Plasticity in central serotonin across reproduction and role in postpartum socioemotional behaviors
Dr. Joe Lonstein (Michigan State University, USA)

Calcitonin receptor-Amylin signaling in the medial preoptic area and the common basis of social affiliation in female mice
Dr. Kumi Kuroda (Riken Center for Brain Science, Japan)

12:30pm to 2:00pm **Lunch on your own**

2:00pm to 2:45pm **Keynote: How stress can influence brain adaptations to motherhood**
Dr. Pilyoung Kim (University of Denver)
Chair: Dr. Joe Lonstein (Michigan State University, USA)

2:45pm to 3:45pm **JNE Young Investigator Symposium**
Chair: Dr. Oliver Bosch (University of Regensberg, Germany)

Maternal depression moderates error-related negativity across pregnancy and postpartum
Sejal Mistry (Texas A&M University, USA)

Impact of a bisphenol A, F, and S mixture and maternal care on the brain transcriptome of rat dams and pups
Dr. Hannah Lapp (University of Texas at Austin, USA)

Neural Correlates of Infant Stimuli and Cannabis use in the Second Trimester
Shannon Powers (University of Denver, USA)

Offspring loss-mediated impact on brain and behavior in rat mothers
Luisa Demarchi (University of Regensburg, Germany)

First-time fathers show longitudinal grey matter cortical volume reductions: evidence from two international samples
Magdalena Martínez-García (Instituto de Investigación Sanitaria Gregorio Marañón, Spain)

A role for lactogenic hormones in maternal motivation in mice
Judith Swart (University of Otago, New Zealand)

3:45pm to 4:00pm **Break**

4:00pm to 4:45pm **Keynote: La Matrescence**
Clémentine Sarlat
Chair: Dr. Jodi Pawluski (Univ Rennes 1, France)

4:45pm to 6:00pm **Posters** (Presenters of even numbered posters)

6:30pm **Trainee Social (L'Embraque)**

Wednesday, May 18th, 2022

9:00am to 10:30am **Symposium 3: Parental Brain – Beyond Rats and Humans**
Chair: Dr. Kumi Kuroda (Riken Center for Brain Science, Japan)

Titi Monkeys (Plecturocebus cupreus) and the Biparental Brain.
Dr. Karen Bales (University of California at Davis, USA)

Mother rabbits: their hormones, brains, and reproductive success.
Dr. Gabriela Gonzalez-Mariscal (CINVESTAV-Universidad Autónoma de Tlaxcala, Mexico)

Neuroendocrine regulation of avian parental behaviour
Prof. Simone Meddle (The University of Edinburgh, UK)

Multi-tasking males: neuroendocrinology of parenting behavior in a sexually plastic fish
Dr. Devaleena Pradhan (Idaho State University, USA)

10:30am to 11:00am **Coffee Break**

11:00am to 12:30am **Symposium 4: Parent-Offspring interactions**
Chair: Dr. Paula Brunton (University of Edinburgh)

Fathers' Brains: Ready to Jump into Fatherhood?
Prof. Dr. Marian Bakermans (Vrije Universiteit Amsterdam, NL)

Learning through Playful Parent-Infant Social Interactions: A Dyadic Neuroscience Perspective
Dr. Victoria Leong (Nanyang Technological University, Singapore)

Interactions between maternal care provisioning and extra-maternal influences in the maternal environment on offspring neurodevelopment and later-life behavior
Dr. Patrick McGowan (University of Toronto, Canada)

Nature, nurture, and neuromodulation in motherhood
Dr. Bianca Jones Marlin (Columbia University, USA)

12:30pm to 2:00pm **Lunch on your own**

2:00pm to 2:45pm **Keynote: Prolactin-induced adaptations in the parental brain**
Prof. Dave Grattan (University of Otago, NZ)
Chair: Dr. Jodi Pawluski

2:45pm to 4:15pm **Symposium 5: Mental Illness and the Parental Brain**
Chair: Dr. Pilyoung Kim (University of Denver)

Sociocultural stressors, cortisol and maternal depression in women of Mexican descent
Dr. Kimberly D'Anna-Hernandez (Marquette University, USA)

Impact of gestational opioids on the maternal brain and behavior
Dr. Susanne Brummelte (Wayne State, USA)

Investigating the maternal brain and caregiving in the context of substance use
Dr. Helena Rutherford (Yale University, USA)

The brain functional and dynamics correlates of working memory and emotional processing in postpartum psychosis
Prof. Paola Dazzan (King's College London, UK)

4:15pm to 4:30pm **Break**

4:30pm to 6pm **Posters** (Presenters of odd numbered posters)

7:00pm **Dinner (Restaurant Les Chiens du Guet, St Malo)**

PRE-MEETING WORKSHOP

USING SOCIAL MEDIA FOR SCIENCE COMMUNICATION AND OUTREACH

Hovington C

Curious Neuron

Science communication is indeed an art, however, in the world of social media, we also need to offer parents more than the findings of a research study. Dr. Cindy Hovington, Ph.D. is the founder founder of Curious Neuron, explains how she grew an online community of 60,000 parents by translating research into applicable bite-sized pieces.

Bio: Cindy Hovington holds a Ph.D. in neuroscience from McGill University. After her postdoctoral fellowship in Science Education, she founded Curious Neuron, an evidence-based parenting resource that translates parenting and child development research into applicable advice for parents. She supports research labs by helping them find participants, hosts the Curious Neuron Podcast (supported by the Tanenbaum Open Science Institute at The Neuro) and is an advisor for children's toy and media companies.

KEYNOTE SPEAKER ABSTRACTS

HOW STRESS CAN INFLUENCE BRAIN ADAPTATIONS TO MOTHERHOOD

Kim P

University of Denver

The early postpartum period represents a sensitive period when new mothers adapt to the highly challenging tasks they encounter in taking care of a newborn. Whether the new parents successfully adapt to parenting or not is critically associated with infants' developmental outcomes. The brains of the mothers undergo dynamic brain morphological and functional changes that support the transition to parenthood. However, some of the mothers unfortunately experience more difficulties in this transition. In this talk, I will review the structural and functional plasticity in human mothers' brains, and how stress that mothers experience can influence the brain and psychological adaptation to parenting. I will also review strategies that the mothers use to cope with stress including active coping styles and prenatal cannabis use and how they may further influence maternal brain responses to infants. I will discuss the early postpartum period as a window of vulnerabilities and opportunities when the maternal brain is influenced by stress, but also susceptible to support and interventions.

LA MATRESCENCE

Sarlat C

Bordeaux, France

La Matrescence is the podcast that goes through the life of parents or parents-to-be to give them tools through interviews with professionals and testimonials from parents. It was created in March 2019 from the realization that finding clear and easy information about what a woman, and by extension a man, goes through when discovering parenthood is not easy. With more than 4 million downloads since its launch in 2019 and 350,000 listens per month, Matrescence is a leader in the parenting world.

Clémentine Sarlat is a French sports journalist, podcaster, speaker, yoga instructor and parent of 3. In 2019 she created *La Matrescence,* a podcast for parents. For more see https://clementinesarlat.com/

PROLACTIN-INDUCED ADAPTATIONS IN THE PARENTAL BRAIN

Grattan DR

Centre for Neuroendocrinology, University of Otago, Dunedin

The pregnant female undergoes many changes to prepare her for the physical and physiological challenges of becoming a mother, including numerous adaptations in the maternal brain. Dynamic fluctuations in key hormones during pregnancy induce these adaptive changes to enable the mother's physiology to adjust to the new demands of these reproductive states and to provide the optimal environment for the development of her baby. Here, I will present evidence showing that the "lactogenic hormones" (i.e. the multiple pituitary and placental hormones that act through the prolactin receptor) are critical for many of the adaptive changes that occur during pregnancy. It is well accepted that prolactin is required for lactation, but it is now clear that these hormones have a much wider role. We have used a variety of mouse models to characterize and manipulate prolactin signalling in the brain, and investigated the consequences changes prolactin action on maternal physiology and behaviour in pregnancy and post-partum. Some roles of prolactin in the maternal brain were perhaps predictable, based on prior literature. We have found that the prolactin receptor in the medial preoptic area is necessary for maternal behaviour, and that its expression in arcuate nucleus kisspeptin neurons is required for the maintenance of lactation infertility. We have also observed a small role for prolactin in promoting food intake in lactation. Some other functions, however, were unexpected. For example, we have shown that prolactin action on GABAergic neurons in the medial preoptic area mediates a profound suppression in voluntary physical activity in pregnancy, and we have exciting new data showing a role for prolactin in thermoregulation. We have also recently discovered a role for prolactin in the ventromedial nucleus of the hypothalamus in moderating levels of maternal aggression. Collectively, we believe these observations are consistent with the hypothesis that prolactin (and its placental homologue placental lactogen) plays a key role in coordinating the behavioural and physiological adaptations to pregnancy in the mother, and lactation could be considered simply another in this suite of prolactin-mediated physiological adaptations. These data highlight a much more comprehensive role for prolactin in the process of mammalian reproduction than is typically considered for this "lactation hormone".

SYMPOSIUM SPEAKER ABSTRACTS

SYMPOSIUM 1: MATERNAL BRAIN ACROSS THE LIFESPAN

A LONGITUDINAL MAGNETIC RESONANCE IMAGING STUDY TO ASSESS THE PLASTICITY OF THE MATERNAL BRAIN IN MICE

Barrière D; Ella A; Szeremeta F; Adriaensen H; Même W; Chaillou E; Migaud M; Même S; Lévy F; Keller M

Physiologie de la Reproduction et des Comportements, UMR INRAE/CNRS/Universitéde Tours/IFCE, Nouzilly, France (DB, AE, HA, EC, MM, FL, MK); UniversitéParis-Saclay, CEA, CNRS, BAOBAB, NeuroSpin, 91191 Gif-Sur-Yvette, France (DB); MRC Cognition and Brain Sciences Unit, University of Cambridge, UK (AE); Complexes Métalliques et IRM, Centre de Biophysique Moléculaire, UPR44301 CNRS, Orléans, France (FS, WM, SM)

Reproduction induces changes within the brain to prepare for gestation and motherhood. However, the dynamic of these central changes and their relationships with the development of maternal behavior remain poorly understood. Here, we describe a longitudinal morphometric neuroimaging study in female mice between pre-gestation and weaning, using new magnetic resonance imaging (MRI) resources comprising a high-resolution brain tem- plate, its associated tissue priors (60-µm isotropic resolution) and a corresponding mouse brain atlas (1320 re- gions of interest). Using these tools, we observed transient hypertrophies not only within key regions controlling gestation and maternal behavior (medial preoptic area, bed nucleus of the stria terminalis), but also in the amygdala, caudate nucleus and hippocampus. Additionally, unlike females exhibiting lower levels of maternal care, highly maternal females developed transient hypertrophies in somatosensory, entorhinal and retrosplenial cortices among other regions. Therefore, coordinated and transient brain modifications associated with maternal performance occurred during gestation and lactation. In conclusion, MRI appears to be an interesting tools to study longitudinal changes occuring in the maternal brain.

MAPPING THE IMPACT OF PREGNANCY AND MOTHERHOOD ON A WOMAN'S BRAIN

Hoekzema E

Amsterdam University Medical Center

Pregnancy involves radical hormone surges and biological adaptations that facilitate a woman's transition to motherhood. Animal studies have demonstrated reproduction-related neural and behavioral changes that are evident across the lifespan. However, the effects of pregnancy on the human brain have long remained a virtually unexplored territory. We have previously shown that pregnancy renders substantial changes in human brain structure that are highly consistent and long-lasting. Interestingly, these anatomical changes most strongly affect neural networks involved in social cognition, and they predict measures of mother-infant bonding. Further studies revealed that these changes are also associated with the reactivity of a mother's neural reward circuit to her infant after birth. These findings thus indicate that pregnancy represents a period of striking brain plasticity, and provide support for a process of neural adaptation that benefits aspects of maternal caregiving. Using prospective neuroimaging studies, we are mapping the changes in a woman's brain across this transformative period and aim to elucidate their role in maternal functioning and mental health.

POPULATION-BASED NEUROIMAGING REVEALS TRACES OF CHILDBIRTH IN THE MATERNAL BRAIN

de Lange AM

LREN, Centre for Research in Neurosciences, Department of Clinical Neurosciences, Lausanne; University Hospital (CHUV) and University of Lausanne, Lausanne, Switzerland; Department of Psychology, University of Oslo, Oslo, Norway; Department of Psychiatry, University of Oxford, Oxford, UK

Dynamic brain changes have been shown across pregnancy and postpartum, but less is known about potential long-term effects of pregnancy on the brain. By using machine learning models in a large population-based dataset, Dr. de Lange and colleagues recently showed an association between parity and a younger brain age, with prominent effects in subcortical regions. In this talk, Dr. de Lange will discuss potential protective effects of parity on the ageing brain, and how population-based studies can contribute to a more complete understanding of women's brain health across the lifespan.

NEUROCOGNITIVE ADAPTATIONS TO MOTHERHOOD ACROSS THE LIFESPAN

Orchard ER[1,2], Ward PGD[1], Chopra S[1,2], Egan GF[1], Jamadar SD[1]

[1]Monash University (O, W, C, E, J); [2]Yale University (O, C)

The peripartum period involves rapid and extreme physiological and psychosocial changes, which prepare a woman's body and mind for motherhood. During early motherhood, the maternal brain undergoes significant structural and functional neuroplasticity and cognitive adaptations. However, the long-term impact of this neurodevelopmental period is only recently beginning to be characterised and understood.

Here, I present our understanding of maternal neurocognition across the lifespan, based on results from three studies. First, in early motherhood, we investigated cognitive performance in 43 first-time mothers, and 43 age- and education-matched nulliparous women. We found no evidence to suggest mothers suffer cognitive decrements at one-year postpartum, challenging the persistence of cognitive deficits into the late postpartum period. Mothers at one-year postpartum self-rated their memories as worse than non-mothers, and this negative self-perception in mothers was related to poor wellbeing (sleep, depression, and anxiety). Additionally, in two studies of late-life motherhood (220 elderly mothers), we found a life-long impact of motherhood on the brains and minds of women. Mothers with more children showed improved verbal memory, increased thickness of the parahippocampal gyrus, and 'younger' patterns of brain activity.

Taken together, the results indicate that motherhood may confer cognitive benefits both in the short- and long-term, suggesting a favourable neurocognitive trajectory following the early postpartum period. This trajectory is consistent with evidence from early motherhood, where memory returns to pre-pregnancy levels in the postpartum period. This trajectory of recovery appears to endure, and extend into cognitive enhancements in mid- and late-life.

SYMPOSIUM 2: NEURAL MECHANISMS MEDIATING PARENTAL BEHAVIOR

A BRAIN SWITCH FOR MATERNAL AGGRESSION

Broberger C

Department of Biochemistry and Biophysics, Stockholm University, Stockholm, Sweden

To care for their offspring, the brains of parents need to undergo a series of dramatic adaptive reconfigurations. Typically, these changes need to be reversible in order to enable successive periods of pregnancy and nursing. Parental adaptation in rodents involves the triggering of physiological functions, such as the production of breast milk, but also changes in behavioural programs. While these are most often discussed in terms of ensuring that pups are fed and warm, equally important is to protect them from conspecifics that may cause them harm. Thus, while female rodents typically do not express aggression in the non-puerperal state, the dam will usually vigorously attack an intruder into her cage. The mechanisms whereby the mother's brain suddenly and reversibly assumes an aggressor phenotype is poorly understood, and touches upon the even larger question of how an individual can transiently access a behaviour normally outside of its repertoire. We have previously shown that a small population of neurons in the ventral premammillary nucleus that express the dopamine transporter ("PMv^{DAT} neurons") are required for the expression of intermale aggression. Here, we demonstrate that these cells are normally quiescent in the female mouse brain, but shift into hyperexcitability post-partum. Moreover, the activity of these cells turns out to be required for the expression of maternal aggression. We further show that two key hormones of the maternal state – prolactin and oxytocin – strongly stimulate the discharge of PMv^{DAT} neurons through several parallel mechanisms. Finally, our data reveal that activation of PMv^{DAT} neurons, while triggering aggression in dams, simultaneously blocks normal pup retrieval behaviour. These findings reveal the existence of a normally dormant neuronal network that can be reversibly recruited to allow the mother to defend her offspring

PARENTING CONTROL IN MICE: FROM CELL TYPES TO CIRCUIT FUNCTION

Dulac C

Harvard University; Howard Hughes Medical Institute

The study of affiliative and agonistic behaviors of male and female mice towards pups offers a unique opportunity to conduct a multifaceted investigation of circuits underlying social interactions. What is the role of the various hypothalamic cell populations activated during infant mediated behaviors? How is the brain-wide sensory-motor transformation leading to infant-mediated behavior achieved in males and females, and what transcriptional and circuit mechanisms gate the display of infanticide versus parenting according to the animal sex and physiological state?

PLASTICITY IN CENTRAL SEROTONIN ACROSS REPRODUCTION AND ROLE IN POSTPARTUM SOCIOEMOTIONAL BEHAVIORS

Lonstein JS

Neuroscience Program & Department of Psychology, Michigan State University, East Lansing, MI 48824 USA

The female brain undergoes remarkable structural and chemical plasticity across reproduction. This plasticity underlies changes in socioemotional behaviors known to be essential for successful motherhood. In humans, maternal anxiety and depression commonly derail optimal mothering, with the first-line pharmacotherapies still the selective serotonin reuptake inhibitors (SSRIs). This is despite the fact that very little is known about female reproduction-related changes in central serotonin and serotonin's effects on the postpartum brain and behavior. Our research studies how the central serotonin system changes structurally and functionally across pregnancy and postpartum, and how serotonin is involved in maternal caregiving and affective behaviors. We have found that female reproduction and maternal experience alter survival and death of cells in the midbrain dorsal raphe nucleus (DR; primary source of forebrain serotonin), concomitant with changes in central serotonin metabolism and serotonin receptor expression. We also showed that selectively lesioning DR serotonin cells negatively affects postpartum caregiving and affective behaviors. Recent work revealed a periparturitional peak of 5HT-1A mRNA and receptor binding in the nucleus accumbens shell (NAcSh), which was prevented by pregnancy stress. Furthermore, shRNA-mediated knockdown of 5HT-1A in the NAcSh to prevent its periparturitional peak derailed numerous postpartum behaviors. This line of research reveals that the DR is a novel site for motherhood-related structural and chemical plasticity, and that DR serotonin synthesis and NAcSh serotonin signaling are critical for motherhood. Greater knowledge about serotonin's effects on the maternal brain and behavior will greatly improve our understanding of how serotonin is involved in maternal psychopathology and refine how SSRIs are used to treat the peripartum population.

CALCITONIN RECEPTOR-AMYLIN SIGNALING IN THE MEDIAL PREOPTIC AREA AND THE COMMON BASIS OF SOCIAL AFFILIATION IN FEMALE MICE

Kuroda KO

Laboratory for Affiliative Social Behavior; RIKEN Center for Brain Science

Pioneering researchers in this field have identified that the medial preoptic area (MPOA) is critical for maternal, paternal and alloparental care, and that MPOA neurons expressing ERa or galanin mediate pup retrieval and pup grooming, respectively. To further specify the essential neurons for pup retrieval anatomically and molecularly, we have screened the candidate molecular markers and identified the calcitonin receptor (Calcr) in the central part of the MPOA (cMPOA). Specific deactivation of Calcr+ cMPOA neurons inhibits both maternal and allomaternal behaviors, without affecting mating or parturition in female mice, while chemogenetic activation prevents infanticide in virgin males. Suppression of peripartum Calcr increase in the cMPOA hampers risk-taking pup rescue. Thus, Calcr+ cMPOA *neurons* are indispensable for basal parental and alloparental nurturing, and Calcr *molecules* in the cMPOA function to facilitate risk-taking maternal care.
Calcr and its brain ligand amylin also mediate social affiliation among adult female mice. Isolation of females from free social interactions first induces active contact-seeking, then depressive-like behavior, concurrent with a loss of Amylin expression in the cMPOA and in the adjacent anterior commissural nucleus in the MPOA. Reunion with peers activates both amylin+ and Calcr+ neurons and leads to a recovery of Amylin expression. Chemogenetic activation of amylin+ neurons increases, and knockdown of amylin or Calcr attenuates contact-seeking behavior, respectively. These data support a long-postulated notion that parental care is the evolutionary origin of social affiliation among adult animals, and may also be relevant for cooperative parenting, observed in mice and humans.

SYMPOSIUM 3: PARENTAL BRAIN – BEYOND RATS AND HUMANS

TITI MONKEYS *(PLECTUROCEBUS CUPREUS)* AND THE BIPARENTAL BRAIN

Bales KL; Baxter A; Karaskiewicz CL; Savidge LE

Department of Psychology, University of California

Titi monkeys are small, arboreal, pair-bonding primates that engage in biparental care with high amounts of carrying by the fathers. In the current studies, we examined differences between active parents and non-parents in oxytocin and vasopressin receptor binding throughout the brain, as well as changes in androgens, pair behavior, learning, and memory in parents. Findings include an association between parenthood and higher oxytocin receptor binding in the presubiculum, as well as widespread reduction of vasopressin receptor binding in parents. Parenthood had effects on maintenance of the pair bond. Pair affiliation peaked during pregnancy, decreased across the postpartum period, and rose after reaching minimum affiliation 32.6 weeks postpartum (a point which also coincides with increasing infant independence). Pairs in which fathers carry infants more than average had lower and shorter dips in affiliation at the infant's birth, and returned to baseline sooner. Androgens were surprisingly high in titi monkey females, and analyses of androgens in relationship to parental behavior are on-going. Biparental care relies on a suite of neurobiological and behavioral changes in both parents to support behavioral coordination of infant care.

MOTHER RABBITS: THEIR HORMONES, BRAINS, AND REPRODUCTIVE SUCCESS

González-Mariscal G

Centro de Investigación en Reproducción Animal, CINVESTAV-Universidad Autónoma de Tlaxcala, México

Mother rabbits live in the laboratory, on the farm, in the field, and in human homes. They have been studied in these niches around questions concerning: lactation, nest-building, behavioral ecology, and animal welfare. These varied approaches have yielded a large amount of information that -although scattered across disciplines- has presented a rich picture of the capacity of these lagomorphs to successfully produce offspring across latitudes and housing conditions. Pregnancy hormones are essential for initiating maternal behavior (MB), specifically by: a) regulating the onset and offset of nest-building, acting on the preoptic area; b) promoting a change in the hedonic value of kit odors from aversive to attractive. Consolidation and maintenance of MB require the perception of stimuli from the litter at parturition and in early postpartum. The single daily nursing bout has a fixed duration (ca. three min) and occurs with circadian periodicity. These precise temporal characteristics rely heavily on a threshold amount of suckling stimulation but they do not involve milk output *per se*. Whether the translation of such stimuli from the periphery to the brain involves oxytocin and the suprachiasmatic nucleus is being investigated. The above evidence suggests that a “maternal brain” is “built” from late pregnancy into early lactation by hormones and somatosensory stimuli to allow does to recognize kits as a “meaningful” stimulus and display “adequate” behaviors towards them. Laboratory, farm, and field studies can converge to reveal the underpinnings of MB neuroendocrinology, to improve farming practices, and to guide conservation programs of wild animals.

NEUROENDOCRINE REGULATION OF AVIAN PARENTAL BEHAVIOUR

Meddle S

The Roslin Institute, The University of Edinburgh, UK

Parental behaviour promotes offspring survival. The behavioural and physiological changes which occur when an animal 'becomes parental' are significant and often include changes in reproduction, aggression and a modulation of the stress response. While the underlying neurobiology and hormonal regulation of mammalian parental care has been extensively studied, less is known about the neuroendocrine changes regulating parental care in birds. Recent investigations into the neural mechanisms underlying complex social and parental care in birds have highlighted the importance of the central nonapeptide mesotocin and vasotocin systems. Studies in altricial zebra finches and precocial chickens, have revealed the importance in nonapeptides in nest building, incubation and chick care. In male zebra finches vasotocin, but not mesotocin, mRNA increases in the hypothalamus two hours from the start of nest building. Moreover nesting material pick up, and greater time spent together with the female in the nest is associated with increased activation (Fos-ir) in bed nucleus of the stria terminalis (BnST) vasotocin neurones. Fos-ir is also higher in mesotocin BnST neurones in nest-building males and females compared to controls. In hens during incubation, there are decreased social interactions and this is associated with decreased mesotocin and vasotocin mRNA expression in the BnST and higher numbers of gonadotropin inhibitory hormone cells in the paraventricular nucleus (PVN). In contrast, chick rearing is concomitant with increased mesotocin mRNA expression in the PVN. Studies are ongoing, but dynamic changes in the neuroendocrine system appear pivotal for coordinating the parental care that is critical for avian reproductive success.

MULTI-TASKING MALES: NEUROENDOCRINOLOGY OF PARENTING BEHAVIOR IN A SEXUALLY PLASTIC FISH

Pradhan DS

Department of Biological Sciences, Idaho State University

Fishes exhibit a wide range of parenting strategies to improve the survival and reproduction of their young. To understand the regulation of both fixed and plastic characteristics of parenting, we study the bluebanded goby, Lythrypnus dalli, a small marine fish capable of adult sex change. These fish live in linear dominance hierarchies consisting of a dominant male and subordinate females. Only males display courtship jerk swims, territoriality, and parenting. Parenting involves fanning and rubbing using whole-body movement over the nest substrate and eggs. Brain 11-ketotestosterone (KT), the potent teleost androgen, is necessary for parenting. Males also have high levels of cortisol throughout the brain, which rapidly decreases during status instability. Males spend >99% time inside the nest, while dominant alpha females enter and exit the nest multiple times, spending ~38% time inside, but do not exhibit parenting. Within minutes of male removal, the alpha female establishes dominance and territoriality spending ~75% time inside the nest. Transitioning fish display egg cannibalism and fanning. Within 60 min, brain KT is higher and gonadal KT is lower in transitioning fish that display fanning compared to females who do not. After 5 d of transition, parenting display is highly variable, but these fish have higher KT in trunk muscles that are attached to fins compared to females. Concurrent with external genitalia rearrangement, transitioning fish lay viable sperm within 7-14 d and similar rates of parenting compared to males. Future studies will better describe fin movement, muscular performance, and metabolism involved in parenting.

SYMPOSIUM 4: PARENT-OFFSPRING INTERACTIONS

FATHERS' BRAINS: READY TO JUMP INTO FATHERHOOD?

Bakermans-Kranenburg MJ

Vrije Universiteit Amsterdam, the Netherlands; National Institute of Education, Singapore

Fathers matter. The publication of Michael Lamb's book, The Role of the Father in Child Development, in 1976 marked growing awareness of fathers' role in the development of their offspring. And as a result of societal changes, men became more active participants in child care. In one generation, fathers show a three- to six-fold increase in hours spent on child care over what their own fathers typically did. This demonstrates the role of socio-cultural factors in a biobehavioral model of emergent fatherhood. Indeed, the transition into fatherhood is a developmental milestone with often huge behavioral changes in men's lives. Are these accompanied by changes in new fathers' brains and hormone levels? And can we stimulate such changes to promote the adaptation to their new lives? In this presentation I will present the results of a series of correlational and experimental studies on fathers, with a special focus on the transition into fatherhood.

LEARNING THROUGH PLAYFUL PARENT-INFANT SOCIAL INTERACTIONS: A DYADIC NEUROSCIENCE PERSPECTIVE

Leong V

Nanyang Technological University, Singapore

During early life, temporally-coordinated social interactions between infants and caregivers – such as during play - provide a powerful stimulant for learning. Yet current neuroscience frameworks do not address how social interactive behaviour potentiates learning in the infant brain. Recent evidence suggests that human infants are capable of spontaneous neural synchronisation with adults during social interaction, and levels of parent-infant neural synchronisation predict communicative efficacy and social learning. In this talk, I will present a dyadic neuroscience perspective for understanding how parents use 'Natural Pedagogy', enacted through ostensive signals such as eye contact and infant-directed speech, to attune fine-grained neural oscillatory processes between themselves and their children, creating synchronised brain states for learning. I will further discuss how social playful interactions afford optimal opportunities for the emergence of synchronised behaviour and brain activity, thereby potentiating early learning.

INTERACTIONS BETWEEN MATERNAL CARE PROVISIONING AND EXTRA-MATERNAL INFLUENCES IN THE MATERNAL ENVIRONMENT ON OFFSPRING NEURODEVELOPMENT AND LATER-LIFE BEHAVIOR

McGowan PO

University of Toronto

The early-life maternal environment has a profound and persistent effect on offspring neuroendocrine function, neurotransmitter systems, and behavior. Studies using rodent models suggest that early-life maternal care can influence the developmental programming of offspring in part through altered epigenetic regulation of specific genes. The exploration of epigenetic regulation of these genes as a biological mechanism has been important to our understanding of how animals adapt to early life adversity and how these developmental trajectories can be altered. In addition, other non-maternal factors have been shown to act directly, or to interact with maternal care, to influence later-life phenotype. We will discuss our work on differences in maternal care provisioning within the litter on persistent changes in brain and behavior in offspring, including how maternal care received may affect future maternal care provided by offspring. We will also discuss early-life variations in ambient temperature exposure and offspring genotype x environment interactions as examples of non-maternal factors that influence later-life phenotype.

NATURE, NURTURE, AND NEUROMODULATION IN MOTHERHOOD

Jones Marlin B

Zuckerman Institute, Columbia University

Bianca Jones Marlin, Ph.D. is a neuroscientist and Herbert and Florence Irving Assistant Professor of Cell Research at the Zuckerman Institute at Columbia University in New York City. Her research investigates how organisms unlock innate behaviors at appropriate times, and how learned information is passed to subsequent generations via transgenerational epigenetic inheritance. Dr. Marlin's experimental approach combines neural imaging, behavior, and molecular genetics to uncover the mechanisms by which learning and emotion are biologically transmitted from neurons of the parent to neurons of their offspring. The resulting insights into how learned behavior in the parent can become innate behavior in the offspring promise to make a profound impact on societal brain health, mental well-being, and parenting.

SYMPOSIUM 5: MENTAL ILLNESS AND THE PARENTAL BRAIN

SOCIOCULTURAL STRESSORS, CORTISOL AND MATERNAL DEPRESSION IN WOMEN OF MEXICAN DESCENT

D'Anna-Hernandez K

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Experiencing stress during pregnancy is associated with alterations to the maternal hypothalamic pituitary adrenal axis (HPA) and its end product cortisol. Such changes in HPA activity have been related to maternal mental health risk and adverse long-term infant outcomes. Mexican-American women have perinatal depression rates twice that of the general population and report high rates of psychosocial stressors during pregnancy. In addition, they are exposed to cultural stressors related to cultural adaptation, including discrimination and acculturative stress that are associated with poor mental health outcomes. Yet, whether levels of cultural stressors contribute to maternal mental health risk and trajectory of cortisol across pregnancy in mothers and role of the potential protective factor of traditional Mexican cultures values is unclear . Hair and salivary cortisol were compared to depressive symptoms, anxiety, acculturative stress, discrimination and Mexican cultural values in 153 pregnant women of Mexican descent. with Saliva collection occurred 4 times/day over 3 days to obtain an average daily cortisol decline during pregnancy and hair collected at every trimester. During pregnancy, acculturative stress was associated with increases in maternal depression, anxiety and a dysregulation in salivary maternal daily cortisol decline, but not hair cortisol. Greater identification with Mexican cultural values was associated with better perinatal mental health symptoms and birth outcomes. Lastly, a mother-infant Still Face task of emotional regulation was performed and greater identification with Mexican culture values buffered the adverse relationship of acculturative stress on maternal sensitivity in mother-infant interactions. Overall, maternal cultural adaptation stressors during pregnancy may pose a unique risk for changes in perinatal physiology, mental health outcomes and emotional regulation in Mexican-American mothers.

IMPACT OF GESTATIONAL OPIOIDS ON THE MATERNAL BRAIN AND BEHAVIOR

Brummelte S

Department of Psychology, Wayne State University

The opioid epidemic has resulted in many pregnant women being treated with medication for opioid use disorders (MOUDs, e.g., buprenorphine (BUP)) to combat negative effects of misused opioids on the mother and developing offspring. BUP is a partial mu-receptor agonist and kappa-receptor antagonist that produces better infant outcomes after gestational treatment compared to methadone or misused opioids. However, effects of BUP on the mother and maternal brain while transitioning to motherhood are not well understood. We implemented a translational rodent model to mimic chronic opioid (mis)use (morphine) or MOUD exposure (BUP) to investigate the behavioral and neurochemical consequences of gestational opioid exposure on dams and their offspring. Opioid or saline administration began prior to pregnancy and was either continued until postpartum day 2 or discontinued shortly before parturition. Our results show that even a low dose of BUP decreased maternal care, delayed offspring development, and decreased offspring body weight gain and pain sensitivity later in life. Importantly, a high dose of BUP drastically reduced maternal care and offspring survival, while both continued and discontinued morphine exposure seemed to result in only minor deficits in maternal behavior. Overall, our results suggest, that perinatal exposure to BUP may inhibit the neuronal ‘switch’ from aversive to rewarding perception of pups that is necessary to initiate appropriate maternal behavior. More research is essential to understand how BUP interacts with the maternal brain network during the transition to motherhood to help avoid possible negative consequences on maternal care and compounded effects on opioid-exposed offspring.

INVESTIGATING THE MATERNAL BRAIN AND CAREGIVING IN THE CONTEXT OF SUBSTANCE USE

Rutherford HJV; Wall KM; Penner F

Yale Child Study Center

Maternal substance use has been associated with caregiving challenges, with recent work focusing on how substance use affects maternal neural processes. Event-related potential (ERP) studies have examined the N170 as an early perceptual marker of processing infant faces, finding a delayed N170 response to infant face stimuli in mothers using substances relative to mothers not using substances. This prior ERP work has been limited to categorical assessments of substance use (present or absent), overlooking whether other risk factors in addition to maternal substance use affect the N170, and the significance of maternal substance use and N170 associations to caregiving. Therefore, in 106 postpartum mothers we examined: (1) a continuous assessment of maternal substance use and its impact on the N170 elicited by infant faces; (2) whether latent profiles of maternal risk, incorporating this new maternal substance use assessment alongside clinical symptom measures, explained the N170 response; and (3) whether the N170 to infant faces mediated the relationship between our latent profiles of maternal risk and caregiving outcomes (parental reflective functioning). We replicated prior categorical work where greater maternal substance use was associated with a more delayed N170. We also identified two profiles of maternal risk that differentiated the N170 response to infant faces. Finally, N170 responses to infant faces mediated the relationship between maternal risk profile membership and reflective functioning. Taken together, these findings identify the perception of infant faces, indexed by the N170, is an important mechanism underscoring associations between maternal risk related to substance use and caregiving outcomes.

THE BRAIN FUNCTIONAL AND DYNAMICS CORRELATES OF WORKING MEMORY AND EMOTIONAL PROCESSING IN POSTPARTUM PSYCHOSIS

Dazzan P

Institute of Psychiatry, Psychology and Neuroscience, King's College London

While altered brain function and connectivity may contribute to the risk for psychoses unrelated to the puerperium, this remains unexplored in postpartum psychosis (PP), a severe mental disorder that affects women in the first few weeks after delivery.

We recruited 56 women at risk (AR) of developing PP (26 became unwell and 30 remained well in the postpartum), and 47 healthy women. They completed two functional magnetic resonance imaging tasks: a working memory (n-back) and emotional face recognition task (fearful faces) in a 3Tesla scanner. A subset of women also underwent an fMRI scan at rest and during an emotional-processing task.

Compared to controls, AR women showed hyperconnectivity of the right dorsolateral prefrontal cortex (DLPFC) with varius parieto-occipito-temporo-cerebellar regions during n-back, and hyperactivation of fronto-cingulo-subcortical regions, and hypoconnectivity between left amygdala and ipsilateral occipito-parietal regions during the fearful faces task.

In the resting state, women AR, and specifically those who remained well, showed increased connectivity within an executive network compared to controls. During the emotional task, they also showed decreased connectivity in the executive network, and altered emotional load-dependent connectivity between executive, salience, and default-mode networks. The unwell women particularly showed increased salience network-dependent modulation of the default-mode and executive network.

The findings show that PP does not present the reduced connectivity with the DLPFC reported in psychoses unrelated to puerperium; and that the executive network and its interplay with other brain networks implicated in goal-directed behavior are intrinsically altered and could represent neural phenotypes for PP.

POSTER ABSTRACTS

Poster 1

THE DOMINO EFFECT OF PCOS: FETAL EXPOSURE TO ANTI-MÜLLERIAN HORMONE REPROGRAMS THE FETAL BRAIN AND TRIGGERS A TRANSGENERATIONAL TRANSMISSION OF POLYCYSTIC OVARY SYNDROME DEFECTS IN ADULTHOOD

Mimouni NElH; Paiva I; Barbotin AL; Timzoura FE; Plassard D; Le Gras S; Ternier G; Pigny P; Catteau-Jonard S; Simon V; Prevot V, Boutillier AL; Giacobini P

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Polycystic ovary syndrome (PCOS) is the most common endocrine and metabolic disorder affecting women in reproductive age. Women with PCOS exhibit 2-3x higher levels of circulating Anti-Müllerian Hormone (AMH) as compared to healthy women and it is unclear if the elevation of AMH is a bystander effect or is driving the condition. Moreover, PCOS has a strong heritable component, however the etiopathology of the disease and the mechanisms underlying its transmission remain to be elucidated.

Here, we measured AMH levels in a cohort of pregnant women with PCOS and control women revealing that AMH is significantly more elevated in the former group versus the latter. We then treated pregnant mice with AMH to model our clinical findings and investigated the neuroendocrine phenotype of their female progeny across multiple generations. Prenatal AMH-treated (PAMH) female offspring recapitulated the major PCOS cardinal neuroendocrine reproductive features, namely hyperandrogenism, elevation in LH pulse frequency and oligo-anovulation, and a persistent rise in the GnRH neuronal firing activity in adulthood. This new preclinical PCOS model showed that fetal exposure to excess AMH drives a transgenerational transmission of reproductive and metabolic PCOS alterations across multiple generations via altered landscapes of DNA methylation. Collectively, our results challenge the concept of PCOS originating in utero and appear to consolidate the role of AMH as a trigger of the pathogenesis. This work further points to PAMH mouse model as an excellent preclinical tool to investigate both neuroendocrine disturbances of PCOS and how developmental programming effects are transmitted, while offering a therapeutic avenue for the treatment of the disease.

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Poster 2

IS BABY-BRAIN SPECIFIC TO BIRTHGIVING MOTHERS? COGNITION IN BIRTHING AND NON-BIRTHING PARENTS IN THE POSTPARTUM

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Subtle, yet consistent declines in memory occur during pregnancy, however the evidence is unclear whether these decrements endure into the postpartum period. It is also unknown whether cognitive decrements are specific to birthgiving parents, or also occur in non-birthgiving parents. In this study, we compared cognition between birthgiving mothers and parents sex assigned female at birth (P-AFAB) (N=35), non-birthgiving mothers and P-AFAB (N=9), and female non-parents (N=33). Mothers and P-AFAB were parents to at least one child aged 0-24 months. Participants completed a computerised survey and cognitive battery. Participant groups did not differ in sleep (Pittsburgh Sleep Quality Index), depression (Beck Depression Inventory) or anxiety (Beck Anxiety Inventory). ANOVA and t-tests revealed that birthgiving and non-birthgiving mothers/P-AFAB performed significantly worse on processing speed (Simple Visual Reaction Time) and subjective memory (Prospective and Retrospective Memory Questionnaire) when compared to non-parents. No significant differences between birthgiving and non-birthgiving mothers/P-AFAB was found on any measure of cognition, including working memory, executive function or verbal memory. For both birthgiving and non-birthgiving mothers/P-AFAB, subjective memory was significantly related to depression and anxiety, with poorer subjective memory related to increased scores on the depression and anxiety inventories. These preliminary results indicate that slower processing speed and poorer subjective memory in the postpartum period is not exclusive to birthgiving mothers/P-AFAB, and may also be seen in non-birthgiving mothers/P-AFAB. The results are consistent with our previous results and indicate that subjective memory impairments in birthgiving and non-birthgiving parents are related to mood in the postpartum.

Research supported by:

Poster 3

RAPID EVOLUTIONARY LOSS OF PARENTAL CARE IN STICKLEBACK FISH

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Natural variation in family structure provides an opportunity to dissect the causes of evolved changes in family life. What happens during evolution when the burden of care is shifted between the parents, for example? Or when offspring used to rely on their parents, but now have to fend for themselves? In most three-spined stickleback families, the father is solely responsible for providing care for the offspring, but there is an unusual ecotype of this species (the so-called “white” stickleback) that has recently lost paternal care. The recent loss of parental care in the white ecotype provides a lever to find the genes and molecular pathways that underlie the mechanisms and evolution of parental care and family life itself. In this talk I will summarize recent studies on the inheritance, neurogenomics, plasticity and development of behavior in this intriguing system.

Research supported by: NIGMS

Poster 4

INTERPERSONAL COUNSELLING VERSUS PERINATAL-SPECIFIC COGNITIVE BEHAVIOURAL THERAPY FOR WOMEN WITH DEPRESSION DURING PREGNANCY OFFERED IN ROUTINE PSYCHOLOGICAL TREATMENT SERVICES: A PHASE II RANDOMISED TRIAL

Evans J; Ingram J; Law R; Taylor H; Johnson D; Glynn J; Hopley B; Kessler D; Round J; Ford J;Culpin I; O'Mahen H

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Background: One in eight women experience prenatal depression. Early recognition and treatment is important to prevent the effects of stress during pregnancy on the mother and fetus, however referral by midwives and take up of treatment by pregnant women is extremely low. To improve this, we assessed the feasibility and acceptability of a trial of Interpersonal Counselling (IPC), a brief, low-intensity form of Interpersonal Psychotherapy for prenatal depression in routine services. Methods: We conducted a small randomised controlled trial in two centres. 52 pregnant women with mild or moderate depression were randomised to receive 6 sessions of IPC or perinatal specific CBT. Primary outcome was the number of women recruited. Secondary outcomes included maternal mood, attachment and participant and staff acceptability. Results: 71% of women in IPC completed treatment. Women reported IPC was acceptable, and supervisors reported high treatment competence in IPC arm by jMHWs. Outcome measures indicated there was improvement in mood in both groups (Change in EPDS score IPC 4.4 (s.d. 5.1) and CBT 4.0 (s.d. 4.8). Conclusions: A full-scale trial of IPC for antenatal depression in routine IAPT services is feasible.

Research supported by: NIHR in the UK under its Research for Patient Benefit Program.

Poster 5

PREGNANT WOMEN WITH BIPOLAR DISORDER WHO HAVE A HISTORY OF CHILDHOOD MALTREATMENT: INTERGENERATIONAL EFFECTS OF TRAUMA ON FETAL NEURODEVELOPMENT AND BIRTH OUTCOMES

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Columbia Univeristy (VB, MO, TF, SL, CM); New York State Psychiatric Institute (SL); NYU Langone Health (OB); University of Arkansas for Medical Sciences (BTK); University of Texas at Austin (JDN); University of Wisconsin at Madison (ZNS)

Intergenerational transmission of trauma occurs when effects of childhood maltreatment (CM) influence the next generation's development and health; prenatal programming via maternal mood symptoms is a potential pathway. CM is a risk factor for bipolar disorder which is present in 1.8% of pregnant women. Mood symptoms are likely to increase during pregnancy, particularly for those with a history of CM. We examined whether there was evidence for intergenerational transmission of trauma in utero in this population, and whether maternal mood was a transmission pathway. Methods: CM and maternal mood were self-reported by N=82 pregnant women in treatment for bipolar disorder. Fetal heart rate variability (FHRV) was measured at 24, 30, and 36-weeks' gestation. Gestational age at birth and birth weight were obtained from medical charts. Results: A cluster analysis yielded two groups, Symptom+ (18.29%) and Euthymic (81.71%), who differed on severe mood symptoms ($p < .001$) but not on medication use. The Symptom+ group had more CM exposures ($p < .001$), a trend of lower FHRV ($p = .077$), and greater birth complications (33.3% vs. 6.07% born preterm $p < .01$). Maternal prenatal mood mediated the association between maternal CM and birth weight in both sexes and at trend level for gestational age at birth in females. Conclusions: This is the first study to identify intergenerational effects of maternal CM prior to postnatal influences in a sample of pregnant women with bipolar disorder. These findings underscore the potential enduring impact of CM for women with severe psychiatric illness and their children.

Research supported by: NIMH P50MH077928 and NICHD R01HD092062

Poster 6

ASSESSING THE ROLE OF THE IMPRINTED GENE MAGEL2 IN PARENTING BEHAVIOUR

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Imprinted genes are frequently cited to be implemented in maternal care behaviour, yet only four imprinted genes, when manipulated in dams, have been shown to have maternal care deficits in mice. Furthermore, the understanding of parenting behaviour in mice is reaching a level of sophistication by which the specific neuronal population responsible for it have been elucidated. Using single-cell RNA sequencing datasets, we first demonstrated an enrichment for imprinted gene expression in galanin neurons of the hypothalamus and specifically, the key parenting associated galanin neurons of the preoptic area. We then assessed the parenting behaviour of Magel2-null mice, an imprinted gene selected for this assessment according to its elevated expression in these parenting associated galanin neuron subtypes. Magel2-null mothers, fathers and virgin females demonstrated behavioural deficits in their parenting behaviour. This was seen as deficits in retrieval behaviour, nest building or pup-directed motivation. Our findings add a new imprinted gene to the list of those with parenting deficits, and for the first time show that imprinted genes can have a role in parenting outside of the maternal-infant dyad. Furthermore, this study shows the value of the publicly available single-cell RNA sequencing datasets as this behavioural deficit was predicted primarily from its expression patterns at the single-cell level.

Research supported by: Sources of Funding: Wellcome PhD Studentship (220090/Z/20/Z).

Poster 7

A PROSPECTIVE STUDY OF RESTING STATE CONNECTIVITY DURING PREGNANCY AND THE EARLY-POSTPARTUM PERIOD

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During pregnancy, almost every organ in the human body adapts to facilitate the gestation process and prepare women for childbirth and motherhood. The brain is no exception to that. Pregnancy leads to pronounced structural changes in regions overlapping with social cognition networks. The functional implications of these changes are just beginning to be explored. Resting-state fMRI (rs-fMRI) has emerged as a valuable technique to investigate brain function without task interference. However, the few studies that have analyzed the functional connectome of mothers are cross-sectional and have focused on the postpartum period. In this prospective study, we used rs-fMRI to investigate whether pregnancy modifies the intrinsic functional connectivity of the mother's brain. We scanned 32 first-time mothers before conception and during the first postpartum month and 17 nulliparous control women at a similar time interval. Then, using graph theory, we created a functional network comprising the nodes of the social cognition network previously found to undergo structural changes during pregnancy. Lastly, we analyzed the effect of pregnancy on within-network functional connectivity. We hypothesize that, compared to nulliparous women, first-time mothers will display an increased integration of the social cognitive network. Hence, we expect to observe a link between the structural and functional changes occurring during pregnancy. The current research will contribute to understanding how the human brain changes during pregnancy and the postpartum period.

Research supported by: Ministerio de Ciencia, Innovación y Universidades project (RTI2018-093952-B-100); "La Caixa" Foundation under the project code LCF/PR/HR19/52160001; European Research Council (ERC) - European Union's Horizon 2020 research and innovation programme under grant agreement number 883069

Poster 8

A ROLE FOR LACTOGENIC HORMONES IN MATERNAL MOTIVATION IN MICE

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Lactogenic hormones (prolactin and placental lactogen) are important regulators of maternal behaviour, acting through prolactin receptors (Prlr) in the medial preoptic area (MPOA) in the brain. The mechanism by which lactogenic action in this region induces maternal behaviour is unclear. Since MPOA neurons project to and activate reward-processing regions, we hypothesised that lactogenic hormones promote maternal behaviour by activating reward pathways, so that interactions with pups are rewarding. After identifying that motivation to interact with pups emerges during lactation, we aimed to investigate the role of lactogenic hormones in regulating this behaviour. First, we anatomically characterised projections from the MPOA to a key region of the reward circuitry, the ventral tegmental area (VTA), using two complimentary tracing methods. After unilateral injection of retrogradely-transported fluorescent Retrobeads into the VTA of Prlr-Cre/tdtomato mice, Retrobeads were detected in tdtomato-labelled (Prlr-expressing) MPOA neurons. More specifically, unilateral injection of Cre-dependent tdtomato tracer in the VTA of Prlr-Cre/tGFP mice resulted in tdtomato-labelled MPOA neurons, providing additional support for prolactin-responsive projections between the MPOA and VTA. Subsequently, we investigated whether Prlr deletion disrupted maternal motivation, using mice with a conditional Prlr deletion from Gamma-Aminobutyric Acid (GABA) neurons (Prlrlox/lox/VGat-Cre mice). In a novel T-maze test that assesses motivation to retrieve pups, lactating Prlrlox/lox/VGat-Cre knockouts showed incomplete and slower retrieval behaviour than controls. Together, this indicates that lactogenic action on GABA neurons is required for full maternal motivation, and we have identified a potential pathway through which lactogenic hormones could act on the reward system to promote maternal motivation.

Research supported by: University of Otago PhD Scholarship (awarded to Judith Swart) and was conducted during the tenure of the Sir Charles Hercus Health Research Fellowship (by RSE Brown) of the Health Research Council of New Zealand.

Poster 9

RE-ORGANIZATION OF THE CORTICAL MANTLE DURING LATE GESTATION AND EARLY POSTPARTUM IN EXPECTANT FIRST-TIME MOTHERS

Paternina-Die, M[1,2]; Martinez-García, M[1,2]; Desco, M[1,2,3,4]; Vilarroya, O[5,6]; Carmona, S[1,2].

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Converging evidence indicates that the anatomy of a woman's brain changes during pregnancy and early postpartum. These changes have been suggested to be adaptive for the mother in preparing her for the new cognitively demanding challenges she will need to face: caring for a newborn. Yet, when do these brain changes start, and the follow-up trajectories remain unknown. The present study explores whether these changes are already present before childbirth or whether they begin right after delivery. We acquired high-resolution structural Magnetic Resonance Images in 117 pregnant women at 36 weeks of gestation and at 2-3 weeks postpartum. As a control group, we also scanned a sample of 36 nulliparous women in a time interval comparable to that of the mothers-to-be. To analyze the brain morphology, structural images were processed using FreeSurfer surface-based methods, and the cortical whole-brain and vertex-wise estimates of each group were compared. We observed that even before childbirth, at late gestation, pregnant women's brains already differ from the non-mothers and that these differences begin to recover during the early postpartum period. Women's unique hormonal and immunological factors during late gestation and early postpartum might be regulating the observed neural plasticity before and after parturition. To date, the current database represents one of the world's largest prospective neuroimaging samples assessing brain differences in first-time expectant mothers.

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Poster 10

FIRST-TIME FATHERS SHOW LONGITUDINAL GREY MATTER CORTICAL VOLUME REDUCTIONS: EVIDENCE FROM TWO INTERNATIONAL SAMPLES

Martínez-García M; Paternina-Die M; Cardenas SI; Desco M; Villarroya O; Saxbe DE; Carmona S

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The transition to parenthood is a critical window for enhanced adult neural plasticity. Studying fathers offers a unique opportunity to explore how parenting experience can shape the human brain, even when pregnancy is not directly experienced. Yet very few studies have examined neuroanatomic adaptations of men transitioning into fatherhood. The present study reports on an international collaboration between two laboratories, one in Spain and the other in California, that have prospectively collected structural neuroimaging data in 20 expectant fathers before and after the birth of their first child, and a group of 17 Spanish childless control men. We tested whether the transition into fatherhood entailed anatomical changes in brain cortical volume, thickness, and area, as well as in subcortical volume. Despite these different samples and study designs, we found overlapping trends of cortical grey matter volume decrease across both samples of first-time fathers after controlling for fathers' age, scan interval and the child's age at the postnatal scan. The cortical volume reductions were accompanied by a significant decrease in cortical thickness in the Spanish fathers, whereas Californian fathers exhibited a decrease in cortical area. We speculate on cultural or behavioral differences that may have informed these distinct findings. In line with previous literature, we found that neuroanatomic changes in fathers affect cortical circuits -which are more involved in social understanding- rather than subcortical limbic circuits -which are more associated with emotion and reward processing-. This study provides the first convergent evidence for cortical structural changes in fathers, contributing to the idea that transition to fatherhood may represent a meaningful window of experience-induced structural neuroplasticity in males.

Research supported by: Instituto de Salud Carlos III project PI17/00064, and Miguel Servet Type I research contract (CP16/00096) and Predoctorales de Formación en Investigación en Salud (PFIS) (contract FI18/00255) co-funded by European Social Fund Investing in your future; Ministerio de Ciencia e Innovación project RTI2018-093952-B-100 Instituto de Salud Carlos III projects CP16/00096 and PI17/00064 co-funded by European Regional Development Fund (ERDF), A way to make Europe; la Caixa Foundation (project code LCF/PR/HR19/52160001); European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 883069); Centro Nacional de Investigaciones Cardiovasculares (CNIC). The CNIC is supported by Instituto de Salud Carlos III (ISCIII), Ministerio de Ciencia e Innovación and the Pro CNIC Foundation, and is a Severo Ochoa Center of Excellence (SEV-2015-050)

Poster 11

PREGNANCY-INDUCED U-SHAPED TRAJECTORY OF BRAIN CORTICAL THICKNESS IN FIRST-TIME MOTHERS

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Motherhood is a uniquely transformative experience at the physiological and psychological levels. Neuroimaging studies have shown that human pregnancy causes pronounced changes in the female brain associated with maternal attachment. However, the time course of these brain changes and the etiological mechanisms underlying them remain unknown. The aim of this study was twofold. First, we wanted to delineate the trajectories of cortical thickness throughout the transition to motherhood. Second, we wanted to determine whether these trajectories are different between gestational and non-gestational mothers (female partners of the pregnant mothers). This comparison allowed us to dissociate the contribution of internal gestational factors from that of external environmental factors that accompany motherhood. We used a prospective longitudinal design that followed primiparous mothers at four time points: 1) before pregnancy; 2) at 18 weeks of gestation; 3) at 34 weeks of gestation; and 4) and at one month postpartum. We extracted cortical thickness (CT) from T1-MRI acquisitions using Freesurfer surface-based methods for each of these time points. Data from the pregnant mothers were compared with that of their same-sex partners and a control group of nulliparous women. Results suggest a U-shaped CT trajectory in gestational mothers initiated by CT decreases during pregnancy, followed by CT increases after parturition. Non-gestations mothers only show CT increases after their couple's parturition.

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Poster 12

MATERNAL GLUCOCORTICOIDS DO NOT DIRECTLY MEDIATE THE EFFECTS OF MATERNAL SOCIAL STRESS ON THE FETUS

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Stress during pregnancy negatively affects the fetus and increases the risk for affective disorders in adulthood. Excess maternal glucocorticoids are thought to mediate fetal programming, however, whether they exert their effects directly or indirectly remains unclear. During pregnancy, protective mechanisms including maternal hypothalamic-pituitary-adrenal (HPA) axis hyporesponsiveness and placental 11β-hydroxysteroid dehydrogenase (11βHSD) type 2, which inactivates glucocorticoids, limit mother-to-fetus glucocorticoid transfer. However, whether repeated stress negatively impacts these mechanisms is not known. Pregnant rats were exposed to repeated social stress on gestational days (GD) 16-20 and several aspects of HPA axis and glucocorticoid regulation, including concentrations of glucocorticoids, gene expression for their receptors (Nr3c1, Nr3c2), receptor chaperones (Fkbp51, Fkbp52) and enzymes that control local glucocorticoid availability (Hsd11b1, Hsd11b2), were investigated in the maternal, placental and fetal compartments on GD20. The maternal HPA axis was activated following stress, though the primary driver was vasopressin, rather than corticotropin-releasing hormone. Despite the stress-induced increase in circulating corticosterone in the dams, only a modest increase was detected in the circulation of female fetuses, with no change in the fetal brain of either sex. Moreover, there was no change in expression of genes that mediate glucocorticoid actions or modulate local concentrations in the fetal brain. In the placenta labyrinth zone, stress increased Hsd11b2 expression only in males and Fkbp51 expression only in females. Our results indicate that any role glucocorticoids play in fetal programming is likely indirect, perhaps through sex-dependent alterations in placental gene expression, rather than exerting effects via direct crossover into the fetal brain.

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Poster 13

A LONGITUDINAL MAGNETIC RESONANCE IMAGING STUDY TO ASSESS THE PLASTICITY OF THE MATERNAL BRAIN IN MICE

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Reproduction induces changes within the brain to prepare for gestation and motherhood. However, the dynamic of these central changes and their relationships with the development of maternal behavior remain poorly understood. Here, we describe a longitudinal morphometric neuroimaging study in female mice between pre-gestation and weaning, using new magnetic resonance imaging (MRI) resources comprising a high-resolution brain tem- plate, its associated tissue priors (60-µm isotropic resolution) and a corresponding mouse brain atlas (1320 re- gions of interest). Using these tools, we observed transient hypertrophies not only within key regions controlling gestation and maternal behavior (medial preoptic area, bed nucleus of the stria terminalis), but also in the amygdala, caudate nucleus and hippocampus. Additionally, unlike females exhibiting lower levels of maternal care, highly maternal females developed transient hypertrophies in somatosensory, entorhinal and retrosplenial cortices among other regions. Therefore, coordinated and transient brain modifications associated with maternal performance occurred during gestation and lactation. In conclusion, MRI appears to be an interesting tools to study longitudinal changes occuring in the maternal brain.

Research supported by: Région Centre Val-de-Loire (IMACERVOREPRO project) and Agence Nationale de la Recherche

Poster 14

UNDERSTANDING VULNERABILITY TO POSTPARTUM ANHEDONIA AND UNDERLYING MECHANISMS

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Approximately 60% of new mothers experience postpartum mood disturbances known as the “baby blues.” Fortunately, most new mothers recover within a few weeks but a significant subset (10-15%) go on to develop postpartum depression (PPD). The present study aimed to examine the onset of anhedonia and associated changes in neuroimmune and endocrine function postpartum. First time dams underwent a series of sucrose preference tests (prior to breeding and postpartum) to examine depressive-like behavior. Sucrose preference data revealed pre-pregnancy, most rats exhibit a strong sucrose preference (>80%) but immediately postpartum approximately 40% of new mothers display anhedonia suggesting some mothers are susceptible and others resilient to this onset of postpartum anhedonia. To better understand these individual differences, brain tissue was collected from animals at either postnatal day 2 or 9 and assessed for neuroimmune function. Fecal samples were also collected and assayed for estradiol and corticosterone levels. Results indicated an increase in IL-6 in susceptible animals in the dorsal hippocampus and medial prefrontal cortex (mPFC) at P2 and P9 time points as well as decreased BDNF in the mPFC at P2 and P9. Increased corticosterone postpartum was observed in resilient animals while no differences were observed in estradiol. Current work is further investigating these differences by examining alterations to functional brain networks using resting state fMRI imaging. Overall, this work aims to better understand and predict susceptibility or resiliency to postpartum anhedonia with hopes to proactively identify risk factors associated with PPD to aid in the development of future targeted therapeutics.

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Poster 15

LONG-TERM ADMINISTRATION OF MELANIN-CONCENTRATING HORMONE (MCH) AND ITS ANTAGONIST IMPACTS MATERNAL-DRIVEN BEHAVIORS IN THE LATE LACTATION PERIOD

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The melanin-concentrating hormone (MCH) modulates several motivated behaviors, including feeding, sleep, and mating. Exclusively during lactation, this peptide is synthetized in the medial preoptic area (MPOA), a hypothalamic region that triggers the expression of maternal behavior, reaching its highest levels around the 19th day after parturition. Nonetheless, the role MCH plays throughout lactation remains to be determined. We aimed to evaluate the maternal impacts of long-term administration of MCH, NEI peptide (transcripted with MCH gene), and MCH receptor 1 (MCHR1) blockage in lactating rats. Dams received the peptide/drug through an icv cannula attached to an osmotic pump from pregnancy day 14th to postpartum day 26th, being monitored for body weight and food intake. Maternal behavior parameters and the number of MPOA MCH-immunoreactive (ir) cells were assessed. Chronically, MCH increased dams body weight without exacerbating their food intake, whereas MCHR1-antagonist decreased body weight and the amount of food consumed. No significant differences were observed until postpartum day 10th. From that day, dams receiving both MCH+NEI combined showed fewer MCH-ir cells on MPOA, remaining for prolonged periods crouching over pups. Furthermore, MCH+NEI and MCHR1-antagonist groups showed longer latencies to retrieve the first pup. Antagonist-receiving mothers also showed impairment in grouping all the pups in the same nest. On the 19th day, this group presented more MCH-ir cells on MPOA than any other. Therefore, MCH expression on MPOA may have a dual role on lactation, signaling the extinction of maternal-driven behaviors as weaning approaches.

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Poster 16

IMPACT OF PERIPARTUM STRESS ON POSTPARTUM MATERNAL BEHAVIOR AND ASSOCIATED ENDOCRINE AND NEUROBIOLOGICAL SUBSTRATES

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The purpose of this study is to measure the impact of perinatal stress on postpartum maternal behaviors and assess changes in the biological substrates associated with maternal care. We utilized a limited bedding and nesting (LBN) condition to simulate a stressful environment that mimics the stressors a new mother might experience when lacking adequate resources to care for her infant, which is a common risk factor for postpartum depression (Gifford et al., 2021). We measured the frequency of various maternal care behaviors throughout the postpartum period. We also collected brain tissues to examine hormone receptor expression in the medial preoptic area (MPOA), a brain structure necessary for maternal behavior. We found a significant effect of stress, such that LBN dams exhibited significantly decreased archback nursing across postnatal days (P)0 - P9 ($p < 0.003$), with an associated increase in simple blanket nursing across P0-P9 ($p < 0.003$). We found no differences in the expression of progesterone receptor, estrogen receptor (ER)-β, or oxytocin receptor in the MPOA on P2 and P9. We found a main effect of postpartum condition on the expression of ER-α in the MPOA, which was also confirmed by analysis of ER-α immunohistochemistry. Interestingly, postpartum females (CON and LBN) had decreased expression of ER-α mRNA ($p < 0.0001$) and protein ($p = 0.0049$) in the MPOA compared to non-pregnant females. We conclude that limited bedding and nesting stress decreases important archback nursing behavior, with no associated differences in the expression of hormone receptors in the MPOA during this time.

Research supported by: R21MH122862 to JMS

Poster 17

CORTICOSTERONE EFFECTS ON MELANIN-CONCENTRATING HORMONE IN THE MEDIAL PREOPTIC AREA DURING LACTATION

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The Melanin-Concentrating hormone (MCH) is found in the medial preoptic area (MPOA) only during lactation in rats, reaching its peak at the end of this period. MPOA plays a major role as an integrative area for maternal behavior expression. The suppressive effects of corticosterone (CORT) on maternal behavior are well established. However, the effects of CORT on neurons that synthesize MCH specifically in the hypothalamic area are yet unknown. We evaluated the effects of dexamethasone (DEX) and metyrapone (MET, corticosterone synthesis inhibitor) on maternal behavior and MCH-producing neurons in the MPOA. Female rats were assigned into 3 groups: Control (C, saline 0,9%, n = 4); DEX (0.1 mg/kg, n = 4); and MET (50 µg/g, n = 4). From postpartum day (PPD) 1 to 19, dams were treated daily, and maternal behavior analysis was performed for 1 hour in the morning period. On PPD19, lactating females were euthanized and had their brains collected to identify MCH-immunoreactive (ir) neurons; blood and adrenals were obtained to evaluate plasma levels of CORT as well as the adrenal weight variation among experimental groups. DEX mothers showed higher self-grooming throughout lactation and reduced plasma CORT levels compared to the other groups. Adrenal weight was decreased in the MET group in relation to control. Therefore, we were able to impair adrenal/corticosterone functions in the dams and expect that MCH-ir neurons will be increased in these animals, since lower levels of CORT may increase the number of MCH neurons in some brain areas of lactating females.

Research supported by: FAPESP (grant # 2016/02224-1), CNPq and CAPES

Poster 18

INVESTIGATION OF THE EFFECTS OF PMCH EXPRESSION SILENCING BY SIRNA IN RATS DURING THE LACTATION PERIOD

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Introduction: The melanin-concentrating hormone (MCH) has its synthesis increased according to the progression of lactation days in rodents. The expression of Pmch reaches the peak around the lactation day 19th, and then neither the peptide nor the mRNA are found in the ventromedial part of the medial preoptic area (vmMPOA). The role of MCH synthesis only during lactation has not been fully elucidated in this period. Objective: we aim to investigate the effects of Pmch mRNA inactivation through the RNA interference technique (siRNA) in PC-12 cells and female rats. Material and methods: we performed two experimental models:1) assays were carried out in cell culture using plasmids (Pmch and scramble) to validate the silencing of Pmch in PC-12 cultures, also obtaining viral particles necessary for intracerebral injections and, processing the samples to verify possible differences in the Pmch expression; 2) female rats of the Long-Evans strain were submitted to intracerebral injection of Pmch siRNA or scramble lentivirus in hypothalamic sites. Then, brain areas were dissected by micropunch and submitted to RT-qPCR or collected to immunohistochemistry. Results: PC-12 cells treated with 20 mM lithium chloride for 12 hours showed a significant increase in the relative expression of Pmch compared to the control group, ANOVA with Dunnett's post-test ($p<0.0001$). Moreover, PC-12 cells transfected with Pmch siRNA presented a significant decrease in relative Pmch mRNA expression compared to the scramble siRNA, unpaired t-test ($p=0.0393$). Stereotaxic surgeries in female rats using lentiviruses are being performed. Perspective: we suggest that Pmch expression may have an impact on the lactation control in rats.

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Poster 19

IMPACT OF A BISPHENOL A, F, AND S MIXTURE AND MATERNAL CARE ON THE BRAIN TRANSCRIPTOME OF RAT DAMS AND PUPS

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Products containing BPA structural analog replacements have increased in response to growing public concern over adverse effects of BPA, but few studies have examined effects of prenatal exposure to BPA alternatives or bisphenol mixtures. In the present study, we investigate the effect of gestational exposure to a low-dose (150 ug/kg body weight per day) mixture of BPA, BPS, and BPF on the transcriptome in five brain regions in Long-Evans pups and dams using RNA-sequencing. We also examined the association between dam licking and grooming, which also has enduring effects on pup neural development, on the transcriptomes. Licking and grooming had region-specific associations with the transcriptome, with the most differentially expressed genes in the hypothalamus of dams and pups. In dams, the prelimbic cortex had the most differentially expressed genes associated with prenatal bisphenol exposure. Prenatal bisphenol exposure had a more robust effect on pups where it changed expression of over 2000 genes, primarily in the amygdala. Hypothesis-driven analysis of genes related to estrogen response, parental behavior, and epigenetic regulation of gene expression revealed region-specific expression associated with licking and grooming and bisphenol exposure that were distinct in dams and pups. Top Gene Set Enrichment Analysis terms were diverse, varied by brain region, and included terms related to steroid hormone regulation, metabolic/biosynthetic processes, and immune function. These data highlight the effects of bisphenols on multiple physiological processes highly dependent on timing of exposure (prenatal vs. adulthood) and reiterate the contributions of multiple experiential factors in shaping the brain.

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Poster 20

INCREASES IN MOTHER-TO-INFANT ATTACHMENT MEDIATES STRESS REDUCTION DURING PREGNANCY

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Pregnant women experience outstanding psychological changes as adaptations for motherhood, including those that will support mother-to-infant bond. For instance, maternal antenatal attachment is critical for the quality of the subsequent mother-to-infant bond and for the psychological well-being of both the mother and the infant. However, there is a paucity of research about maternal antenatal attachment over pregnancy and its potential benefits for pregnant women's psychological well-being. In the present study, we wanted to elucidate the relationship between maternal antenatal attachment and psychological health outcomes such as stress and depression in first time mothers undergoing pregnancy. For this purpose, 54 women undergoing their first pregnancy were recruited for a longitudinal study. Participants were asked to respond to the Maternal Antenatal Attachment Scale, to a State Stress scale and to the Antenatal Edinburgh Depression Scale, at their second trimester (18-22 weeks into pregnancy) and third trimester (34-36 weeks into pregnancy). Longitudinally, we found a significant decrease in depression symptoms by the third pregnancy trimester compared to the second trimester, while maternal attachment significantly increased within the same individuals during the matching period. Complementarily, mediation analysis revealed that 46% of the reduction in state stress in mothers undergoing their first pregnancy was mediated by increases in maternal antenatal attachment. These results suggest that pregnancy has a soothing effect on women's psychological well-being that is linked to the development of the mother-to-infant bond. Our findings shed light on the benefits that antenatal maternal attachment might bring to the future mother's psychological well-being.

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Poster 21

MATERNAL DEPRESSION MODERATES ERROR-RELATED NEGATIVITY ACROSS PREGNANCY AND POSTPARTUM

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Roughly 25% of mothers experience symptoms of perinatal depression (Gavin et al., 2005; O'Hara & McCabe, 2013). Greater risk for perinatal depression result from pregnancy-related changes to the maternal brain (Hoekzema et al., 2017) and subsequently increased vulnerability to psychopathology (Kim, 2016). One promising biomarker for internalizing psychopathology risk is error-related negativity (ERN), a neural marker of self-monitoring that appears following incorrect behavioral responses (Falkenstein et al., 1991). Several studies have demonstrated that ERN is trait-like (e.g., Weinberg & Hajcak, 2011; Hajack, 2012), but the ERN is also notably less stable during critical developmental periods (Meyer et al., 2014). As pregnancy comprises such a period, it is unclear whether the ERN should demonstrate stability during this time. We examined whether ERN was stable in mothers (N=92) across the second trimester, third trimester, and four months postpartum. Furthermore, we investigated whether depressive symptoms moderated ERN stability from second trimester to postpartum. ERN was stable from second to third trimester ($r(39) = .73$, $p<0.001$), third trimester to postpartum ($r(37)=.77$, $p<0.001$), and second trimester to postpartum ($r(30)=.77$, $p<0.001$). Moreover, second trimester ERN interacted with third trimester depressive symptoms to predict postpartum ERN ($B=0.28$, $SE(B)=0.03$, $p<.05$). When depressive symptoms were low, ERN was stable from second trimester to postpartum ($B=0.92$, $SE(B) =0.16$, $p<0.001$); ERN was not stable at high depression ($B=0.33$, $SE(B)=0.20$, $p=.14$). Findings suggest that high levels of depression may disrupt ERN stability during the perinatal period. Data collection was supported by NIGMS and NIMH of the National Institutes of Health.

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Poster 22

EFFECT OF PROBIOTIC TREATMENT WITH LACTICASEIBACILLUS RHAMNOSUS ON THE GUT-BRAIN AXIS OF THE MOTHER IN A RAT MODEL

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Perinatal depression and anxiety are two of the most common illnesses in pregnant women. These disorders affect up to 20% of mothers and currently there is a need for more treatment options. Clinical research and animal studies show that the treatment with certain strains of the probiotic Lacticaseibacillus rhamnosus (L.rhamnosus) can decrease perinatal mood and anxiety symptoms, however, many questions remain to be answered. In this project we focused on three main aims; 1) how supplementation with a type of L.rhamnosus may affect the gut-brain axis, 2) whether these effects are specific to the perinatal period, and 3) how this treatment may modulate maternal caregiving of offspring. To answer these questions, adult female Long Evans rats were used. Half the females were mated for a maternal group and half were age-matched virgins. Females were treated with a specific L.rhamnosus (Fonterra, NZ) in their drinking water, or control (water), from gestation day 2 until sacrifice, and at matched time points in virgin females. To measure changes in gut microbiota, fecal samples were taken weekly. Maternal caregiving behaviors were assessed in mothers during a pup retrieval test on postpartum day 6. Females were perfused after pup retrieval testing, and at matched time points in virgins. Preliminary results show mothers treated with the probiotic retrieved pups more often. Because of the important link between the gut-microbiota, brain and behavior our next steps are to examine the gut microbiota for the phyla involved in mental health, including Bacteroidetes, Firmicutes and Actinobacteria using qPCR and investigate measures of plasticity in the hippocampus. We expect the probiotic supplement will have a more marked effect on pregnant females than on virgin by altering gut microbiota content and hippocampal plasticity.

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Poster 23

STUDYING SLEEP-LIKE AND CIRCADIAN FEATURES IN PARTHENOGENETIC AND ANDROGENETIC NEURONS

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Imprinted genes control fundamental brain functions around 24 hrs, including sleep architecture, which is formed along with corticogenesis and cortical and subcortical brain circuits in early development. To date, it remains unsolved how imprinting control corticogenesis, assembly of circuits during development, modulation of the circadian clock, sleep homeostasis, and synaptic plasticity. To address some of these issues, we study sleep-like features in simplified in vitro systems of parthenogenetic and androgenetic neurons. In particular, we use three parallel models of mono-parental genome cell lines, including mouse 2D derived-neurons cultures, 3D cortical organoids, and chimeric mice models, to identify how the specific maternal or paternal genome physiologically orchestrates the network dynamics. By exploiting both molecular and electrophysiological approaches, we investigate the imprinting genes expression profile at single-cell resolution, together with the neuronal circuits' spontaneous and evoked electrophysiological activity obtained with a high-density MicroElectrode Array (HD-MEA) system. To perform our analysis, we adopted and improved a state-of-the-art spike sorting algorithm able to reliably detect activity from parthenogenetic or androgenetic single units from 2D differentiated neurons, allowing us to track the precise formation of neuronal networks. Our preliminary data show that spontaneous activity is driven by burst leaders from mono-parental genome neurons. This project aims to assess the specific contribution of the maternal or paternal genome in the cortical lineage development both in vitro and in vivo, highlighting new evidence on the "single-cell to global network" regulation and the control of circadian rhythms, sleep-like homeostasis, and synaptic plasticity in mammals.

Research supported by: Institutional funds (IIT)

Poster 24

UNPREDICTABILITY OF MATERNAL SENSORY SIGNALS DURING INFANCY AND CHILD'S EFFORTFUL CONTROL AT FIVE YEARS OF AGE: FINDINGS FROM THE FINNBRAIN BIRTH COHORT STUDY

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Background: A novel study paradigm in parenting research suggests that the unpredictable patterns of maternal sensory signals in maternal care may be related to the neurodevelopment of the child. One outcome studied is child effortful control, a potential predictor for later mental health. However, there is sparse knowledge about longitudinal effects on child development and possible sex differences.

Aims: Aims of the current study were to explore how unpredictability of maternal care during infancy is related to child effortful control at 5 years of age and whether there are sex differences.

Method: Participants consisted of 133 mother-child pairs. Mother-infant interaction was video-recorded when the infant was 8 months of age and unpredictability of maternal sensory signals was calculated. Child effortful control was evaluated by mother-report using the Child Behavior Questionnaire when the child was 5 years of age.

Results: We found in correlational analyses that higher unpredictability at 8 months of child age related to lower child effortful control at 5 years of age ($r = -.172$, $p = .048$). Moreover, there was a significant interaction effect for child sex: for boys, higher maternal unpredictability during infancy related to lower effortful control at 5 years of age after significant covariates (maternal effortful control and depressive and anxiety symptoms and economic satisfaction) were controlled for ($b = -1.365$, $p = .056$).

Conclusions: These results suggest that unpredictability of maternal sensory signals during infancy may be one additional aspect in early care, which relates to the development of child effortful control.

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Poster 25

MATERNAL AND PATERNAL POSTNATAL DEPRESSION AND PARENTAL VOCALISATION BEHAVIOURS IN INFANCY: FINDINGS FROM UK-BASED BIRTH COHORT

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Maternal and paternal postnatal depression (PND) are associated with increased risk of less optimal offspring developmental outcomes, with early exposure to differences in parental vocalisation behaviours potentially playing an important role. We examined the associations between maternal and paternal PND and various aspects of parental vocalisation behaviours in mothers (n=104) and fathers (n=34) of six-months old infants from the Avon Longitudinal Study of Parents and Children Generation-2 (ALSPAC-G2). Video footage of mother- and father-infant interactions was filmed at home using head-worn video cameras (head cams) and coded on multiple aspects of parental and infant vocalisation behaviours using micro-behavioural observational coding system. Parental depression symptoms were measured using the Edinburgh Postnatal Depression Scale (EPDS) and analysed as a continuous score. Frequencies and duration of vocalisation behaviours were similar in mothers and fathers, however, there was indication that fathers demonstrated higher frequency and duration of commands, exclamations and ironic/sarcastic tone and criticism compared to mothers, while mothers engaged in more teaching compared to fathers. Linear regression models indicated that maternal and paternal PND were not associated with the majority of parental vocalisations, however, there were some specific patterns observed mostly related to the emotional tone of parental vocalisations and speech. These findings may reflect the changing nature of contemporary parenting practices in the context of PND, improved ecological validity or methodological limitations of the study, including the explorative nature and multiple comparisons. If replicated, the pattern of findings could suggest that depression in parents may be associated with more emotionally sensitive behaviors.

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Poster 26

BRAIN DISOMY AND MOTHER-PUP INTERACTION: A PRELIMINARY INVESTIGATION OF MADM-12 LINE

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Imprinted genes are distributed across the brain with different imprinting status. To understand whether their role is crucial for specific brain functions, including pups-mom interaction, we used Nestin-Cre/LoxP-mediated single-chromosome recombination mouse model (named MADMs) to simultaneously produce paternal or maternal chromosome disomy in the brain cell populations.

We selected three MADM lines, namely MADM2, MADM7 and MADM12, for their concentration of imprinted, sleep, circadian and behavioral genes. Among them, MADM12 presents genes, such as Dlk1, whose imprinting dysregulation affects energy homeostasis, possibly changing pups' resources demands.

We compared MADM12 pups carrying UPD cells (MADM12CRE+/-) with non-recombinant internal controls from the same litter and with non-recombinant external controls by isolation-induced ultrasonic vocalization (USVs), SHIRPA test, and strange situation procedure (SSD).

In particular, MADM12CRE+/- mice present a more secure attachment than internal controls, confirmed by the lower USV production after maternal separation, higher exploration of stranger females, and higher spontaneous maternal exploration during the SSD. Interestingly, external controls showed similar USVs production and attachment behavior compared to MADM12CRE+/-, suggesting that the presence of high-demanding pups affects specifically non-recombinant littermates. These differences within the groups are not related to altered sensory-motor and neuronal development, as suggested by SHIRPA results. Finally, internal controls show significantly higher locomotor activity than UPD littermates and external controls, in line with the higher mom-seeking behavior of internal controls in SSD procedure.

This evidence of altered attachment according to specific chromosomal UPD suggests that imprinting gene expression may influence intra-litter attachment behavior in pups and possibly sociability in adults.

Research supported by: Institutional funds (IIT)

Poster 27

PARENTAL EARLY LIFE ADVERSITIES AND CHILD BEHAVIORAL DIFFICULTIES: INVESTIGATING THE MEDIATING ROLE OF PARENTAL MENTAL WELL-BEING, PARTNER RELATIONSHIP QUALITY, AND PARENTING PRACTICES IN GERMAN-SPEAKING PARENTS

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Early life adversities (ELA), such as sexual, physical, and emotional abuse and physical and emotional neglect, are major risk factors for psychopathology. In addition, ELA might be transmitted from one generation to the next. This study investigated potential mechanisms in this intergenerational transmission of ELA, specifically parental mental well-being, partner relationship quality, and parenting stress and practices. German-speaking parents (N = 121, age 25 to 60 years, M=40.2±6.7 years; 88.4% female) were invited to participate in an ongoing cross-sectional online study that started in November 2020. Children had to be aged between 2 to 16 years (M= 6.8±3.9 years, 52.1% female). We assessed ELA using the Childhood Trauma Questionnaire (CTQ), symptoms of depression and anxiety using the Brief Symptom Inventory (BSI-18), parenting stress and relationship quality using the German Parent Stress Questionnaire (ESF), parenting using the Alabama Parenting Questionnaire (APQ), and child behavioral problems using the Strengths and Difficulties Questionnaire (SDQ). Preliminary results showed that parental ELA was associated with child internalizing, but not externalizing difficulties. Bootstrap mediation analyses suggested that parental symptoms of depression and anxiety mediated the effect of parental ELA on child internalizing difficulties. Despite no total effect, parental ELA and child total difficulties were indirectly associated through parental symptoms of depression and anxiety. All other investigated mediators did not show any indirect effects. Our findings suggest that promoting the mental well-being of parents with a history of ELA might prevent behavioral difficulties in their offspring, particularly internalizing problems.

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Poster 28

CHANGES IN DORSAL RAPHE CRF2 RECEPTOR EXPRESSION WITHIN 5-HT AND GABA CELLS ACROSS FEMALE REPRODUCTION

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Female reproduction induces striking neurobiological changes that allow for the display of maternal caregiving behaviors. Two facilitatory hallmarks of motherhood are reduced anxiety and blunted stress responsiveness, both of which are regulated by the neuropeptide, CRF. One potential site of CRF action for these effects is the midbrain dorsal raphe (DR), the source of most forebrain serotonin. To begin uncovering the neuromechanisms underlying reduced postpartum anxiety and stress responsiveness, we quantified CRF receptor (CRFR) expression within the female rat DR across reproduction. In Experiment 1, levels of CRFR1 and CRFR2 mRNA within the DR of diestrus virgin, mid-pregnant, recently parturient, and postpartum day 7 females were assessed using qPCR. Greater CRFR2 mRNA was found in the recently parturient and postpartum day 7 females compared to virgins. In Experiment 2, dual-label fluorescent in situ hybridization (RNAscope, ACDBio) was used to determine colocalization of CRFR2 with GAD65 and TPH2 in all five subregions of the DR within the same female groups used in Experiment 1. Recently parturient females had more CRFR2-positive cells in the rostral DR, and more CRFR2 on GAD65 cells in the dorsal DR, compared to diestrus virgins. These results suggest that CRFR2 activity during the postpartum period may increase serotonergic signaling from the rostral DR and decrease serotonergic signaling from the dorsal DR, thus leading to blunted behavioral and neuroendocrine responses to stressors. Our results also have implications for the neurobiological etiology of healthy and atypical stress-related postpartum affective states in women.

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Poster 29

PRENATAL MATERNAL DEPRESSION PREDICTS BRAIN MATURATION IN INFANTS

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Prenatal depression adversely impacts maternal and infant development. Changes in maternal neurocognitive function related to the experience of prenatal depression predict maternal and infant emotionality (Davis et al., 2007) and cognitive function (Barker et al., 2013). Such findings are believed to reflect in-utero programming and a biologically-based pathway for the maternal-to-infant transmission of neural function. Consistent with the notion that emotional development is grounded in developing cognitive processes (Bell et al., 2019), maternal depressive symptoms may represent a form of adversity that shifts developing biological systems in the fetus (Callaghan & Tottenham, 2016). In the current study, we tested whether infant brain maturation, indexed by the ratio of alpha to delta power, comprised a pathway by which maternal prenatal depression simultaneously impact infants' cognitive and emotional development. Results indicated that greater levels of self-reported symptoms of depression in the second (B=-.01, SE(B)=.01, 95% CI [-.02, 0.00], p=.04) and third trimesters (B=-.01, SE(B)=.01, 95% CI [-.03, .00], p=.05) of pregnancy were associated with smaller baseline alpha-delta ratio scores in infants at 4 months at parietal electrodes. Postnatal depressive symptoms were unrelated to infant alpha-delta ratio scores (B=.01, SE(B)=.01, 95% CI [-.01, .02], p=.25). Additionally, smaller alpha-delta ratios were associated with better mother-reported infant regulation (B=-1.40, SE(B)=.61, 95% CI [-2.59, -.20], p=.02) but were unrelated to mother-reported infant negativity (B = -.03, SE(B) = .88, B = -.01, 95% CI [-1.75, 1.69], p = .98). This pattern of results suggests greater symptoms of maternal depression appear to be associated with less mature neural development.

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Poster 30

EFFECT OF PERINATAL GLYPHOSATE AND GLYPHOSATE-BASES HERBICIDE (ROUNDUP®) EXPOSURE ON MATERNAL BEHAVIOR AND HIPPOCAMPAL PLASTICITY IN ADULT MALE AND FEMALE OFFSPRING

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Glyphosate is found in a large array of non-selective herbicides such as Roundup® and is by far the most widely used herbicide. Previously we have reported glyphosate alone or in formulation (Roundup) affects maternal behavior, neuroplasticity and gut microbiota in the mother (Dechartres et al 2019). The present study aimed to understand how perinatal glyphosate exposure alters neuroplasticity in adult male and female offspring. To do this Sprague-Dawly rat offspring were perinatally exposed to glyphosate (5 mg/kg/day), Roundup® (5 mg/kg/day glyphosate equivalent), or vehicle orally administered to the dam from gestational day (GD) 10 to postpartum day (PD) 22. During adulthood the brains of male and female offspring were collected. Plasticity in the hippocampus was assessed using markers of microglia, and neurogenesis. Main results show that perinatal glyphosate exposure, but not Roundup, significantly increased cell proliferation (Ki67-ir cells) in the dentate gyrus of the hippocampus. We also found that both glyphosate and Roundup exposure increased immature neurons (DCX-ir) in the ventral, but not dorsal, regions of the dentate gyrus. There was no impact of glyphosate or Roundup on microglial cell number (Iba1-ir) in the dentate gyrus. There was a significant effect of sex on measures of hippocampal neurogenesis (Ki67-ir cells and DCX-ir cells) with females having fewer new cells than males. Further research will investigate how perinatal glyphosate exposures may impact synaptophysin density in the hippocampus and gut microbiota of the adult male and female offspring. Our results point to an enduring effect of this pesticide on neurodevelopment.

Poster 31

EVIDENCE FOR COGNITIVE PLASTICITY DURING PREGNANCY VIA ENHANCED LEARNING AND MEMORY

Callaghan B; McCormack C; Tottenham N; Monk C

Human and animal neuroscience studies support the view that plastic shifts occur in the brain during pregnancy that support the emergence of new maternal behaviours. The idea of adaptive plasticity in pregnancy is at odds with the notion of “baby brain”, in which pregnant women describe the onset of forgetfulness. While inconsistent evidence for memory deficits during pregnancy has been reported, few studies have investigated spatial associative memory (which is consistently enhanced in studies of pregnant rodents). Moreover, most studies assess domain-general stimuli, which might miss adaptations specific to parent-relevant stimuli. In the present study, we examined the retention of spatial associative memory for parenting-relevant and non-parenting-relevant stimuli across 4-weeks in a sample of women in their third trimester of pregnancy, and compared their performance to a sample of never pregnant women. We demonstrated that relative to never pregnant women, pregnant women exhibited enhanced long-term retention of object-scene-location associations (spatial associative memory), as well as better initial learning about parenting-relevant, relative to non-parenting-relevant, stimuli. Thus, similar to studies in rodents, cognitive improvements were seen during pregnancy in humans, and those improvements were specific to the domain of spatial associative retention, and in the recognition of stimuli relevant to parenting.

Research supported by:

Poster 32

MATERNAL CHILDHOOD MALTREATMENT AND CAREGIVING SENSITIVITY: MODERATION BY SOCIAL COGNITIVE ABILITY AND MOOD SYMPTOMS

McCormack C; Callaghan B; Tottenham N; Monk C

Objective: Maternal childhood maltreatment (CM) is a risk factor for perinatal mood and anxiety disorders and associated with less sensitive caregiving. Cognitive and neural mechanisms for associations between trauma and caregiving are unclear. Here we examine associations between CM and attachment-related outcomes, and whether altered social cognitive ability moderates associations.

Methods: Pregnant women (n=99) were recruited from a hospital clinic. CM was measured with the Childhood Trauma Questionnaire (CTQ). Two aspects of social cognitive ability were examined: Theory of Mind (ToM) and Parental Reflective Functioning (PRF). Caregiving sensitivity was measured via observer ratings of videotaped mother-infant interactions at 4 months, and via self-report Maternal Postpartum Attachment Scale (MPAS).

Results: CM was associated with higher hostility towards infant at 4-months (MPAS subscale) ($F=8.4$, $p=.005$); effect reduced when adjusting for concurrent depression, anxiety, and stress ($F=4.9$, $p=.031$). No association was observed between CM and observer-rated sensitivity. A trend-level interaction was observed between CM and ToM on caregiving sensitivity such that for those with CM only, ToM was associated with higher sensitivity. CM was not associated with ToM or PRF ability. CM was associated with elevated perinatal depression, anxiety, and stress beginning early in pregnancy.

Conclusions: While observer-rated sensitive caregiving behavior and social cognitive ability may not be altered among those with CM, there may be aberrant cognition underlying maternal sensitivity for those with CM, suggesting successful adaptation to parenting in the context of adversity yet potential psychological strain for mothers.

Research supported by:

Poster 33

MEN'S EMPATHY ACROSS TRANSITION TO PARENTHOOD

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Empathy is fundamental to a parent's sensitive caregiving, which in turn predicts a multitude of developmental and health outcomes for children. In this study, we investigated whether childless men, expecting men, and fathers differ in affective and cognitive empathy, i.e., emotional reactivity to and accurate recognition of children's emotions *Methods.* We recruited a total of 530 participants for an online study with a cross-sectional design. Participants' task was to rate their compassion and positive affect in reaction to emotional pictures of children and accurately recognize children's emotions from pictures of the eye area. Our preregistered hypothesis was that fathers would exhibit highest emotional reactivity to child signals and better emotion recognition ability followed by expecting men while childless men would score the lowest on both. *Results.* In line with our hypothesis, expecting men exhibited greater compassion and positive affect towards children than childless men. However, the difference between expecting men and fathers was not significant. Unlike we expected, cognitive empathy did not differ between childless and expecting men. Fathers had lower emotion recognition accuracy than expecting men on a more basic version of the task. *Conclusions.* Possibly, expecting men might be more sensitive and attentive to child signals in preparation for fatherhood, and hence show more affective empathy. Meanwhile fathers might become accustomed to childcare, and their reactions may taper off over time. New fathers might also experience more stress and cognitive load in early parenthood impacting their cognitive empathy. Our partly unexpected findings prompt questions for further research.

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Poster 34

OFFSPRING LOSS-MEDIATED IMPACT ON BRAIN AND BEHAVIOR IN RAT MOTHERS

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The maternal bond is the strongest and most common social bond found in the animal kingdom. This bond is thought to be the neurobiological origin for the capacity to develop any social bonds later in life. Consequently, breaking the bond can have long-lasting impact on both sides. In humans, child loss leads to the development of prolonged grief disorder in 90% of cases. The lack of knowledge of the neurobiological processes in grieving mothers led us to investigate this process further. We used lactating rat mothers as animal model to study the maternal bond disruption from a molecular and behavioral perspective. Female Sprague-Dawley rats were used to assess the impact of short- (1 or 3 or 6 days) and long-term (18 or 19 days) offspring loss. The experimental animals were tested for anxiety-related behavior in the light-dark box and passive stress-coping behavior in the forced swim test. Furthermore, we analyzed their brains for neuronal activation and oxytocin receptor expression. The separated mothers showed lower anxiety but hyperactivity, together with higher passive stress-coping behavior. In the brain, offspring loss led to a positive correlation of the neuronal activity between the prelimbic cortex and the basolateral amygdala. In addition, oxytocin receptor density was altered in different brain regions following the offspring separation, even after a long-term separation experience of 19 days. Our data suggest that rats might be used as a potential animal model to study the effects of offspring loss on the mother and that oxytocin could play a role in the “grieving” process.

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Poster 35

IMPLICATION OF THE CRF SYSTEM THE NUCLEUS ACCUMBENS SHELL IN MATERNAL AGGRESSION AND MATERNAL CARE

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Maternal behavior is a social behavior that sets up naturally in lactating rat mothers. It includes maternal care (MC) and maternal aggression, which is a protective behavior of the mother towards her pups to defend them against a potentially dangerous intruder. When the neurobiological systems involved in the onset and maintenance of maternal behavior are perturbed, these maternal behaviors can be impaired, potentially leading to poor mothering or even neglect. This study aimed to investigate if the corticotropin-releasing factor (CRF) system within the nucleus accumbens (NAcc) shell might be involved in facilitating poor mothering, defined by low MC and maternal aggression in rats. Female Sprague-Dawley rats were bilaterally implanted with guide cannulas targeting the NAcc shell on lactation-day (LD) 2. Observation of MC before and after the maternal defence (MD) test was performed on LD7 and LD9. Just before MD, rat mothers were acutely injected with either vehicle, CRF Receptor 1 agonist (CRF, 2 µg/µL), CRF Receptor 1 antagonist (CP-154,526, 0,8 µg/µL), or CRF Binding Protein inhibitor (CRF(6-33), 10 µg/µL), which releases bound CRF. Interestingly, injections of CRF or CRF(6-33) significantly reduced MC, as shown by lower total nursing following MD, which was not affected by the treatment. The effects of CP-154,526 treatment are still under evaluation. Our data indicate that alterations of the CRF system signaling in the NAcc shell play a marginal role in maternal aggression behavior, whereas they strongly impair MC after stress exposure.

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Poster 36

POOR MOTHERING IN RAT MOTHERS: INVOLVEMENT OF THE CRF SYSTEM IN THE NUCLEUS ACCUMBENS SHELL

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Adequate maternal care has profound impact on the mother's and the young's well-being. To become maternal, complex changes occur in the maternal brain in the peripartum period. However, various factors, like increased signaling of the corticotropin-releasing factor (CRF) system, can cause maladaptation, leading to poor mothering or the development of psychiatric disorders. This study investigates if the activation of CRF receptor type 1 (by CRF) or 2 (by Urocortin 3; Ucn3) within the nucleus accumbens (NAcc) shell underlies poor mothering in rats. On pregnancy-day 18, female Sprague-Dawley rats were bilaterally implanted with guide cannulas targeting the NAcc shell. On lactation-day (LD) 1, maternal care (MC) was observed under basal conditions and after injection of vehicle, Ucn3 (6 µg/µL), or CRF (2 µg/µL). On LD5, anxiety-like behavior after drug administration was assessed in the light-dark box. In another cohort of animals, cannulas were implanted on LD2. On LD9, MC was scored before and after the maternal defense test, a psychosocial stressor. The acute infusion of Ucn3 reduced arched-back and total nursing, and induced an anxious like phenotype. Moreover, Ucn3 strongly decreased maternal aggression, while minor effects were observed on MC following stress exposure. On the other hand, CRF prolongedly impaired MC on LD1, with stronger effects on passive nursing postures. While CRF did not affect maternal anxiety nor aggression, it impaired MC following stress. Our data indicate that activation of both CRF receptors type 1 and 2 in the NAcc shell plays a prominent role in various aspects of poor mothering.

Research supported by: DFG BO1958/8-2 to OJB

Poster 37

MOTHER-INFANT SYNCHRONY AND ITS ASSOCIATION WITH EMPATHY IN ONE YEAR OLD CHILDREN

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Mother-infant behavior synchrony (BS) has been related to infants´ socioemotional maturation, including the development of empathy. However, this association has not been established during the transition to the second year. The present study aims to determine: 1. BS in a free-play interaction according to children's age and 2. its association with children's empathy. The dyads were divided into two groups: a: 11 to 12 months (n=10) and b: 14 to 15 months (n=10). The BS was assessed in a free-play interaction between mother and child. Children's empathy was measured during their mother's pain simulation. All interactions were filmed for subsequent analysis. We found that: 1) old children spent more time in joint attention (JA) and play (P) than the young ones (JA:U=19, p=0.05; P: U=19, p=0.05; Mann-Whitney U test); 2) mother's vocalizations preceded JA and P in both ages (a: p=0.04; b: p=0.023, Binomial Test) but they only preceded mutual gaze in old children (b: p=0.02). 3) JA was positively correlated with the cognitive component of empathy in both groups (a: Tau=0.469; p=0.01; b: Tau=0.551, p=0.02, Kendall correlation test) and dialogue with the motivational component in old children (b: Tau=0.709, p=0.001). In conclusion, BS differed according to the children's age, emphasizing the process of development and was correlated with components of empathy, highlighting its role in organizing social behavior from early ages.

Research supported by: CSIC

Poster 38

THE JOINT CONTRIBUTION OF PRENATAL ADVERSITY, OFFSPRING DOPAMINE-SYSTEM GENES, AND EARLY PARENTING TO TODDLER ATTENTIONAL COMPETENCE

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Background: Due to methodological limitations, few studies have explored the complex gene-by-prenatal environment-by-early postnatal environment interactions that underlie the development of attentional competence. Using our recently developed analytical approach (LEGIT), we examined if variation in dopamine-system genes interact with prenatal adversity to influence toddler attentional competence and whether this influence is buffered by early positive maternal behavior. Methods: From the Canadian MAVAN cohort, 197 participants had information on prenatal adversity (prenatal stressful life events, prenatal maternal depressive symptoms, and birthweight), five dopamine-system genes (*DAT1, DRD4, DRD2, COMT, BDNF*), observed maternal parenting at 6 months (infant-related attention, vocalization, tactile stimulation, and infant-related activities), and parent-rated toddler attentional competence at 18 and 24 months. We used the LEGIT approach to examine simultaneous genes-by-prenatal environment-by-postnatal environment (GxE1xE2) interactions, while controlling for sociodemographic factors and postnatal depression. Results: A three-way GxE1xE2 interaction was not confirmed in our sample. However, consistent two-way (GxE1, GxE2, E1xE2) interactions emerged in the complete-case, imputed, variable-selection, and full models. The components driving these interactions were prenatal stressful life events, *DAT1, COMT,* maternal sensitivity, vocalization, tactile stimulation, and infant-related activities. Conclusions: Our findings highlight the importance of studying the interplay between multiple genetic and environmental factors in early attention development. Importantly, we identified several aspects of early maternal behavior as potential targets for intervention.

Research supported by: The Canadian Institutes of Health Research; the March of Dimes Foundation; the Fonds de la recherche en santé du Québec

Poster 39

MATERNAL ATTACHMENT INSECURITY, PRENATAL MOOD PROBLEMS, AND EARLY MATERNAL FUNCTIONING IN PATIENTS RECEIVING PSYCHIATRIC CARE DURING THE PERINATAL PERIOD

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Background: New research applying attachment theory to perinatal psychiatric symptoms suggests that pregnant women with insecure attachment styles are at greater risk for postpartum depression. It is unclear though if women with insecure attachment are also at greater risk for prenatal depression/anxiety symptoms and impaired maternal functioning. We examined this in a unique multi-site databank that collects clinical information of patients seen at perinatal mental health clinics at six hospitals in Quebec, Canada. Methods: Participants included 112 pregnant patients from the Quebec Perinatal Multisite Databank who completed follow-up assessments at 6 weeks (T2) and at 4-6 months (T3) postpartum by July 31st, 2021. Maternal attachment insecurity, depression/anxiety symptoms, and pregnancy-specific worries were assessed prenatally clinically and with validated questionnaires. Patients reported on overall postpartum functioning in the context of motherhood at T2 and T3. Results: Maternal insecure attachment was related to more depression/anxiety symptoms during pregnancy ($p<0.0001$) and impaired maternal functioning (at T2 $p<0.05$; T3 $p=0.08$). The link between insecure attachment and impaired maternal functioning was significantly ($p<0.01$) mediated by mothers' increased depression/anxiety symptoms during pregnancy at both T2 (proportion mediated=46%) and T3 (proportion mediated=60%). Mediation effects remained significant when controlling for basic sociodemographic and treatment factors, but were no longer significant when additionally controlling for concurrent maternal depression/anxiety symptoms. However, postpartum depression/anxiety symptoms may be part of the causal pathway. Conclusions: Adult attachment style can affect early maternal functioning, possibly by increasing women's perinatal depression/anxiety symptoms. Assessing women's attachment style may further improve perinatal screening and intervention design.

Research supported by: The Montreal General Hospital Foundation; the Fonds de la recherche en santé du Québec

Poster 40

PREGNANCY CHANGES HOW THE BRAIN PROCESSES PUP-DERIVED AND NON-SOCIAL CONTROL STIMULI: A NETWORK VIEW OF THE MATERNAL BRAIN

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Hormones acting onto the brain during pregnancy sharply change female social behaviour, but it is not clear where in the brain these changes occur. Here, we used cFos-expression to compare the neural activity in 19 brain nuclei of late-pregnant (LP) and virgin females (V) exposed to pups or buttons (control). The results reveal changes in chemosensory processing during pregnancy. In LP females, pups activate more than buttons the piriform and vomeronasal cortices, and the posteromedial amygdala, which are more activated by buttons in virgins. Some LP females (but no virgins) attacked pups, a behaviour correlated with activity in the accessory olfactory bulbs and vomeronasal BST: this draws a pathway for infanticide during motherhood. We also analysed nuclei of the social brain and motivation/reward circuit. As expected, pups activated the social brain more than buttons, with minor differences between females virtually restricted to the periaqueductal grey (correlated with infanticide in LP females). By contrast, the motivation brain circuitry shows sharp differences between females: pups activate it more than buttons in LP females, whereas virgins show the opposite profile. Principal component analysis supports a network view of the neural control of maternal behaviours. In fact, linear discriminant analysis allows accurately predicting (>93%) the kind of female (LP or V) and stimulus (pups or buttons) by just looking at the pattern of activity of the socio-motivational brain network, but accuracy is low (<70%) if only the medial preoptic area is considered.

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BEHAVIOURAL SIGNATURES OF INTERGENERATIONAL TRANSMISSION OF MENTAL HEALTH: TRIANGULATION OF EPIDEMIOLOGY AND DEVELOPMENTAL PSYCHOLOGY

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Context and Aims: Despite substantial evidence that parental behaviour is a potentially modifiable mechanism in the intergenerational transmission of mental health risk, there is still little understanding of which aspects of parenting to target (and in which contexts) and, more importantly, how to target them. This limits the success of parenting support and interventions.

A key issue in knowledge generation in parenting research is measurement: if parenting is self-reported, it will be subject to recall and reporting biases; whilst when recorded or observed by researchers, it will be subject to performance bias. Thus, triangulation of multiple sources of data is needed. A further limitation is separating effects of parenting from shared genetics and social circumstances of parents and children. The aim of the ERC-funded MHINT (Mental Health Intergenerational Transmission) study is to advance measurement of parenting behaviour, thus providing novel insights for modifiable target behaviours that improve parent–child interactions and, in turn, improve offspring mental health outcomes.

MHINT study: In the Mental Health IntergeNerational Transmission (MHINT) program, we have developed the integration of large-scale longitudinal studies measuring parenting, social context and genetics to allow us to explore long-term effects of variations in parenting at a population level. Such findings identify key concepts and help separate parenting effects from social and genetic confounds. However, they are limited with regards to providing insight into every day behavioural manifestation in parenting habits. This is a key goal for sustainable behavioural interventions. An important advancement of MHINT was to use wearable cameras at home to capture less-biased interactions (https://doi.org/10.1016/j.infbeh.2017.02.006). We have now collected data on >100 families in the Children of the Children of the 90s study (see The second generation of The Avon Longitudinal Study of Parents and Children (ALSPAC-G2): a cohort profile - PubMed (nih.gov)) and we have worked with an industrial-user development company to improve the design of the original device. The new cameras have been adopted by other research groups worldwide, including in South Africa and Brazil.

In this poster, we will summarise the development and validation of the devices and present evidence from population studies and present ways to translate this knowledge to behavioural manifestations.

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NEURAL CORRELATES OF INFANT STIMULI AND CANNABIS USE IN THE SECOND TRIMESTER

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In the state of Colorado, USA, recreational cannabis use during pregnancy is increasing in popularity; thus, understanding the effects of cannabis during pregnancy and the transition to parenthood is imperative. Neural network transformations in response to infant cues early on in pregnancy is imperative to prepare parents biologically to respond to their infant. During the postpartum period, the prefrontal cortex (PFC) has shown dampened signaling in substance users. This study investigated both the effects of infant cries and infant faces on prefrontal hemodynamic response using function Near-Infrared Spectroscopy during the second trimester among cannabis users (CU=13) and non-users (NU=50). Cannabis use was defined by a positive urine drug screen test, or using a Timeline Followback/Self-Report Drug Use Scale. For viewing infant faces, HbO channel 5 in the DMPFC ($F=4.595$, df(2), $p=.023$, and channel 34 in the DLPFC ($F=4.579$, df(2), $p=.016$). The DLPFC in CU showed significantly more activation to neutral infant faces than the control group. For listening to infant cries, HbO channel 5 in the DMPFC ($F=5.229$, df(1), $p=.025$), and channel 24 in the DMPFC ($F=5.115$, df(1), $p=.027$) showed greater activation in CU to infant cries than to matched white noise. This preliminary data shows cannabis use is associated with increased PFC responses to infant cues during pregnancy. It may suggest altered emotional reactivity and regulation to infant cues. Future research is needed how the prenatal brain responses to infant cues (not specific to own infants) may be related to the postpartum brain and behavioral responses to own infants.

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MATERNAL CHILDHOOD HISTORY AND CARDIAC VAGAL REGULATION: THE ROLE OF THE EVOLVED DEVELOPMENTAL NICHE

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Early life adversity impairs adult health (Felitti & Anda, 2005) and parenting behaviors (Lomanowska et al., 2017) but what experiences support healthy parental outcomes? The Evolved Developmental Niche (EDN; Narvaez et al., 2013), identified worldwide among human groups, represents the human species' millions-years-old evolved system of care that optimizes biopsychosocial development. Emerging evidence suggests that the EDN supports autonomic functioning across the lifespan into adulthood (Tarsha & Narvaez, 2021). Given its importance, we investigated which EDN components most strongly influenced maternal cardiac vagal regulation years later. To address this question, mothers (N = 78) self-reported their childhood history according to the EDN and their respiratory sinus arrhythmia (RSA), a biomarker of mental health resilience (Pereira et al., 2020) and healthy parenting behaviors (Perlman et al., 2008), was assessed. RSA was measured across relaxing and stressful conditions, providing indexes of both cardiac vagal tone and flexibility. Three latent growth curve models demonstrated that childhood history of positive home climate and social embeddedness outperformed the other EDN components. Childhood experiences of positive home climate predicted higher cardiac vagal tone (βstress to recovery=.59, p .03; βlevel of recovery=.50, p=.048) whereas childhood social embeddedness predicted both tonic (βstress to recovery=-.40, p=.035) and flexible cardiac vagal regulation (βbaseline to stress=-.31, p=.008). The results suggest that provision of the EDN in childhood, specifically that of positive home climate and social embeddedness, may promote overall cardiac vagal tone and vagal flexibility in mothers years later, supporting the neurobiological architecture needed for supportive parenting behaviors.

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HIGH MATERNAL BMI IS ASSOCIATED WITH PERINATAL DEPRESSION AND INCREASED INFLAMMATION

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Obesity and depression are known to have a bidirectional relationship with a physiological inflammatory milieu in common. There is no consensus on the impact of maternal high BMI on perinatal depression outcome. In this study, we examine the relationship between pre-pregnancy high BMI and perinatal depression and the possible mediation by inflammatory markers and DNA methylation during pregnancy. Pregnant women (n= 176) answered the Edinburgh postnatal depression scale (EPDS) questionnaire and gave blood samples at gestation weeks (GA) 12-22, 23-28, and 34-36 and postpartum. Plasma obtained from blood samples (GA 23-28, and 34-36) were analyzed for a number of inflammatory biomarkers (TNF-α, IL-6, IL1RA, CRP, IL-8, IL-4). Our preliminary results indicate that women with high BMI had higher EPDS scores overall. In addition, using an EPDS score of ≥10 as a risk score of depression, we found significantly more women with high BMI (68%) in the risk group. Women with high BMI exhibited significantly higher levels of IL-6, IL1RA, and CRP. Future analysis will examine differential effects of high BMI on DNA methylation of T-cells from these women and its relationship to the augmented inflammatory biomarkers observed.

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THE ROLE OF STRUCTURED PARENTING AND SHARED PARENTING RESPONSIBILITIES IN PARENTAL MENTAL HEALTH DURING THE COVID-19 PANDEMIC

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Background: The COVID-19 pandemic has precipitated deterioration in parental mental health. Lockdowns have impacted structured parenting (use of routines and limits) and shared parenting responsibilities. Here, we investigate the role of structured parenting and shared parenting on parent mental health during the pandemic. Method: 828 parents with 3450 observations (88.2% mothers, meanage = 43.64, SD = 5.77) in Ontario, Canada, completed online surveys. Structured parenting and shared parenting responsibilities (Childbearing Attitudes Questionnaire1) were assessed in April-May 2020. Depression symptoms (Patient Health Questionnaire-82) and anxiety symptoms (General Anxiety Disorder-73) were assessed repeatedly April 2020-March 2022. We used linear mixed models to examine associations between structured parenting and shared parenting responsibilities with parent mental health stratified by age group (6-9 years, 10-12 years, 13-18 years). Results: Across all age groups, controlling for household income, assigned sex, ethnicity, and previous child mental health diagnosis, parents who reported high levels of shared parenting responsibilities at the start of the pandemic had lower depression (βs = -0.13 - -0.25, all ps < .01) and anxiety symptoms (βs = -0.13 - -0.21, all ps < .01) during the pandemic. Parents of children 10-12 years old who reported more structured parenting at the start of the pandemic had lower depression symptoms during the pandemic (β = -0.11, p < .05). Structured parenting was not significantly associated with parent anxiety symptoms for any age group. Conclusion: Support of structured parenting and shared parenting responsibilities may be a promising strategy to ameliorate parent mental health during the pandemic recovery.

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THE ROLE OF ESTROGEN AND PROGESTERONE IN THE MCH SYSTEM IN FEMALE RAT DAMS

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The neuroendocrine system is an important regulator of reproduction. We evaluate the effect of estrogen and progesterone in the melanin-concentrating hormone (MCH) neurons and its serum concentration, as this peptide is a neuromodulator related to maternal behavior. The aims were: to investigate the effect of hormonal manipulation in the production of MCH neurons in some brain areas; to study the effect of estrogen and progesterone in the serum concentration of MCH, consequently its role as a neurohormone. Methods: Sprague-Dawley rats were divided into two groups: 1) lactating dams were submitted to bilateral ovariectomy (ovx) or sham surgery on the first day post-partum with no hormonal replacement. The brain and blood were collected on day 15 or 19 post-partum; 2) after a bilateral ovariectomy the dams were submitted to protocols of hormonal replacement (injection of estrogen, progesterone, or both hormones). Results: 1) an increase in the number of MCH neurons occurs in the medial preoptic area (MPOA) after the ovx, no effect was observed in the paraventricular nucleus of the hypothalamus and the incerto- hypothalamic area, the serum MCH had an increased concentration after the ovx; 2) the hormonal treatment confirmed these results, showing that the estrogen injection reduces the number of MCH-ir neurons in the MPOA and its serum concentration, also the injection of progesterone alone had no effect. Conclusion: Estrogen is an inhibitor of the MCH system, but progesterone alone had no effect. The neuroendocrine regulation of MCH occurs on the MPOA of the rat dams, a brain site directly related to maternal behavior.

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