

# What our brain sees that our eyes do not: Natural visual search

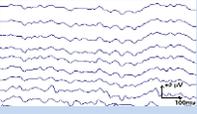
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## Introduction and Background

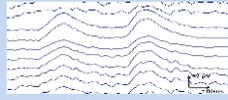
The understanding of how the human brain processes visual information has been largely sourced from the two independent fields of brain Event-related potentials (ERP) and eye movements.

The problem previously was that natural, free eye-movements create artifacts in the electroencephalogram (EEG) signal, which could lead to false conclusions about the potentials found.

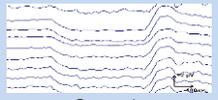


Typical EEG trace

### Artifacts: Voltage spikes in EEG

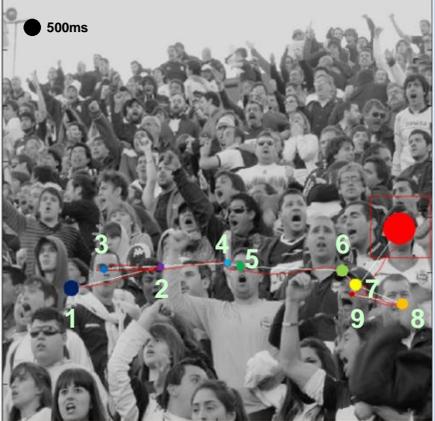


Blinks

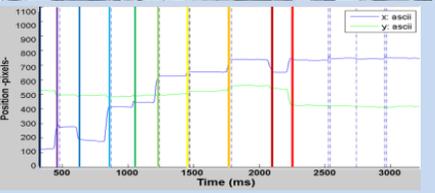


Saccades

## Behaviour – What our eyes show us



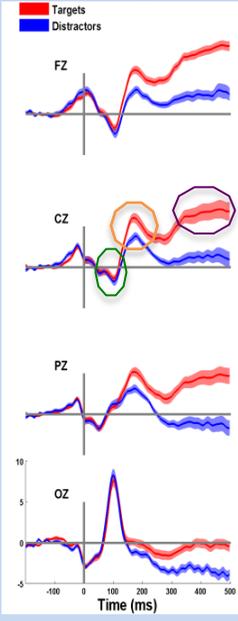
Top left shows the movements of the eyes during one trial of the experiment. The dots show the fixations made; the size and colour correspond to the duration of the fixation and the order respectively.



Middle left shows the x and y position traces of the eyes from the eye tracker during the course of one trial. The colour lines also correspond to the fixations.

Bottom middle a flow chart of how the two different technologies work together to get the fERPs

## Physiological – What our brains show us



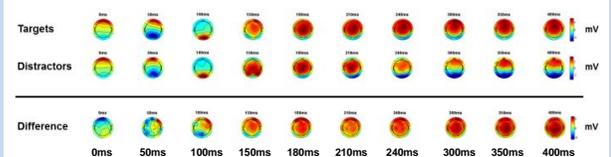
In the left panel we show robust fERPs that contain potentials, previously associated with visual processing and target detection, in a completely natural visual search task.

We can also observe spatially where these potentials are eliciting from the topographies (bottom panel).

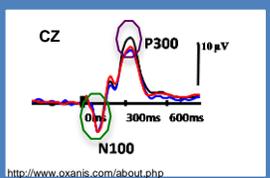
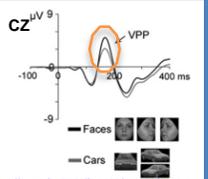
By combining the two technologies we were able to provide the first steps into understanding visual processing in the real world.

These potentials bare many similarities to those recorded from fixed-gaze ERP research but perhaps the differences could be a modulation of the signal due to the natural conditions of the task [1][2].

Current efforts are focused on finding the exact variables that modulate these signals.



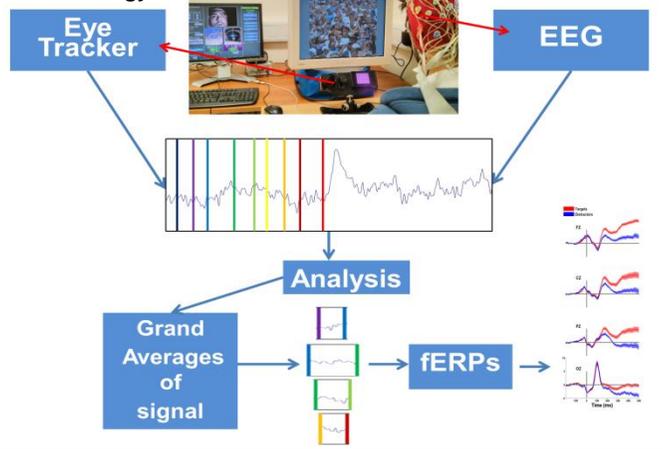
## ERP Components



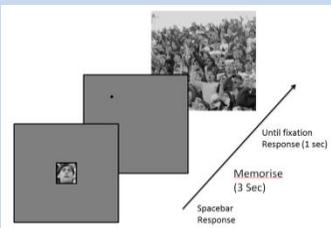
Previous findings in EEG have shown an association:

- P100/N100: Visual Processing
- VPP: Facial Processing
- P300: Target Detection

## Methodology Flow Chart



Paradigm:  
Where's Wally?



## The Future: Next Steps

Our findings provide the first steps towards being able to utilise these brain potentials with the next generation of brain computer interfaces, which could range from gaming to assistive technologies.

## Bibliography

1. Polich, J et al. Updating P300 *Clin Neurophys* 2007
2. Bentin et al. Electrophysiological studies of face-perception in humans *JCN* 1996
3. Kamienskowski et al. Fixation-related potentials in visual search *JOV* 2012
4. Kaunitz et al. Looking for a face in the crowd *Neuroimage* 2014