# Developing paradigms for a combined EEG fMRI study: An exploration of factors influencing P3a amplitude in an auditory attention orienting task.

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## INTRODUCTION

Potter et al. (2008) found in event-related potential (ERP) evidence of differences in the distribution of the P3a component which suggests a dissociation of activity in stimulus-driven (SDN) and goal-driven networks (GDN) of the attention reorienting system (Corbetta *et al.*, 2008).

We plan a combined electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) study to test this hypothesis. To improve the temporal and spatial resolution of the event-related fMRI we plan to use convolved derivatives of the EEG signal as predictors of activation in specific components of the SDN and GDN.

To explore the feasibility of this we have used single trial across-subject averaging of EEG to study the effects of auditory stimulus probability, frequency, amplitude and duration on P3a ERP amplitude and distribution.

## METHODS

The primary task was a forced choice auditory odd/even number decision. Novel auditory stimuli were presented either before or simultaneously with the numbers and were positioned such that they would activate the SDN only or SDN+GDN, the latter resulting in attention orienting.

EEG recordings from Fz, Cz, Pz, CP6 & CP5 in 15 participants were analysed using EEGLAB & in-house MatLab scripts.

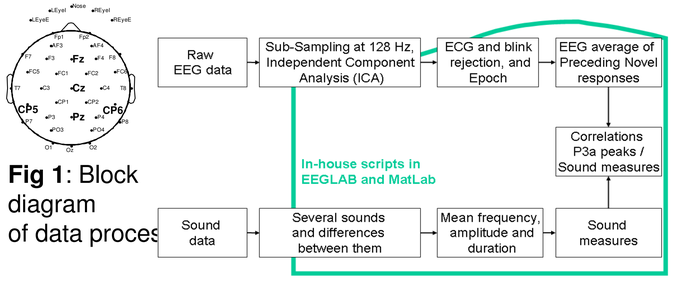
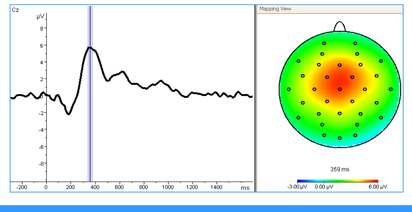



**Fig 1**: Block diagram of data proces

Statistical analysis employed bootstrap correlation followed by a false positive correction using a 'p' value threshold of 0.05.

## RESULTS

**Fig 2**: Subtraction waveform used to visualize the attention orienting response: novel_number minus tone_number.



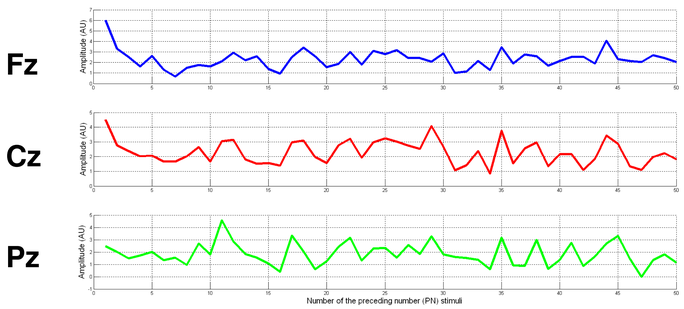
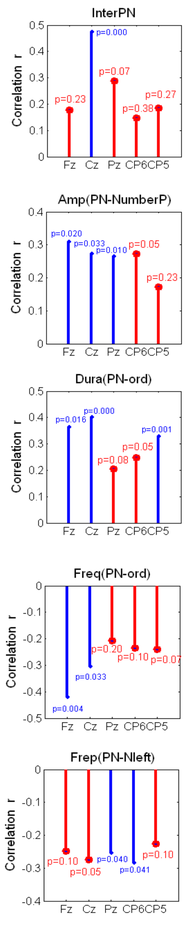



**Fig 3:** Long-term variation in amplitude of P3a over 30 minutes




Increasing inter-trial intervals between Novels are correlated with larger P3a amplitudes. The maximum significant correlation is at the midline (Cz).

Larger differences in sound amplitude are correlated with larger P3a amplitudes with maximum significant correlation at the frontal electrode (Fz).

Larger differences in sound duration are correlated with larger P3a amplitudes. Maximum significant correlation is at Cz.

Larger differences in sound frequency are correlated with smaller P3a amplitudes with maximum correlation at the frontal electrode (Fz). This is probably due to the presence of an overlapping frontal negative deflection.

There is a right hemisphere asymmetry of P3a amplitude when the previous novel is presented to the left ear. Maximum significant correlation at right parietal electrode (CP6).

**Fig 4**: Correlations between P3a amplitude and local probability, amplitude, duration and frequency of novel sounds.

## DISCUSSION

Novel P3a amplitude showed significant variation over time but does not decrease in the long-term. In addition P3a amplitude was not simply predicted by inter-trial intervals as predicted by Gonsalvez & Polich (2002), showing non-significant correlation near to 0.3. Instead this variation is significant with sound properties appearing correlations of 0.3 to this task and significant variation with Inter-Stimulus Interval was significant in Cz.

P3a amplitude showed positive correlations with differences in sound Duration and Mean Amplitude as well as a negative correlation with Frequency differences. In the case of durations below 180 [ms] should not to be correlated with memory processing as was found by Kanoh *et al.* (1996), our results show significant correlations with previous sounds in novel sounds.

The P3a evoked by novel stimuli was lateralized to the right hemisphere. This may be consistent with activation of the stimulus-driven system Corbetta *et al.* (2002, 2008) acting in conjunction with the goal driven system during attention orienting.

Hemodynamic activity was improved when frequency in sound stimuli change, but was not a greater ERP than the standard tone at combine EEGfMRI (Kiehl *et al*, 2005). We predict that several distinct sources will show activation in an EEGfMRI study based on the differences in distribution of the P3a maxima associated with the different dimensions of the stimuli and stimulus sequence in the present study.

## CONCLUSIONS

These findings suggest that this number parity decision paradigm could be successfully used to dissociate stimulus- driven (SDN) and goal-driven networks (GDN) activation in attention reorienting in a combined EEGfMRI study.

## REFERENCES

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