The Role of Premotor Cortex in Non-motor Decisions

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INTRODUCTION

Background: Premotor cortex (PM) is engaged in action-related valence evaluation and decision-making related to the individual's own motor actions, and also when observing others' overt motor actions in familiar motor tasks[1-4].

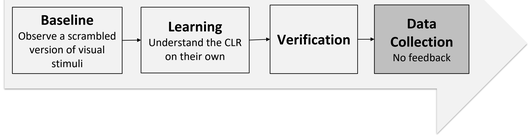
What is missing?

Whether PM is involved in the interpretation and assessment of observed arbitrary *non-motor* sensory events that respect or violate specific stimulus-response associations, *in the absence of prior motor training.*

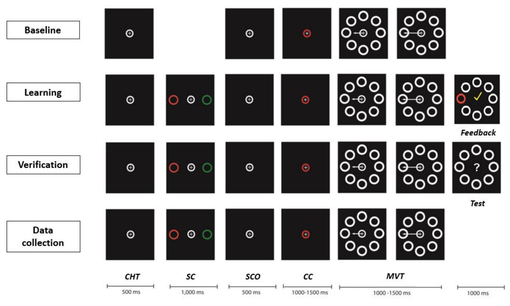
EXPERIMENTAL DESIGN

Goal: Record the brain activity using magnetoencephalography (MEG) and compare the PM activity for two groups (Active Learners, AL; Passive Learners, PL) and two conditions (Passive Observation, PO; Active Performance, AP)

A) MEG scan session contains three phases for each experimental condition



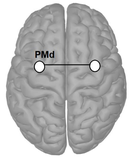
B) Sequences of stimulus events in different phases



C) Experimental conditions

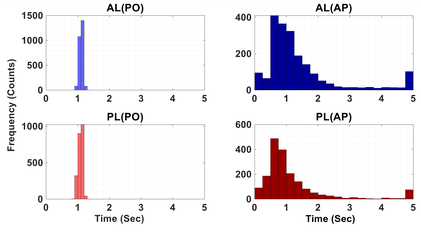
Participants (N = 18), 18-40yrs

D) Region of interest



PMd: dorsal pre-motor cortex

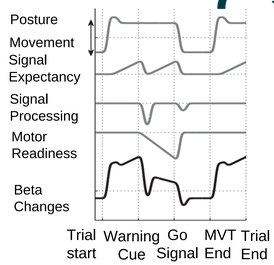
BEHAVIOURAL RESULTS



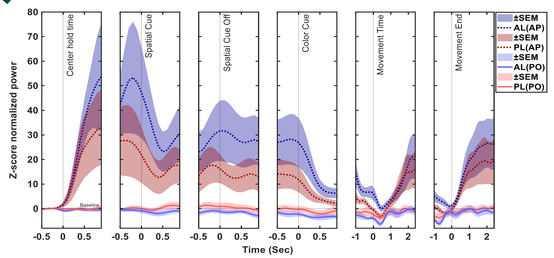
A) The durations of arrow movements toward a target are less variable in the PO condition than the AP condition.

MEG RESULTS

A) Expected beta changes[1]

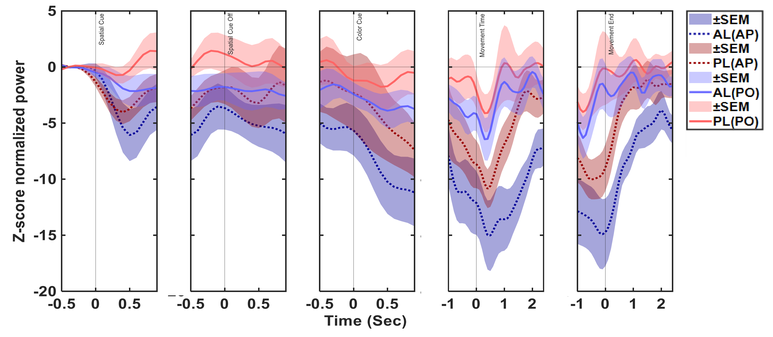


B) Pre-center hold time normalized beta-band power over PMd

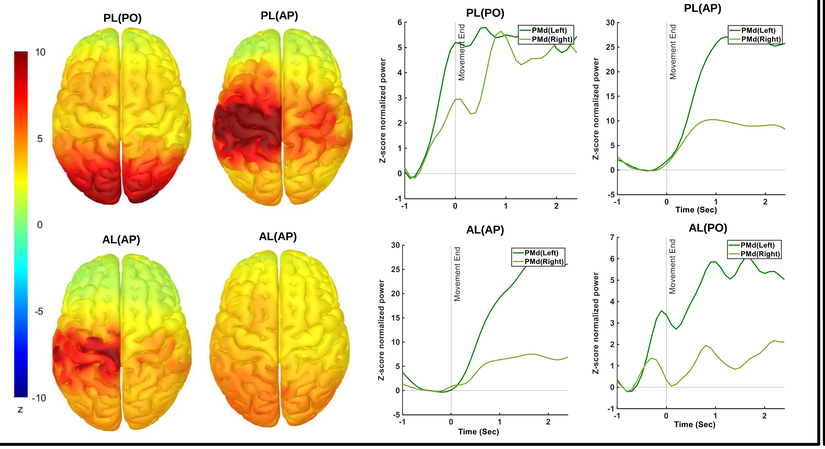


B) Beta suppression and rebound during PO are weaker than those during the AP. Also, beta rebound occurs earlier in the PO than the AP in both groups.

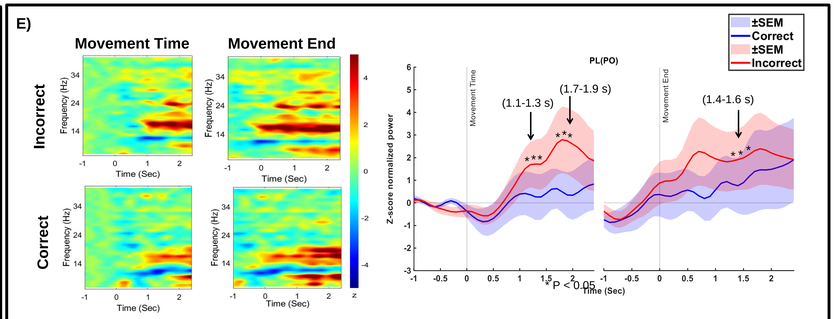
C) Pre-spatial cue normalized beta-band power over PMd. For both groups, PO follows the similar pattern as AP.



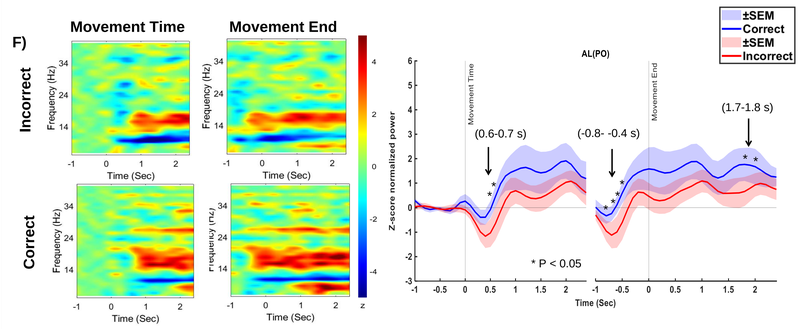
D) Stronger post-movement beta rebound in contralateral spatial hemifield



E)



F)



E and F) Pre-movement normalized beta-band power over PMd for correct and incorrect responses. PL(PO) data show a stronger rebound in error trials. In contrast, the AL(PO) data showed the opposite pattern. One possible contributing factor is that the AL(PO) data showed a stronger beta suppression during observation of cursor movement in the incorrect trials than in the correct trials, and this might have contributed to the reversal of effects on the beta rebound.

CONCLUSIONS

- *PMd beta activity is modulated during the passive observation period in both subject groups but lacks a major positive response component resulting from the engagement of the subjects in the performance of hand movements in the active condition.*
- ***For the first time, we show that beta rebounds were stronger during passive observation of incorrect vs. correct trials by PLs.***
- *PM is involved in the appraisal of observed sensory events, even when they are arbitrary and non-biological and had not yet become associated with any particular motor actions.*
- *More data is required to confirm these results and draw significant conclusions about the effect of performance monitoring on beta activity in PMd in the passive observation condition for both groups.*

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