**Title**: **The Impact of Household Chaos on Children's Emotion Regulation: The Mediating Role of Neural Index of Error Processing**

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**Introduction**: Emotion regulation is a critical skill for children’s social, emotional, and academic success (Graziano et al., 2007). The question of what environmental features is associated with children’s emotion regulation is always a question. Household chaos as an indicator of the home environment, characterized by high noise levels, disorganization, and unpredictability, may negatively impact children's emotional regulation when they face demanding challenges and situations (Andrews et al., 2021). Currently, literature still lacks further exploration of how household chaos disrupts children's emotion regulation focusing on underlying neural mechanisms. Error-related negativity (ERN), a neural marker of error processing, may be associated with children's ability to regulate their emotions (Moser et al., 2013). This may be because the ERN reflects cognitive control and self-monitoring functions, which are critical for managing emotional responses and adjusting behavior in demanding situations (Meyer, 2017). ERN typically emerges when individuals engage in tasks that require quick decision-making or motor responses, resulting in an error (Ibanez et al., 2012). Children who live in chaotic home environments may interfere with their efficiency in error processing, which further impacts their emotion regulation skills. Our study explores whether ERN serves as a mediator in the relationship between household chaos and child emotional regulation. We hypothesize that children from more chaotic home environments will exhibit poorer emotional regulation, and that this relationship will be partially mediated by ERN. Specifically, a more chaotic environment is expected to dampen ERN responses, which in turn is associated with poorer emotional regulation.

**Method**: Fifty-two children participated (female = 22, male = 30; *M*age = 8.90 years, SD = 1.38). Child emotion regulation is assessed using the Temperament in Middle Childhood Questionnaire (TMCQ), focusing on emotional control abilities (Kozlowski et al., 2022). Household chaos is measured using Chaos, Hubbub, and Order Scale (CHAOS), capturing the level of disorganization in the home (Matheny et al., 1995). ERN is measured using a computer-based Go/No-Go task. The Go/No-Go task used animal pictures to represent Go and No-go conditions, with Emotional and Neutral conditions in a 2x2 design (Lamm et al., 2014). Children acted as zookeepers, pressing a button quickly to capture escaping animals (go trials), but not for monkeys, their helpers (no-go trials). There were 280 pictures across four blocks: Neutral (non-threatening) and Emotional (threatening and non-threatening). EEG was recorded continuously using a 128-electrode Geodesic Sensor net (EGI-Magstim) and processed offline with EEGLAB and ERPLAB.

**Results**: We used a mediation analysis to examine how household chaos impacts emotional regulation, with ERN as the mediator. We also conducted bootstrapping to assess the stability of the indirect effects. The direct relationship between household chaos and emotional regulation was found to be significant (B = 0.030, p = 0.005). This finding indicates that children from more chaotic households exhibit poorer emotional regulation abilities. The association between household chaos and ERN was marginally significant (B = -0.172, p = 0.089), suggesting a trend where higher levels of chaos tend to reduce ERN responses, reflecting weaker neural sensitivity to errors. Additionally, the effect of ERN on emotional regulation was significant (B = -0.035, p = 0.022), indicating that lower ERN amplitudes (i.e., weaker neural responses to errors) are linked to poorer emotional regulation. The indirect effect of household chaos on emotional regulation via ERN was marginally significant (z = 1.89, p = 0.058). The mediation coefficient of 0.006 suggests that ERN explains approximately 19.6% of the overall impact of household chaos on emotional regulation, although the effect size remains modest. These results indicate that while ERN mediates part of this relationship, its contribution is relatively small. Bootstrapping analysis confirmed the marginal significance of the indirect effect (p = 0.058), suggesting that ERN partially mediates the link between household chaos and emotional regulation.

**Discussion:** Our study highlights that household chaos significantly undermines child emotional regulation, and this relationship is partially mediated by ERN, although the mediation effect is small. The findings suggest that chaotic environments reduce children’s neural sensitivity to errors, which in turn negatively impact their emotional regulation abilities. However, given the small indirect effects, further exploration of other potential mediators, such as parenting style or emotional support, is warranted to better explain the relationship between environmental chaos and emotional regulation in children.

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