Can SSVEPs be used to measure neural computation of abstract numerosity? 

A method of spatial dimensionality-reduction that maximizes between-trial covariance, can be applied in the time- or frequency domain number processing in electrodes over occipital cortex fast update rates (8 & 1 Hz) and found evidence of previous studies have used relatively numerosity changes at oddball frequency.

Background

At the end of each trial, participants were asked to report whether or not there had been a change in numerosity. Sensitivity was weakest in the 6 & 1 Hz case, but consistently above chance when number changed by 3.

Reliable Components Analysis

A method of spatial dimensionality-reduction that maximizes between-trial covariance, can be applied in the time- or frequency domain and produces physiologically plausible spatial filters

Experiment 1: Temporal tuning

Experiment 2: Varying distance

Experiment 3: Does direction matter?

Stimulus parameters

We measured dot size and dot cloud area in pixels (based on convex hull) for each update over 10 trials of data.

Visual responses

We passed the images through a second-order contrast model that simulates responses in visual areas V1, V2, V3, V4.

Conclusions

Across 3 experiments, SSVEPs measured with relatively slow presentation rates (3 & 0.5 Hz) consistently produce two response components, centered over parietal and occipital cortex. The occipital component mostly captures responses driven by image updates, while the parietal component captures responses related to changes in numerosity at the oddball frequency. The SSVEP oddball paradigm could provide the foundation for creating a rapid and portable neurometric approach to quantifying number sense in educational settings.