THE NEURAL CIRCUITRY UNDERLYING ERROR MONITORING DURING SOCIAL COGNITION

Teresa Sousa, João Estiveira, Camila Dias, Diana Costa, João Castelhano, Andreia Pereira & Miguel Castelo-Branco

Coimbra Institute for Biomedical Imaging and Translational Research (CIBIT), Institute of Nuclear Sciences Applied to Health (ICNAS), University of Coimbra

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Background: Error monitoring is the metacognitive process by which we detect and signal errors. Although this is a vital function for human adaptive behavior, it remains understudied in social contexts.

Aims: In this research project, we investigated the neural circuitry associated with error monitoring during the integration of social cues to gain insights into its role in social cognition. Our aim was to unravel the neural mechanisms that come into play in situations where error awareness is critical, employing both electroencephalography (EEG) and functional magnetic resonance imaging (fMRI).

Method: Through EEG, we explored the dynamic brain processes related to self-monitoring while anticipating and performing an error. More specifically, we tested how task-specific variables, such as cognitive demand and control, influenced these processes. Subsequently, we employed fMRI to elucidate the contribution of different brain regions to such mechanisms. We conducted two EEG and two fMRI tasks with 40 healthy participants each, during actions based on facial cues integration and implicit error monitoring.

Results: We found opposing midfrontal theta modulation when anticipating and committing an error, regardless of the response type (social or non-social). This suggests midfrontal theta's role in cognitive control during performance monitoring, not just response adaptation. Moreover, our EEG results also showed an advantage in studying error monitoring in complex scenarios, such as social ones, when focusing on frequency-domain components. The fMRI data revealed that the communication between the salience and frontoparietal networks is involved in both explicit and implicit error monitoring. The anterior insular cortex was found to play a crucial role in switching between these networks, supporting the salience network's role as a hub in facilitating interactions between distinct networks during higher-order functions of the human brain.

Conclusions: Our research highlights the utility of midfrontal theta as a robust indicator for studying error monitoring in complex social contexts. It also emphasizes the salience network's role as a crucial hub connecting different neural networks in the process of error monitoring. These results pave the way for future studies exploring error monitoring dynamics in dyadic or peer interactions within genuine social scenarios.

Keywords: Error monitoring, Social cognition, Executive function, fMRI, EEG

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E-mail contact: tsousa@uc.pt