Research Project: Neuroplasticity of emotion perception

Theoretical background

The perception of emotional facial expressions is a fundamental social process involving various cortical areas. The superior temporal sulcus (STS) plays a key role in processing social cues and facial expressions, while the primary visual cortex (V1) is responsible for initial visual information processing. Recent studies (Borgomaneri et al., 2023) have shown that Cortico-Cortical Paired Associative Stimulation (ccPAS), aimed at strengthening backward connectivity from STS to V1, improves emotional expression perception. However, the neurophysiological correlates of this modulation remain largely unexplored.

Aims and Hypotheses

We hypothesize that ccPAS, by strengthening the connectivity from STS to V1, will not only enhance the perception of emotional expressions but will also modify neurophysiological responses measured through EEG, specifically the event-related potentials (ERPs) associated with viewing faces displaying emotional expressions. We expect an enhancement in ERP components related to emotional processing, such as the N170 and the LPP (Late Positive Potential).

Methods

The study will involve a group of participants who will undergo ccPAS to strengthen the backward connectivity between STS and V1. Before and after the stimulation, participants will complete an EEG session while viewing faces with various emotional expressions (happiness, fear, neutral). ERP responses, particularly the N170 (related to facial recognition) and the LPP (associated with emotional processing), will be analyzed to assess changes induced by ccPAS.

Expected results and implications

We anticipate a potentiation of the N170 component, indicating increased sensitivity to facial configuration, and an enhancement of the LPP component, indicative of heightened emotional processing, especially for fear and happiness expressions, following ccPAS stimulation. This would support the hypothesis that strengthening cortico-cortical connectivity between STS and V1 modulates not only behavioral perception but also the neurophysiological correlates of emotional expression processing.

The results of this study will have significant implications for understanding the neural mechanisms underlying emotional expression processing. They could also open new avenues for using neuromodulation techniques like ccPAS to enhance social and emotional perception, with potential therapeutic applications in neuropsychiatric disorders characterized by deficits in emotional perception.

Plan of activities

Project activities: literature review to acquire relevant theoretical knowledge, define stimulation parameters and behavioral procedures; recruitment of participants; execution of a pilot study to assess the experimental duration and participants' compliance; data collection and analysis; writing of a draft of the main findings to be submitted to a scientific journal; research dissemination at national/international congresses.

Training activities: readings, discussions with the supervisor, direct involvement in lab meetings, attendance of lectures and workshops, manuscript revision; activities aimed at acquiring: 1) theoretical knowledge related to cognitive neuroscience of emotion perception, neuroplasticity, behavioral and neurophysiological evaluation of social cognitive functions; 2) skill for designing and conducting scientific research projects, data analysis and use of advanced TMS protocols; 3) writing

and oral communication skills for scientific dissemination; 4) skills for translation of scientific knowledge into the development of novel rehabilitation programs.

Timing of activities:
Literature search, Design & piloting: from month 1 (M1) to M3
Data collection & analysis: from M4 to M11
Dissemination: from M5 to M12
PI supervision: from M1 to M2