



Effects of visibility and point of gaze on saccades and evoked potentials during naturalistic target discrimination

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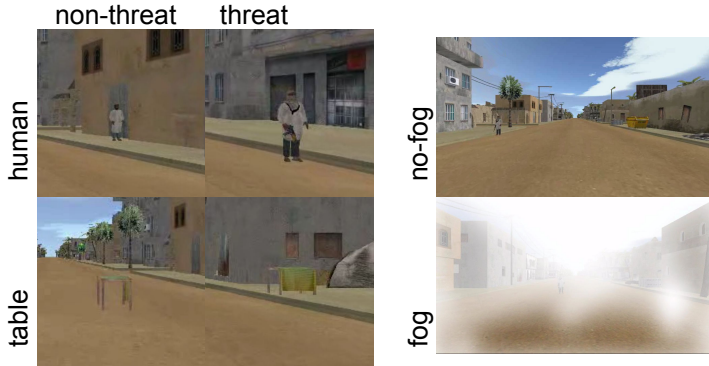
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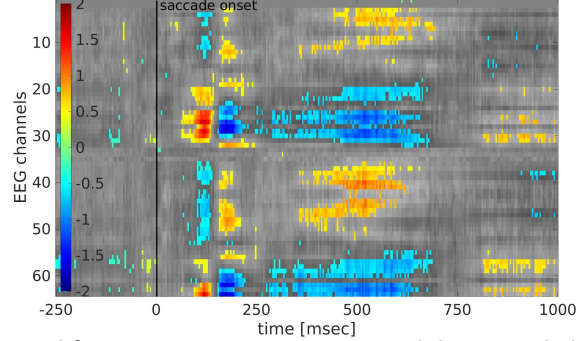
Introduction: Our first hypothesis is that objects in the periphery should elicit stronger responses relative to the fovea because they are attention grabbing and drive gaze: different point of views impacts neural responses. Research has shown that poor visibility conditions like nighttime driving and driving in the rain impact the performance of visual search and inevitably reaction time (Konstantopoulos et al., 2010). Our second hypothesis is that visibility conditions should exhibit a difference in neural responses given there is an impact in reaction time. Our third hypothesis is an interaction between these two in which visibility conditions may have an impact on neural responses for point of gaze.

Experiment:

3D video game with target discrimination task recorded 64 channel EEG and eye movement. 16 subjects (3 male). Two conditions: visibility (fog and no-fog) and POV (foveal/peripheral).

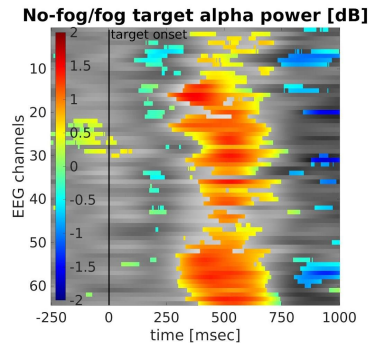
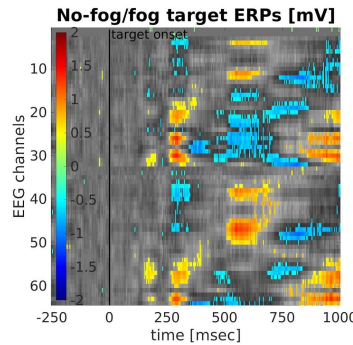
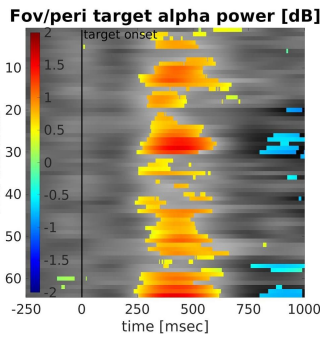
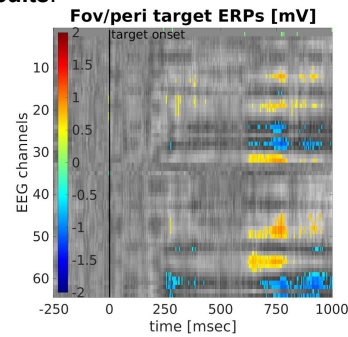


Eye-movement control: Target vs non-target saccades [mV]



As a control for eye movement we compared the saccade-locked ERP response of target related saccades to non-target related which shows a strong difference. This control suggests that the task related saccades do modulate evoked responses but it cannot account of how much of this signal is eye-movement related in the POV conditions.

Results:

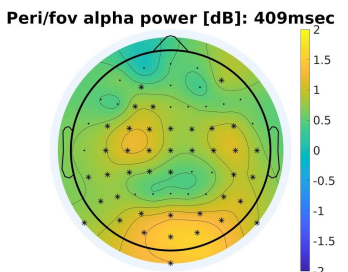


There is a significant ERP contrast between foveal and peripheral target conditions. However, saccades are asynchronous which suffices a look at power.

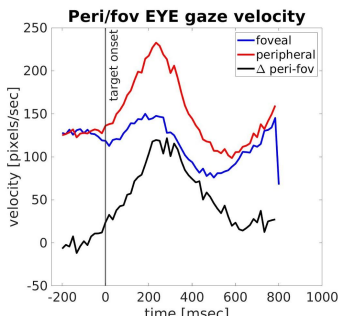
This is accompanied by a strong alpha power boost for the non-fog condition between 250-750 msec after target onset.

There is strong event related potential (ERP) contrast between the clear and foggy visibility conditions. Results in color show significance.

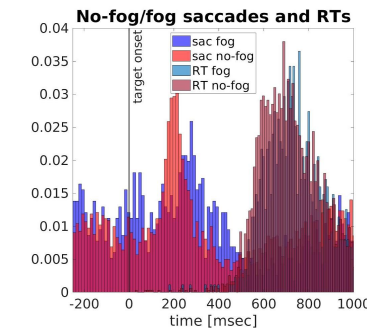
This is accompanied by a strong alpha power boost for the non-fog condition between 250-750 msec after target onset.



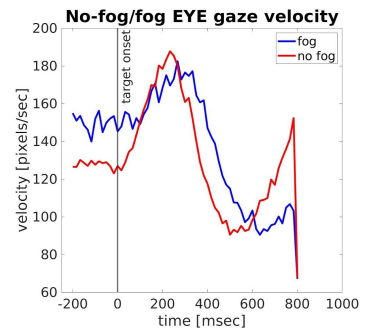
Topoplot at 409 msec after target onset showing occipital and bilateral motor alpha power increase.



Peripheral trial eye movements have faster eye velocities compared to foveal trials suggesting the alpha power is because of eye movements.



Behaviorally subjects saccade to target and button press significantly later in the clear compared to the foggy visibility.



In addition the peak eye movements are higher and peak later in the clear compared to foggy visibility.

Conclusion: Hypothesis 1: Peripheral trials do exhibit a stronger response in power but this is confounded by stronger eye movements. Hypothesis 2: Clear visible conditions have faster responses and stronger neural responses in comparison to the foggy condition. Hypothesis 3: While results suggesting there is an interaction between visibility and point of view there is no detectable interaction between the two factors across for alpha power, eye speeds, saccade timing, or RTs.

References: Konstantopoulos, P., Chapman, P., & Crundall, D. (2010). Driver's visual attention as a function of driving experience and visibility. Using a driving simulator to explore drivers' eye movements in day, night and rain driving. *Accident Analysis & Prevention*, 42(3), 827-834. <https://doi.org/10.1016/j.aap.2009.09.022>