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Self-Cognition and Parental Brain

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SYNOPSIS

A key feature of parenting is that it is observable starting from behaviors that are performed daily by adult caregivers during repeated interactions with the child. Functional magnetic resonance imaging (fMRI) research on parental brain should integrate settings that resemble ecologies of situations in which parents typically care for children. However, as our commentators point out, ecological settings in fMRI research are challenging and require a multiperspective approach that systematically considers psychological and behavioral complexities of "mommy brain" to better understand how contingent mental states of mothers articulate with specific multi-tasking situations.

As suggested by the three commentaries on our article (Ablow & Measelle, 2019; Laurent, 2019; Zeifman & Baird, 2019), parenting is a multilevel, multitasking activity that happens in a real world and is regulated by myriad factors. Consequently, the relevance and the challenges of research focused on parenting need to be discussed considering ecology. In our study, we used a multitasking paradigm to investigate the impact of self-cognitions on responsiveness to infant distress vocalizations in mothers and non-mothers. Specifically, participants were occupied in self-referential or goal-oriented tasks, while exposed to human infant and adult vocalizations with different emotional valences. Results showed an interaction between processes activated by the tasks and the sounds, indicating a kind of competition for brain resources at play during processing of simultaneous sources of information. Task drives the focus of attention either to themselves (in the self-oriented task) or to external visual stimuli (in the goal-oriented task). However, even salient emotional vocalizations that were task-unrelated captured attentional resources.

As suggested by Ablow and Measelle (2019), our design in some way promoted a competition for attentional resources. However, the competition was not expressed in terms of attentional resources only. The experimental tasks did not consist merely of visual stimulation but required active and aware evaluations of the adjectives (visual stimuli) using self-relevant or self-irrelevant knowledge. One task activated knowledge about self and the other counting skills. Given their intrinsic nature, the two tasks called for different brain resources. The goal-oriented cognitive task, with a very low difficulty level to avoid stress, recruited cognitive resources; whereas, the personality

task impacted cognition at a qualitatively different level. Evaluating the self-relatedness of an adjective has a lot to do with personal experience and feelings.

Heinze and Northoff (2014) highlighted the importance of not neglecting the emotional component linked to the subjective experience of the self and to the self-related elaboration: "stimuli that concern our self are linked to many types of cognitive processing such as focusing of attention, but above all they are linked to a certain phenomenal experience. It somehow feels like being our self and we also somehow feel personally affected by certain stimuli as opposed to being a neutral observer". Moreover, Heinze and Northoff suggested that one's own emotional experience can never be self-related.

The human infant and adult cry and infant laugh are emotional sounds that might interact with the personal experience and feelings; therefore, it was plausible that emotional sounds might activate processes that underlie self-relatedness. In these terms parent experience can matter (Parsons et al., 2017). In this regard, Zeifman and Baird (2019) and Laurent (2019) drew attention to the importance of qualifying and differentiating dimensions that refer to the individual experience with children to determine which brain mechanisms shape caregiver responses. For example, the length of the postpartum period impacts brain response. The experience of being a mother is accompanied by brain changes in regions important to social cognition (Hoekzema et al., 2017) that potentially influence maternal cognition and, therefore, responsiveness to infant stimuli; moreover, brain plasticity based on the accumulated experience dynamically follows the postpartum period (Kim et al., 2010). However, such dynamics of experience cannot be inferred from our study. We recruited mothers in a late postpartum period, around 24 months, and we did not evaluate previous experience with children in nulliparous women.

In our study, mothers likely accumulated and refined their care response to needs of the child for 2 years. In typical conditions, such experience provides women with knowledge and skills to emotionally regulate their responses while listening to crying; good emotion regulation promotes in mothers behavioral approaches oriented to understand the cause of infant distress rather than their negative feelings in reaction to infant cry (Kurth et al., 2013). This maternal "attitude", as a result of learning processes triggered by the experience of motherhood, is reflected in better regulation of one's own response and through self-referential processes (Swain et al., 2017). Few studies have investigated the role of self-cognition in shaping parental responses. The initial evidence on this matter came from Swain et al. (2017) who reported that self-referential processes are associated with lower levels of maternal stress if they are oriented toward understanding the state of the child (what the child feels). Such findings suggest that self-referential processes can exert a positive impact in maternal (caregiver) emotion regulation in response to own child distress. In agreement with Zeifman and Baird (2019), it would be interesting to distinguish how individual differences in the DMN in atypical populations modulate listener responses to emotional sounds.

All three commentaries (Ablow & Measelle, 2019; Laurent, 2019; Zeifman & Baird, 2019) raise the critical point that in our study we found that all sounds affected maternal DMN activity during the goal-oriented task. In the self-oriented task, where self-relevant processes triggered by emotional sounds compete with the self-

related task, by contrast, we found that the DMN activity was most affected by infant cry and to a lesser extent by the other vocalizations in mothers and non-mothers (Rigo et al., 2019), and previously in women contrasted to men (Rigo et al., 2017). This pattern of findings needs further explication, and we agree with Laurent (2019) that our study suffers from a lack of behavioral measures that could help to account for the different involvement of the DMN.

All three commentaries appreciate that our paradigm to study involvement of self-referential processes – which play a role in maternal emotional regulation – in a multitasking situation has potential ecological value. We agree that further considerations deserve to be discussed. All commentaries correctly noted the importance of considering individual factors, such as individual mental health and stress thresholds, which can moderate reactivity to negative infant sounds. Indeed, the response of the DMN can predict level of stress; high DMN activation is associated with high parental stress elicited by infant cry (Swain et al., 2017). Another potential limit to the ecological validity of our findings is the absence of own infant sounds. Given the special status of being the "own child" and the attachment relationship between mother and her child, the own child represents a stimulus with strong self-referential value for mothers that could modulate involvement of the DMN differently to unfamiliar children. In accordance with what has been reported, we see the need for future studies to consider aspects of maternal well-being and cognition and consideration of stimuli coming from own child to increase the value of research in multitasking ecological settings.

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