UNIVERSITÄT LEIPZIG
Experimental Psychology and Methods[1]

Tracking Depth-Selective Visual Attention using SSVEP

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INTRODUCTION

- The role of space as a feature in feature-based attention is still not resolved (Maunsell et al., 2006).
- Active deployment of visual attention can be tracked by presenting two differently colored Random Dot Kinematograms (RDKs) that flicker at different below-flicker-fusion frequencies (Müller et al., 2006).
- RDKs evoke frequency-specific steady-state visual evoked potentials (SSVEPs). RDKs usually show an enhanced SSVEP amplitude while they are attended and a decreased amplitude while they are ignored (Forschack et al., 2017).
- The goal of this study was to explore attentional deployment for the visual feature of spatial depth by using a similar approach.

www.youtube.com/watch?v=JaVDw6i7Lp8

DISCUSSION

- Behavioral measures confirmed that attention is guided by the cued feature rather than flicker frequency information.
- SSVEP spectra of the first 18 participants showed amplitudes at evoked flicker frequencies and at the intermodulation frequencies, replicating previous experiments.
- Topographies of the evoked flicker frequencies indicate the signal to originate in central posterior regions that are associated with very early visual processing.
- Pronounced amplitudes at intermodulation frequencies suggest the processing of the stimuli as one percept in the visual cortex, at least at some point (Fuchs et al., 2008).
- Time-course dynamics of the attentional modulation may be occluded by too wide analysis time windows.

METHOD

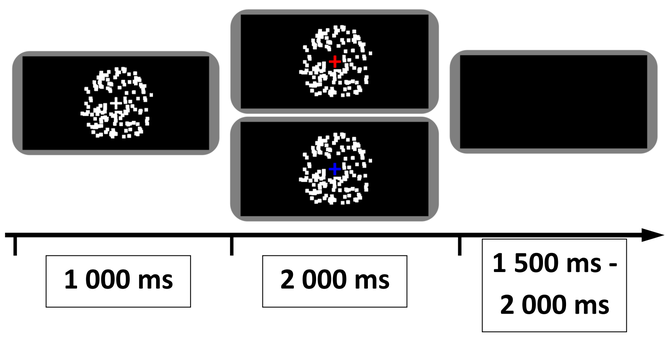

Fig. 1: Typical trial. After cue presentation subjects attended to RDK in cued depth (red = in front of fix. cross, blue = behind it) and ignored the other one. Subjects had to react to coherent movements in the cued RDK by button press. Front RDK flickered with 15 Hz, rear RDK with 18 Hz. All stimuli were projected on a screen at 480 Hz refresh rate.

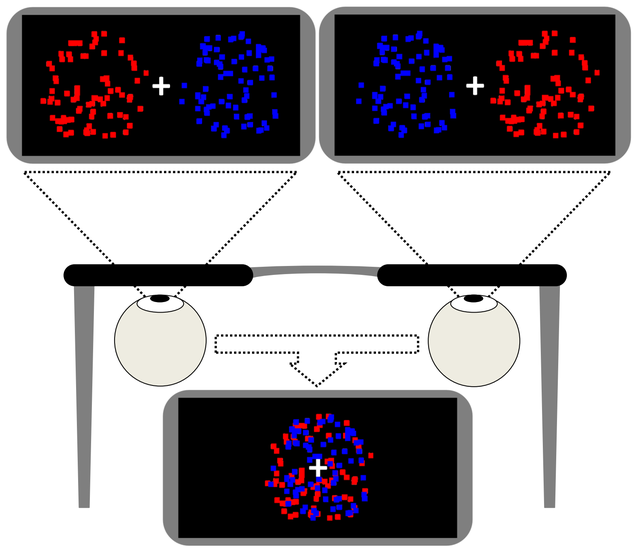

Fig. 2: Stereoscopic 3D setup using a polarizing shutter and passive glasses. All RDKs are colored white actually. To achieve binocular depth, the frontal RDK (red) is presented with positive disparity (offset to the right for right eye, offset to the left for left eye), while the rear RDK (blue) is presented vice versa (Mean disparity = 5.3 cm). Retinal images merge into one front and one rear RDK perceptually.

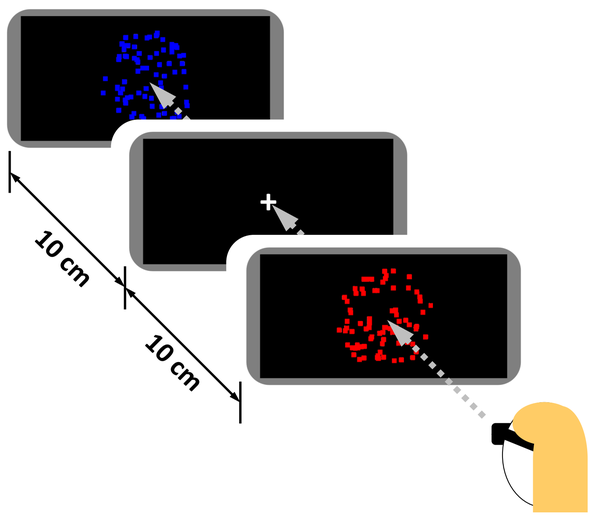

Fig. 3: Simulated depth perception. Fixation cross is presented without binocular disparity and thus appears in the retinal fixation point.

RESULTS

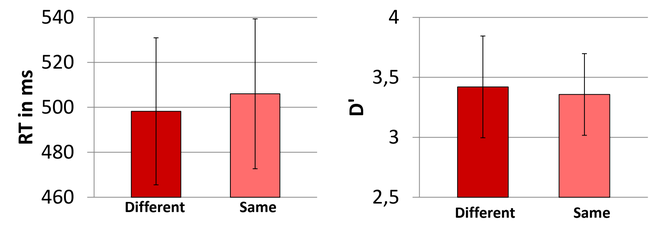

Fig. 4: Control study comparing performance for different and same flicker frequency. Error whiskers denote 95%-CI.

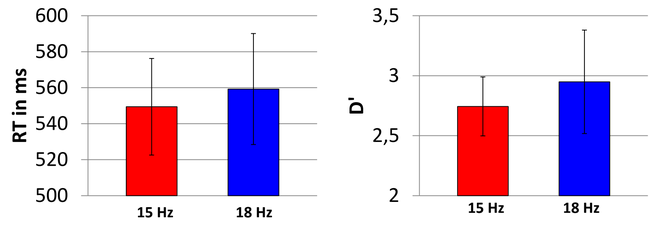

Fig. 5: Performance results of the current study for the 15 Hz RDK and the 18 Hz RDK. Error whiskers denote 95%- CI.

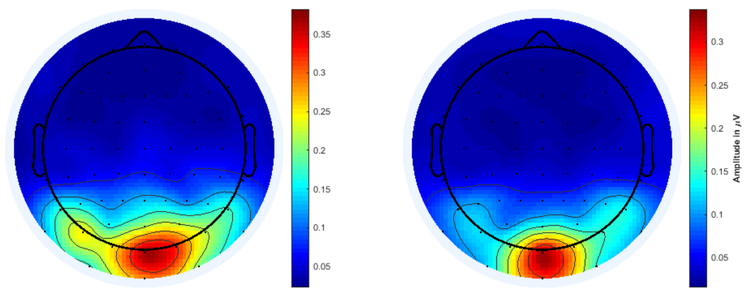

Fig. 6: SSVEP topographies for attended front RDK (15 Hz, left) and rear RDK (18 Hz, right). Electrode positions Oz, O1, O2 and Iz show maximal voltage amplitudes in both.

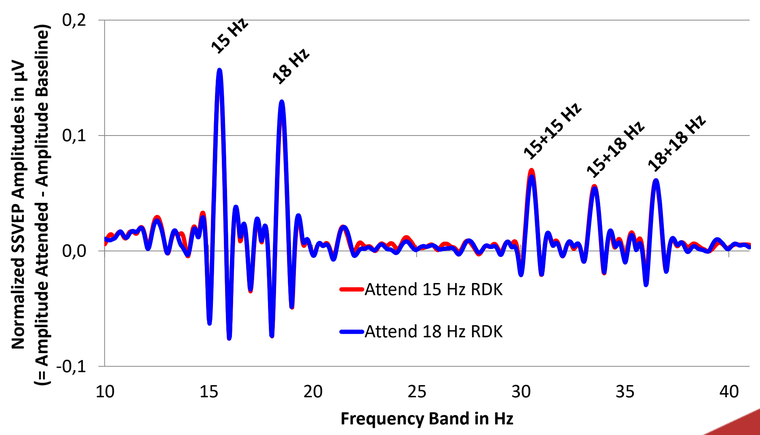

Fig. 7: Spectrogram of attention effects for front RDK (red) and rear RDK (blue). amplitudes are averaged from Oz, O1, O2 and Iz.

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