



## Editorial

## Beyond the baby brain: Moving towards a better understanding of the parental brain and behavior



This Special Issue of *Frontiers in Neuroendocrinology* features a collection of reviews submitted following the Parental Brain Conference, held in Toronto, Canada July 13–14, 2018. In keeping with the purpose of the meeting, the articles in this Issue discuss various topics related to the neural consequences of pregnancy and parenting, mechanisms of caregiving behavior as well as parental physical and psychological health.

Parental care, most often exhibited as maternal care, is essential for proper offspring development (Bowlby, 1950; Meyer et al., 1975). Because of this, the neurobiological mechanisms of mothering, as well as the conditions under which they are impaired or fail, are topics of great interest and importance. Indeed, more than half a century worth of research in humans, non-human primates, and rodent models has documented the negative neurobehavioral outcomes in infants that receive suboptimal maternal care (Champagne et al., 2003; Kentner et al., 2019). In this issue, Glynn and Baram (2019) highlight newer evidence showing that fragmented, erratic patterns of maternal care, not just low quantity and quality, critically influence the developing brain and later vulnerability for mental health disorders. This Special Issue also considers the numerous factors that can derail mothering. Lambert and Byrnes (2019) review a wide range of challenges that have been shown to compromise maternal care and do so from a neuroethological and translational perspective. Many of the threats that Lambert et al. discuss receive additional attention in other reviews of this Special Issue. Swain et al. (2019) focus on opioids – a threat to mothering of increasing concern due to the opioid crisis in the United States. Summarizing human findings from brain imaging studies as well as research from translational animal models, Swain et al. highlight the effects that opioid maintenance therapy can have on the maternal behavioral network and how it could lead to dysregulation of subsystems that are important for the switch from defensive to nurturing behaviors. Keller et al. (2019) focus on another chemical threat, exposure to environmental endocrine disruptors, and the detrimental, but understudied, effects of these ubiquitous compounds on the maternal brain. Yet another major threat to mothering is peripartum mental illness, including postpartum depression, which affects at least 15% of new mothers. Drawing from both clinical and preclinical research, Payne and Maguire (2019) review the mechanisms that have been implicated in the pathophysiology of postpartum depression including disruptions in reproductive/lactogenic hormones, stress and HPA axis dysfunction, neuroinflammation, epigenetics, altered synaptic transmission, and circuit-level changes in brain regions associated with mood and/or mothering.

Somewhat surprisingly, we still do not fully comprehend the complexity of the physiological adaptations to motherhood even under

normal, non-challenging conditions and the specific factors involved in the adjustments of neuronal networks in preparation for motherhood. Most research to date has focused on hormones such as estrogens, progesterone, oxytocin and prolactin but in recent years, several novel players have been uncovered including insulin-like growth factor-1 (IGF-1) as reviewed by Dobolyi and Lékó (2019). In Pawlusi et al. (2019), the underappreciated role of serotonin in the maternal brain and behavior is discussed. They also explore the issue of selective serotonin reuptake inhibitor (SSRI) medication use on the maternal brain and behavior, rather than the effects of SSRIs on the offspring as is usually the case. Klampfl and Bosch (2019) present an overview of the corticotropin-releasing factor (CRF) system during the postpartum period and how downregulation of this “anti-maternal” neuromodulator is important for the expression of maternal caregiving.

This Special Issue also includes articles addressing advances in the genetics and epigenetics of parenthood. Creeth et al. (2019) and Potter et al. (2019) describe a relatively new field that explores the influence of offspring genes on maternal behavior, highlighting the fact that the mother-infant dyad is a reciprocal relationship in which outcomes can be altered or manipulated by either the mother or the infant. In a similar vein, Stolzenberg and Mayer (2019) discuss how infants are capable of activating distinct neural pathways to elicit specific responses from adult rodents and how this might be explained by alterations in transcriptional regulation within the medial preoptic area of the hypothalamus.

Two additional reviews remind us that well before offspring are born, and long after, there are critical adaptations that occur in the mother. The contribution by Russell and Brunton (2019) focuses on the metabolic and neuroendocrine adaptations required for a successful pregnancy and the cost or allostatic load of these changes for mothers as well as their offspring. The short and long-term consequences of motherhood on the brain are reviewed by Duarte-Guterman et al. (2019) who point out that the effects of pregnancy and motherhood may persist beyond the postpartum influencing cognition, neuroplasticity and brain health and disease into middle age and aging. Finally, Glasper et al. (2019) emphasize that mothers of many species rely on others to help raise their young and provide evidence supporting the idea of a global “parental caregiving” network that is similar for mothers, fathers and foster parents.

In closing, we hope this Special Issue generates new questions and encourages more research that will further advance our understanding of the parental brain and behavior. We would also like to take this opportunity to pay tribute to the late Dr. Craig Kinsley whose work on the maternal brain inspired many of us in this field (Kinsley and Lambert, 2006; Kinsley and Amory-Meyer, 2011).

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