The Neural Response to Visual Symmetry in Wallpaper Patterns

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Background

Any periodic pattern belongs to one of 17 wallpaper groups based on its symmetries. Previous work has focused on mirror symmetry. Here we investigate rotation symmetry by recording EEG responses to 4 wallpaper patterns, each having a different number of rotation folds.

Stimulus

10 exemplars per group Generated from random noise patches 10 spectrum-matched controls

Sensor Space Results

We found a configural evoked response for all four wallpaper groups. The amplitude of this response increased linearly with the number of rotation folds.

Analytical Approach

Test condition: P6 pattern alternates with random-noise pattern Control condition: random-noise alternates with random-noise Spectral analysis isolates a configural response evoked by the wallpaper group, that consists of odd harmonics.

Source Imaging

What are the sources of neural activity that generates the signals we measure on the scalp?

Electrode locations digitized in 3D with Polhemus Fastrack MR-based tissue geometry and conductivity model Define source dipole Minimum norm solution

Conclusion

Configural evoked response amplitude increases linearly with the number of rotation folds in the wallpaper groups, indicating that the visual system parametrically represents rotation symmetry. Source localization suggests that this representation begins in early visual cortex.

References


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