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.

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.

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.

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 MRI-based tissue geometry and conductivity model Define source dipole Minimum norm solution

Result: A map of cortical current density that can be combined with ROIs derived from fMRI data.

Source Space Results

Configural evoked responses to the wallpaper groups were found in all 4 ROIs. Activity scales with number of rotation folds at odd but not even harmonics.

Responses are progressively delayed as the signals ascend the visual processing hierarchy.

Conclusion

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


Vision Sciences Society 2014
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