Measuring inattentional blindness with SSVEP

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Background

People may not notice prominent stimuli (including gorillas [1]). Two studies have investigated whether sustained failures of attention are due to failures to gaze at the target, with mixed results [2, 3]. Perhaps inattentional blindness is instead due to a failure of (covert) attentional gain?

Steady-state visual evoked potential (SSVEP) technique is ideally suited to measure attention to multiple stimuli onscreen for extended periods, and also more robust to eye/head-movements inherent in natural search behaviour.

Hypotheses: People who notice "hidden" object (noticers) will gaze at the hidden object longer, and show heightened SSVEP response to that object.

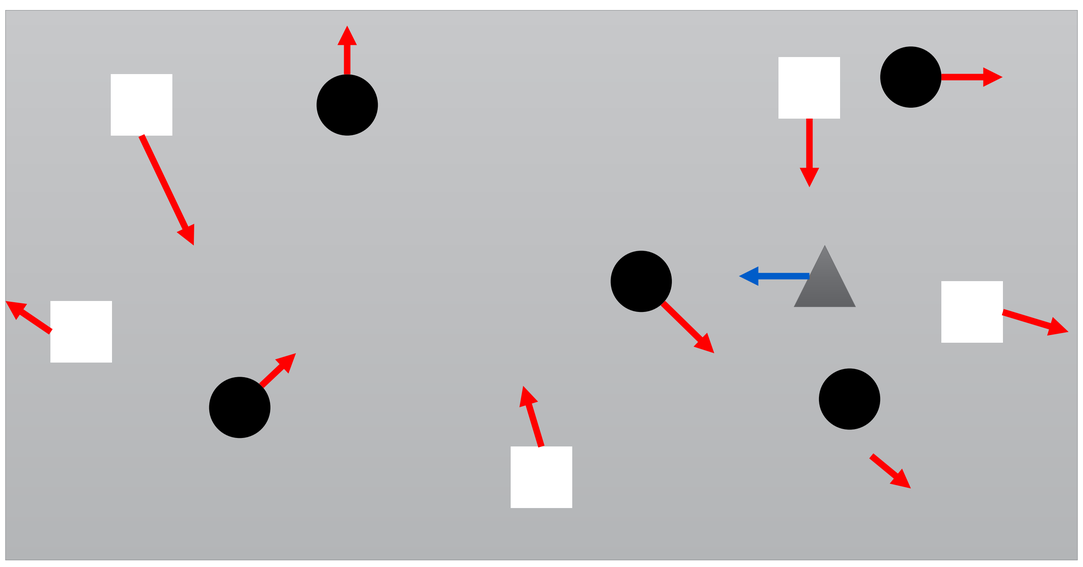
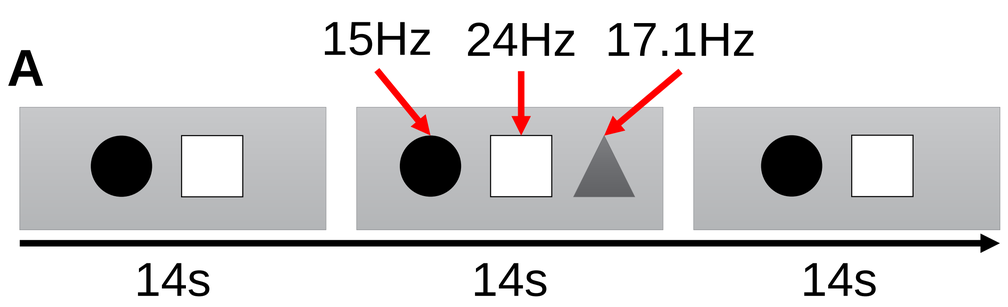


Figure 1: Screenshot from typical trial. Arrows indicate velocities.

Method

- 47 undergraduates completed 7 x 42s trials
- They counted when the white flickering object bounced off the screen edge [4]. All stimuli flickered.
- EEG taken @2kHz, 32-channel.
- Gaze taken @90Hz from 70cm.
- During the middle 14s of trials 5-7, an unsignalled grey shape moved across the screen.
- On each trial, they reported the number of bounces and which shapes they saw



B

Trial #	1-4	Test	Test	Check
Task	Count	Count	Count	None
Hidden	-	Yes	Yes	Yes
Question	-	Yes	Yes	Yes

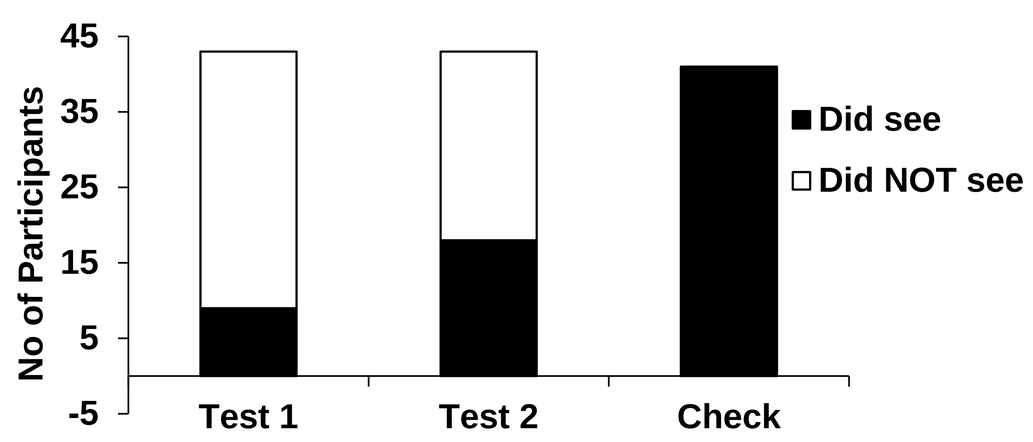
C

Select which shapes you saw in the last trial:

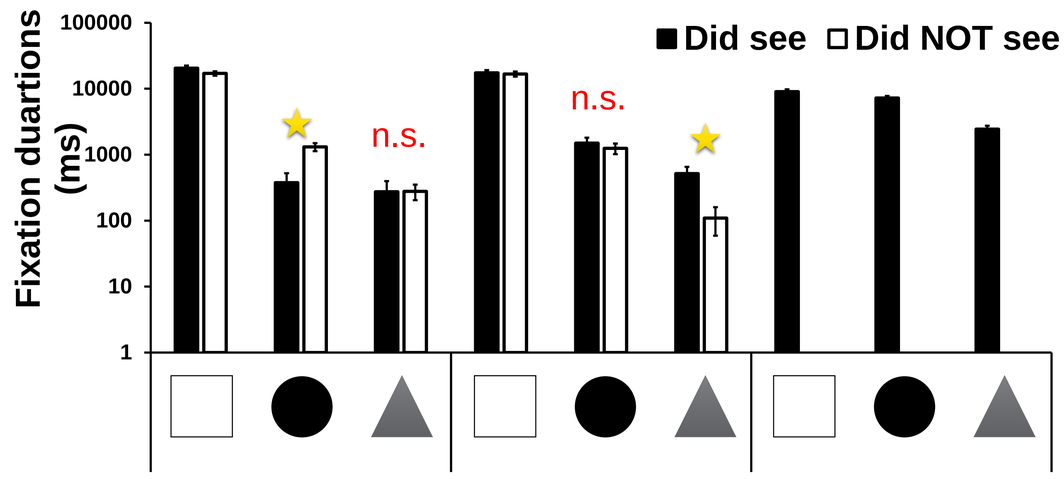
***Panel A**: Time course of each search trial and the flickering rates of each stimulus type.*
***Panel B**: The order and format of the seven search trials.*
***Panel C**: The test question used to assess whether hidden object was noticed.*

Results

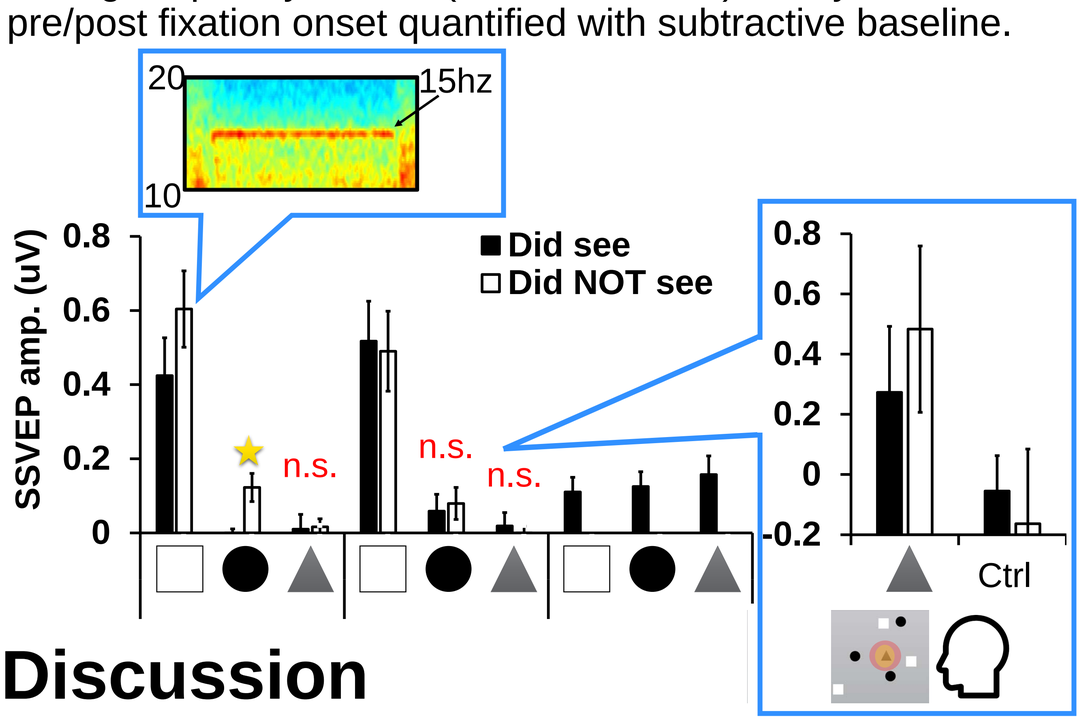
Behavioural: Noticers scored as those who correctly identified three shapes (target, distractors and hidden object).



Gaze: Fixations = <150 deg/sec for >100ms, dynamic AOIs.



EEG: Filtered (Butterworth 0.1-130; notch 50Hz), average referenced. Segmented to middle 14s. Amplitude quantified as driving frequency – mean(nearest 20 bins). Analysis #2: 1.05s pre/post fixation onset quantified with subtractive baseline.



Discussion

- Low rates of noticing sustained across 2 trials.
- During (unsignalled) Test 1, noticers gazed less at distractors than non-noticers (no difference for hidden object). The same pattern was observed in SSVEP magnitudes.
- This gaze pattern was reversed in (signalled) Test 2, but no significant between group differences in SSVEP.
- Technique shows SSVEP measure robust to: head/eye-movements, rapid shifts between targets, use of multiple moving targets. Possibly measureable <1.05s of fixation.

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References
[1.] Simons & Chabris (1999). *Perception*, 28, 1059–1074. **[2.]** Memmert (2006). *Consc & Cog*, 15(3), 620-627. **[3.]** Richards, Hannon & Vitkovitch (2012). *Consc & Cog,* 21(1), 170-176. **[4.]** Most, Scholl, Clifford, & Simons (2005). *Psych Review*, 112(1), 217.