A multi-modal fNIRS/EEG investigation of the fronto-parietal network during audio-visual matching

S. Brigadoi1,2, S. Basso Moro2, F. Meconi1, S. Benavides-Varela1, I.E. Tampu3, M. Doro1, P. Sessa1, F. Simion1, S. Cutini1, R. Dell’Acqua1
1 Department of Developmental Psychology, University of Padova, Italy; 2 Department of Neuroscience, University of Padova, Italy; 3 Department of Information Engineering, University of Padova, Italy
*These authors contributed equally to the work
E-mail: sabrina.brigadoi@unipd.it, sara.bassomoro@unipd.it

INTRODUCTION

The neural substrates of visual attention are known to be rooted in the fronto-parietal circuitry [1], and both frontal and parietal cortices have been hypothesized to play a crucial role in cross-modal matching of audio-visual information. Here we investigated the interplay between frontal and parietal regions both at the electrical and hemodynamic level using a cross-modal matching task. A multi-modal fNIRS/EEG acquisition was performed by simultaneously acquiring fNIRS and EEG data on adults.

MATERIALS AND METHODS

Participants: Sixteen healthy students (mean age=26±3.8 F). Of these, 4 were discarded in the fNIRS analysis (fNIRS subgroup=12) while 7 in the EEG one (EEG subgroup=9).

Data processing: fNIRS data were analyzed with the Homer2 package [2]. Channels with very low intensity were pruned, motion artifacts were identified and corrected applying spline interpolation, and a band-pass filter (0.01-0.5 Hz) was applied. The hemodynamic response was recovered with a GLM approach, simultaneously regressing the SS signals to reduce physiological noise [3]. Only trials associated with correct responses were kept in the analyses. EEG data were offline re-referenced to the average of right and left ears, low-pass filtered (30 Hz) and a notch filter was applied (50 Hz). N2pc was computed at PO7 and PO8 (for each numerosity and audio-visual matching condition) as the difference between neural activity in the contralateral hemisphere to the lateralized targets (presented at either right or left hemifield) minus the ipsilateral activity. Only trials associated with correct responses and not contaminated by eye-movements were kept in the analyses.

RESULTS AND DISCUSSION

![Fig 1: Auditory stimuli consisted of either 2 or 3 beep sounds. The number of beeps was either congruent or incongruent with the number of subsequently presented lateralized visual targets (i.e. either 2 or 3 filled circles). Participants were required to orient covertly their attention to the lateralized visual targets whilst maintaining their gaze at fixation, under the requirement to press the ‘yes’ key when the number of beeps matched the number of lateralized visual targets, and ‘no’ when it did not.](image1)

![Fig 2: Opide and electrode placement. Numbers correspond to fNIRS channels.](image2)

![Fig 3: ERP results. The N2pc (an increment in negativity at posterior electrodes contralateral to an eccentric target relative to ipsilateral symmetrical electrodes), a neural marker of visual selection, seems to be modulated by congruency.](image3)

![Fig 4: Grand-average hemodynamic responses for the congruent (blue and cyan for HbO and HbR respectively) and incongruent (red and magenta for HbO and HbR respectively) conditions. +++ identifies channels showing a main effect for congruency in the 2 (numerosity) × 2 (congruency) × 2 (hemifield) × 2 (hemisphere) ANOVA (min F(1,11)= 5.03, ps < .046).](image4)

![Fig 5: Grand-average hemodynamic responses for numerosity 2 (blue and cyan for HbO and HbR respectively) and 3 (red and magenta for HbO and HbR respectively) conditions. +++ identifies channels showing a main effect for numerosity in the 2 (numerosity) × 2 (congruency) × 2 (hemifield) × 2 (hemisphere) ANOVA (min F(1,11)= 7.90, ps < .017).](image5)

REFERENCE


ACKNOWLEDGMENT

This work was supported by Grant STPD11B8HM from the University of Padova.