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# Harsh parenting and fearfulness in toddlerhood interact to predict amplitudes of preschool error-related negativity

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ABSTRACT

Temperamentally fearful children are at increased risk for the development of anxiety problems relative to less-fearful children. This risk is even greater when early environments include high levels of harsh parenting behaviors. However, the mechanisms by which harsh parenting may impact fearful children's risk for anxiety problems are largely unknown. Recent neuroscience work has suggested that punishment is associated with exaggerated error-related negativity (ERN), an event-related potential linked to performance monitoring, even after the threat of punishment is removed. In the current study, we examined the possibility that harsh parenting interacts with fearfulness, impacting anxiety risk via neural processes of performance monitoring. We found that greater fearfulness and harsher parenting at 2 years of age predicted greater fearfulness and greater ERN amplitudes at age 4. Supporting the role of cognitive processes in this association, greater fearfulness and harsher parenting also predicted less efficient neural processing during preschool. This study provides initial evidence that performance monitoring may be a candidate process by which early parenting interacts with fearfulness to predict risk for anxiety problems.


## 1. Introduction

Extremely fearful infants show more anxiety symptoms by adolescence than do typically developing children (Hirshfeld-Becker et al., 2002). However, given that only about one-third of fearful children develop anxiety disorders (Biederman et al., 2001), numerous exogenous factors may moderate the association between early fearfulness and anxiety problems. One such moderator is parental harshness, which contributes to increasing levels of anxiety in children (Feng et al., 2008). Yet, the mechanism by which harshness exacerbates anxiety symptoms for fearful children is unclear. Research recently revealed that punishment, an aspect of harsh parenting, can have long-term effects on neural processes of self monitoring (Riesel et al., 2012). Thus, it is possible that, over time, fearful children of harsh parents learn to anticipate the potential for punitive, critical behaviors from parents. This learned association may, in turn, lead to hyper-monitoring of one's own behavior in an effort to avoid negative interactions with parents. If this hypothesized process is accurate, hypervigilance, in the form of heightened self-monitoring, becomes a pathway by which risk for anxiety is exacerbated for fearful children. Testing this possibility was the aim of the current study.

As previously stated, heightened fearfulness is an established risk factor for the development of anxiety problems (Clauss and Blackford, 2012). Stable fearfulness over time increases one's likelihood of receiving an anxiety diagnosis (Chronis-Tuscano et al., 2009) and quantifications of extreme fearfulness in minimally-threatening contexts

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appear to strengthen the ability to predict the development of anxiety symptoms (Buss, 2011; Buss et al., 2014). Namely, children who are highly fearful, stable high in fear over time, or show high levels of fear in low-threat contexts appear to be at greatest risk for anxiety problems. Of course, all current methods for quantifying risk imperfectly predict anxiety problems. Thus, identifying intermediate processes impacting early risk for anxiety problems remains important for advancing this area of research.

Some aspects of parenting (e.g., negative affect, intrusiveness) are relatively ubiquitous risk factors for maladaptive child outcomes. However, harsh parenting, typically defined as high levels of control, coercion, punitive behaviors, and/or punishment by parents, has been identified as a risk factor specific to the development of anxiety problems (Shanahan et al., 2008), multiplying risk by a factor of 2–4, depending on the diagnosis. Greater harsh parenting appears to be particularly detrimental for fearful children (Degnan et al., 2010a; Leve et al., 2005). The processes by which harsh parenting is linked to risk for anxiety problems have been understudied. A subset of work implicates cognitive processes as putative mechanisms of early fearfulness, but has not examined these factors in relation to parenting behaviors (e.g., Pérez-Edgar et al., 2011). Theories of moral development posit that consistent and predominant use of harsh parenting strategies is associated with an increasing fear of punishment in children (Hoffman, 1983). An increasing fear of punishment may lead to heightened self-monitoring in an effort to avoid harsh, punitive behaviors from parents. This possibility is supported by empirical research; children at risk for internalizing problems display overcontrolled behaviors (Eisenberg et al., 2001; Santesso et al., 2006). These behaviors, including heightened monitoring and reflection on performance (Messer, 1970), are associated with an increased risk for internalizing problems in children. Therefore, it is possible that harsh parenting may come to augment anxiety risk in children via its influence on the performance monitoring system.

The error-related negativity (ERN) is an event-related potential (ERP) believed to index performance monitoring at the neural level. The ERN is visible as a negative deflection in the response-locked EEG peaking 50–100 ms following incorrect behavioral responses. ERN is believed to capture aspects of error detection (Falkenstein et al., 1991), conflict detection (Botvinick et al., 2001) reinforcement learning (Holroyd and Coles, 2002), emotion processing (Luu and Pederson, 2004), and motivation (Gehring and Willoughby, 2004). In general, the ERN does not appear to be dependent on conscious error-recognition; in fact, an ERN is detectable on correct trials for which participants are uncertain about their performance (Coles et al., 2001). Thus, the ERN likely reflects a general process of performance monitoring (Falkenstein et al., 2000), one aspect of which is error detection.

Traditionally, children were not believed to show a reliable ERN until adolescence, when the ERN takes adult-like form (Davies et al., 2004; Ladouceur et al., 2007). However, recent work suggests that the ERN can be elicited in the young children with the use of developmentally appropriate tasks (Torpey et al., 2009) and ERN has now been demonstrated in children as young as age 4 (Brooker and Buss, 2014). Though the number of studies of ERN in young children is limited, this work has demonstrated smaller (i.e., less negative) and more variable ERN amplitudes (Kim et al., 2007; Santesso et al., 2006; Wiersema et al., 2007) and more broadly distributed ERN (Brooker and Buss, 2014; Hogan et al., 2005) in young children relative to adolescents and adults. These developmental differences are reasonable considering that the Anterior Cingulate Cortex, a putative source of ERN (Dehane et al., 1994), is not fully developed during in early childhood.

In most cases, performance monitoring is an adaptive process in that it signals the need for behavioral changes in order to enhance subsequent performance (Van Veen and Carter, 2006). However, extreme levels of performance monitoring may reflect excessive, persistent concern about negative evaluation, which are hallmark symptoms of Social Anxiety Disorder (DSM-5, 2013). Indeed, adolescents who meet diagnostic criteria for an anxiety disorder show enhanced ERN amplitudes relative to healthy controls (Ladouceur et al., 2006). Greater ERN in adolescents is also related to histories of childhood fearfulness (McDermott et al., 2009). We recently showed that greater fearfulness at age 2 predicted the presence of an ERN at 4.5 years of age; ERN was not observed in low-fear children (Brooker and Buss, 2014). In young adults, enhanced ERN has also been linked to experience of punishment, an association that persisted after punishment was removed (Riesel et al., 2012). Additionally, trait-anxious participants were particularly sensitive to punishment. This pattern of results supports the notion that enhanced performance monitoring may be a pathway by which harsh parenting is associated with anxiety risk in fearful children. Namely, harsher parenting may increase concern or worry about the threat of punishment in the future, enhancing performance monitoring in children who are fearful early in life. Such a pathway is supported by adult work suggesting close associations between anxious apprehension/worry and performance monitoring (Moser et al., 2013).

In the current study, we tested links among early fearfulness, harsh parenting, and performance monitoring. We conducted this work in a sample of preschoolers, as this is a time of rapid cognitive development. Moreover, given recent evidence, we focused on early risk for anxiety problems based on fearfulness in a low-threat context. Our aims were to replicate previous findings that ERN is present in preschool children and to show that harsh parenting predicts the maintenance or increase of fear behaviors for children who were high in fearfulness early in life. Both of these examinations were done longitudinally, such that fearfulness and parenting were measured prior to the measurement of ERN. We then tested whether, across the same time period, high levels of fearfulness would be associated with enhanced performance monitoring (ERN) when children experienced greater harsh parenting as toddlers. Consistent with previous research, we predicted that high levels of fearfulness and greater harsh parenting during toddlerhood would predict more fearfulness and greater ERN during preschool.