The appearance and disappearance of visual forms defined by differential motion evokes distinctive EEG responses in school-age children

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Motivation

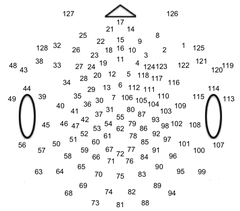
Differential motion patterns aid in the segmentation of visual figures from the background. Adults show evoked brain responses to time-varying motion-defined forms over posterior scalp regions [1],[2]; in these participants, EEG amplitudes scale with the magnitude of direction differences between the figure and background. Little is known about the development of brain responses to motion-defined forms in childhood [3]. In this study, we measured steady-state visual evoked potential (SSVEP) responses in school-age participants and compared the resulting patterns to previous results in adults.

Method

School-age observers (n=37; 4.3-9.0 years, *M*=6.4, 16 female) participated in this study. Participants passively viewed random dot kinematogram displays that depicted visual forms which differed in direction from uniform background motion by 5°, 45°, or 180°. Four 9x9 deg square-shaped figure regions emerged from and disappeared into the background at a rate of 1.2 Hz (F1). Figure and background regions were populated with white (39 cd/m^2) dots on a black (.065 cd/m^2) background at a density of 10%; dot positions were updated at 36 Hz (F2). Each condition was presented at two speeds (1.2 and 6.0 deg/s). All patterns were displayed in an annular region 24°in outer and 4.8°inner diameter at the 60 cm viewing distance.

EEG was collected at 432.43 Hz using a 128 channel EGI system and PowerDiva Video 3.4 software and submitted to a discrete Fourier transform.

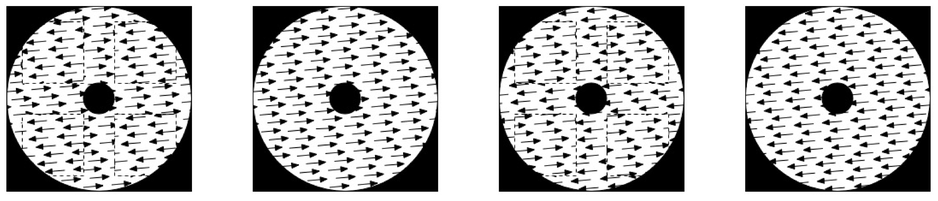
The complex domain (real and imaginary) components of each channel were analyzed using mixed-effects MANOVA, with direction difference and speed as fixed factors and participant as a random factor.



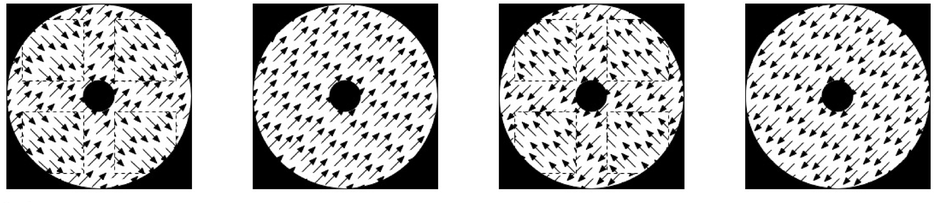
128 Channel Layout

Displays

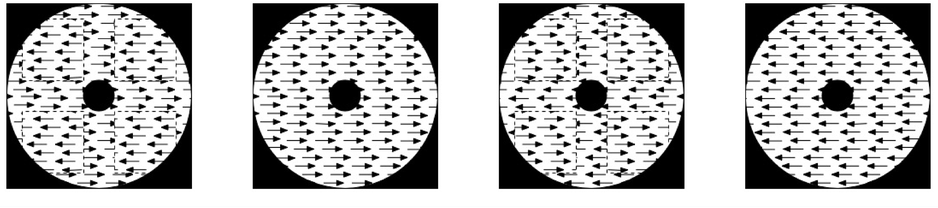
5 degree



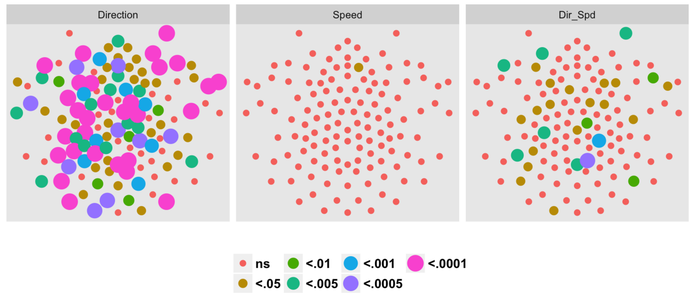
45 degree

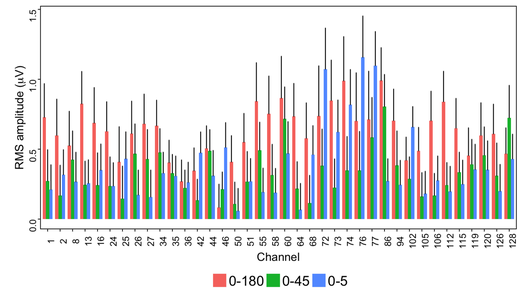


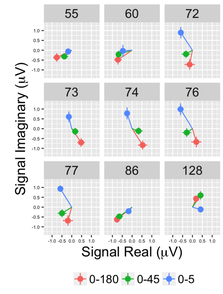
180 degree



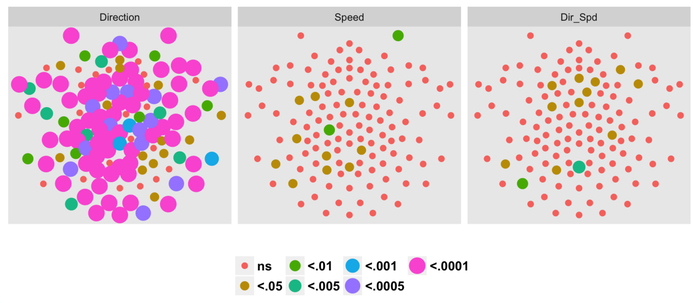
Results - 1F1

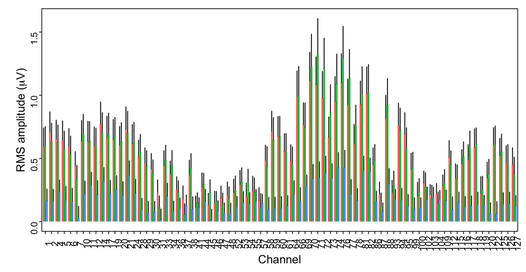


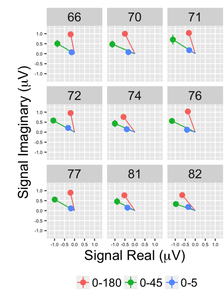




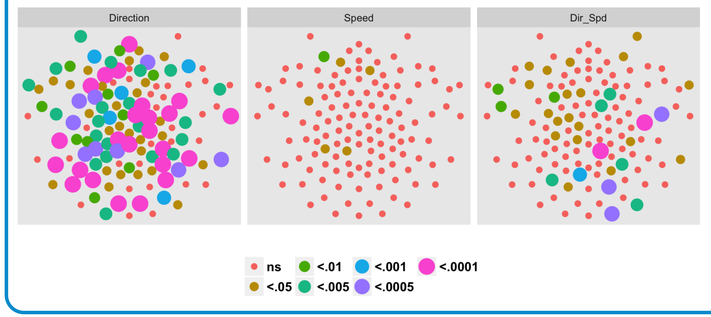
Results - 2F1

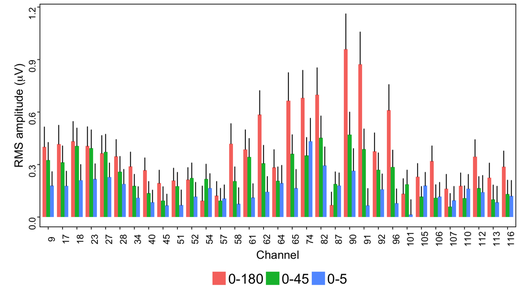


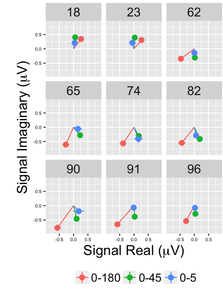




Results - 3F1







Data Sharing

Movies of the displays, metadata about the participants, and raw data files are available at: `http://databrary.org/volume/144`.

Acknowledgements

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References

[1] J. D. Fesi, A. L. Thomas, and R. O. Gilmore, "Cortical responses to optic flow and motion contrast across patterns and speeds," *Vision Research*, vol. 100, pp. 56–71, Jul. 2014. [Online]. Available: http://www.sciencedirect.com/science/article/pii/S0042698914000765

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