

The neural circuitry underlying error monitoring during social cognition

ABSTRACT:

Background

Error monitoring is the metacognitive process by which we detect and signal errors once a response has been made. Monitoring when the outcome of our actions deviates from the intended goal is crucial for behavior, learning, and the development of higher-order social skills.

Aims

In this project, we explored the neuronal circuitry of error monitoring during social cues integration to understand its role in social cognition. We sought to determine the neural mechanisms involved in such error awareness scenarios using electroencephalography (EEG) and functional magnetic resonance imaging (fMRI).

Method

Using EEG, we explored the dynamics of the brain mechanisms related to performance monitoring during response preparation and execution and how task-specific parameters, such as cognitive demand or motor control, influence these processes. We also investigated the advantage of using EEG frequencydomain signatures to study error monitoring in complex scenarios. Then, we used fMRI to clarify the role of the brain regions identified based on EEG data and study implicit performance monitoring (without motor responses) mechanisms.

Results

We found that independently of the action performed, midfrontal theta oscillations are a neuronal index of the error monitoring mechanisms needed to enhance cognitive control and a neuronal predictor of action performance. Our findings also suggest that different salience network regions play a crucial role in the dynamics of performance monitoring.

Conclusions

Our results stress the robustness of midfrontal theta to study error monitoring in complex scenarios, such as social cognition. Moreover, they reinforce the salience network role in error monitoring by functioning as a hub between distinct neural networks.

Keywords

Error metacognition, Social error monitoring, Cognitive control, Electroencephalography (EEG), functional Magnetic Resonance Imaging (fMRI)

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Published Work:

Dias, C., Costa, D. M., Sousa, T., Castelhana, J., Figueiredo, V., Pereira, A. C., & Castelo-Branco, M. (2021). Classification of erroneous actions using EEG frequency features: implications for BCI performance. *Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Annual International Conference*, 629-632. doi: 10.1109/EMBC46164.2021.9630509

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