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Investigating the Impact of Emotional Modulation on Attentional Numerical Representations in Childhood

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Abstract

Emotion dysregulation can heighten attentional biases toward threat, divert attention from goal-directed tasks, and deplete working memory, hindering learning. While research has explored its impact on numerical processing in adults, its developmental trajectory remains unclear. This study examines whether children's emotional modulation, indexed by high-frequency heart rate variability (HF-HRV), relates to neurophysiological markers of numerical attention in ERPs.

Eighty-one children (ages 4, 6, and 8) completed a pirate-themed paradigm, including a novel symbol-learning task and a numeral comparison task. EEG and ECG data were recorded alongside self-reported emotions and parent-reported behavioural profiles. While self-reports showed positive emotions, HF-HRV varied across children and strongly predicted task performance ($r = .41$, $P < .001$). HF-HRV also correlated with ERP markers of attentional numerical representation, emphasising the role of emotion regulation in symbolic number learning. These findings offer insights into early precursors of mathematics anxiety and the reciprocal link between emotional regulation and numerical cognition.