Decoding Grapheme-Color Synesthesia using Multivariate Pattern Analysis

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Background

Synesthesia is a condition in which stimulation of one sensory modality evokes experiences in a second, unstimulated modality.

Grapheme-Color Synesthesia

SYNESTHESIA

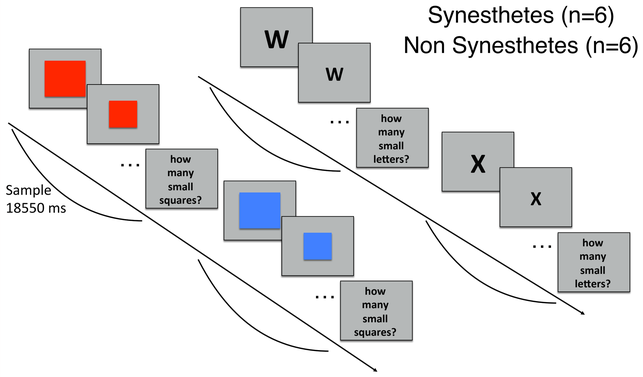
0123456789

Approach

Primary Question: Is the subjective experience of synesthetic color generated by the same, or different, neural processes from those that support the perception of veridical color?

1. To investigate changes in activity levels in neural regions sensitive to visually presented color.
2. To perform whole brain searchlight analyses.

Experimental Design



Training Set

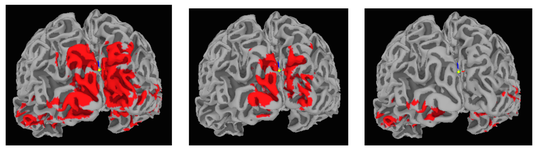
Red Green Blue Yellow

Hypothesis Test

- Step 1: Within-category multivariate pattern analysis (MVPA): “train on color, test on color” to identify regions that represent perceived color.
- Step 2: Cross-category MVPA: “train on *color*, test on *letter*”. Successful cross-category decoding would indicate that synesthetic percepts are supported, in part, by the same neural mechanisms that support the visual perception of veridical color.

Results: Region of Interest Analyses

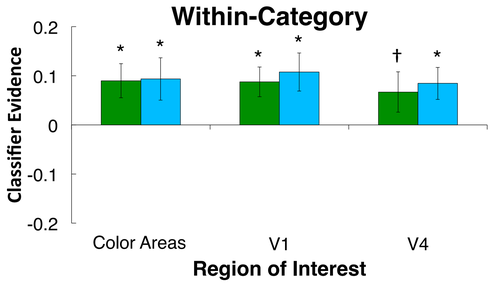
Feature Selection

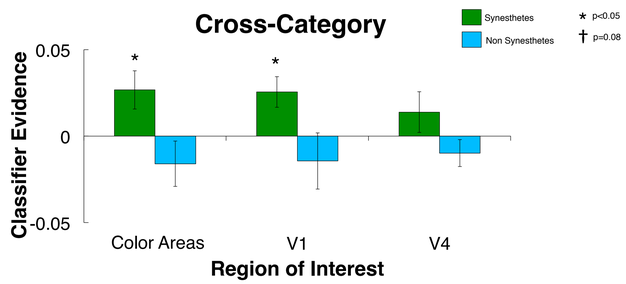


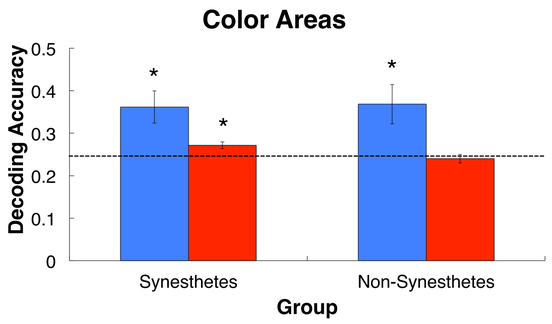
Color Areas: Top 2000 activated voxels to viewing colors in occipital-temporal regions.

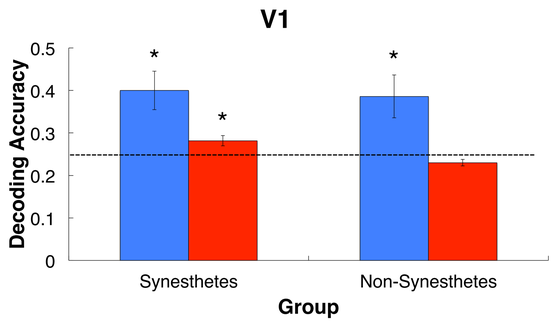
V1: Top 500 activated voxels in the occipital pole.

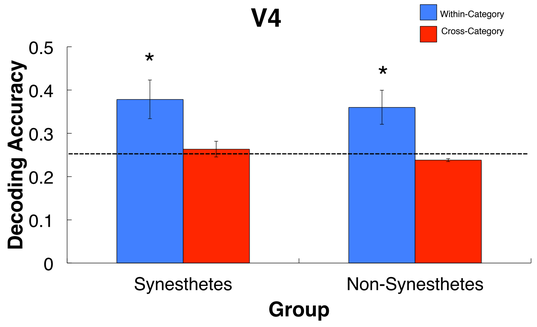
V4: Top 500 activated voxels in the fusiform gyrus.



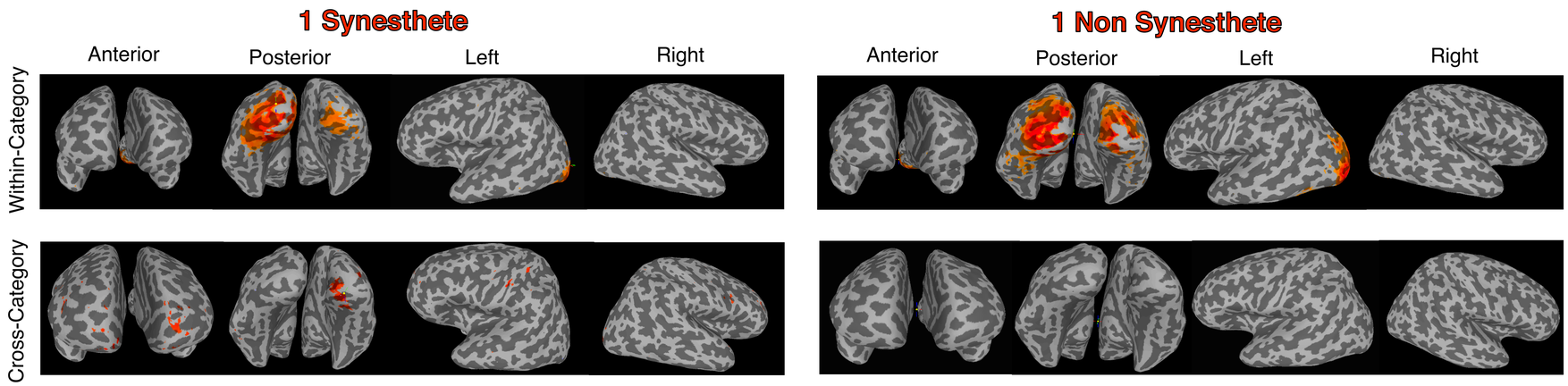








Results: Wholebrain Searchlight



- **Wholebrain Searchlight radius : 4-voxels**
- **Voxel Threshold : p≤ 0.001**

Conclusions

- **Synesthetic percepts are supported by broadly distributed patterns of color-discriminating activity.**
- **Reliable cross-category decoding for V1 suggests that grapheme-color synesthesia may be supported by the representation of color at the earliest stages of cortical processing, a phenomenon presumably arising from feedback from networks that support the discrimination of linguistic symbols.**
- **Synesthesia is a perceptual, rather than a conceptual, phenomenon.**

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