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2019

Setoh, P., & Esposito, G. (2019). What men do when a baby cries : increasing testosterone may lead to less nurturant care but more environmental vigilance. *Parenting: Science and Practice*, 19(1-2), 62-64. doi:10.1080/15295192.2019.1555428

<https://hdl.handle.net/10356/83545>

<https://doi.org/10.1080/15295192.2019.1555428>

This is an Accepted Manuscript of an article published by Taylor & Francis in *Parenting: Science and Practice* on 01 Feb 2019, available online:
<http://www.tandfonline.com/10.1080/15295192.2019.1555428>.

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**What men do when a baby cries: Increasing testosterone may lead to less
nurturant care but more environmental vigilance**

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Abstract. Infants' crying modulates parental behaviors, which in turn, ideally, leads to calming the infant. The mutually beneficial reciprocity between infants' and parents' behaviors is conserved across mammalian species. Although some studies highlight similarities in responses to infant cries across gender, other studies report differences in their behaviors and brain activity. Zeifman and colleagues (2018) found that high levels of infant crying can trigger increases in testosterone in men, which is accompanied by less sensitive caregiving. Some interpret males' lack of sensitive caregiving as neglectful, but these results could be considered as evolutionarily adaptive. Specifically, increases in testosterone levels from intense infant cries could lead to increased vigilance and alertness toward external stimuli, and thus allow males to be better equipped to protect their young.

Keywords: Infant Crying; Testosterone

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Infants vocalizing distress modulates parental behavior. The most prominent behaviors include picking up, holding, and talking to infants. Functional magnetic resonance imaging (fMRI) analyses of maternal brains reveal enhanced activity in concordant brain territories linked to the intention to move and to speak when responding to infants' cries (Bornstein et al. 2017). Similarly, studies have shown that babies tend to respond positively to these behaviors, thus benefiting parents as well because the infants are soothed. This reciprocity between infants' and parents' behaviors appears to be shared across several mammalian species (Esposito et al. 2013; Yoshida et al. 2013; Esposito et al. 2015).

Adults' brain and behavior are strongly affected by infants' cries. A number of studies highlight similarities between male's and female's responses to infant cries, but assessments of behavioral patterns and brain activity have shown some marked differences. For example, de Pisapia and colleagues (2013) found that independent of parental status (parent or nonparents), the default mode network (DMN), which is known to be activated during mind wandering, remained active for males when they were exposed to infant cries, but was interrupted for females. Rigo et al. (2017) conducted a related study, which further demonstrated the link between infant crying and the default mode network (DMN). To manipulate the activation level of the DMN, listeners engaged in two tasks: a self-referential decision task (activates the DMN) and a syllabic counting task (deactivates the DMN). Participants also listened to

either an infant crying or a woman crying. Rigo et al. (2017) found that infant crying deactivated the DMN in women but not in men during the self-referential task. Using event-related transcranial magnetic stimulation (TMS), Messina and colleagues (2016) examined the presence and the time course modulation of motor cortex excitability in males and females in response to infant cries and found concordant results. When females heard an infant cry, there was an automatic muscle activation. The activation was selective to natural cry sounds because it was absent for non-cry stimuli acoustically matched to natural infant cries. The authors suggested that “the brains of adult females appear to be tuned to respond to infant cries with automatic motor excitation” (Messina et al., 2016). However, it is not surprising that males and females respond differently to a specific social stimuli. There are many reasons why this may occur, and there are myriad anatomical and hormonal differences that should be accounted for, but are often neglected, in the human literature.

The elegant study by Zeifman and colleagues (2018) is an example of how including a supplementary level of analysis (assessment of testosterone hormone levels) gives greater insight on human responses to infant cry. While the study of hormonal levels is common in animal investigations (see for example Lingle, 2018), it is atypical in the human parenting literature. Specifically, Zeifman and colleagues (2018) showed that high levels of infant crying can trigger increases in testosterone in men, which is accompanied by less sensitive caregiving. Zeifman et al. (2018) makes a novel contribution to the field by introducing another type of assessment when measuring adult males' responses to intense infant crying. From an evolutionary perspective, we should carefully study the adaptiveness of this behavior. What is the role of the father in caregiving? While the maternal role is associated with nurturing and caregiving, the paternal role is associated with protection. In light of this possibility, increased of testosterone levels during times of high stress (exposure to

incessant high-demand cries) may be related to increased vigilance and alertness toward external stimuli, which in turn may be evolutionarily protective of the species. Future work can explore the role of hormones such as testosterone and adrenaline in both males and females, parents and non-parents, to further understand the interaction effects of hormones and how they affect sensitivity in parenting and caregiving behavior.

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