Shape dimensions, perceptual organization and intermodal selective attention: anterior extrastriate fMRI

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BACKGROUND

- Shape-selective regions have been detected in a growing number of visual cortical regions using fMRI (c.f. Sawamura et al. 2005)
- “Shape” can refer to multiple properties, including Scale and translation invariance
  - Gestalt or figural goodness
  - Perception utilization
  - Integrated vs. separable spatial dimensions
- Do these properties rely on distinct visual system regions?
- Which of these properties rely on selective attention?

STIMULI & TASK

11 participants completed 3 fMRI scanning sessions for a total of 4.5 hours each.
- 10 trials matching task with stimulus triplets as the unit of comparison
- Individual rectangles appeared for 300 ms, screen position and comparison
- 3 types of dimension change:
  1. Area change (constant area, width only, area constant aspect ratio)
  2. Width change (constant area, aspect ratio)
  3. Aspect ratio change (constant area, width only)
- Behavioral results:
  - Poor performance in either aspect ratio or area change conditions.
- Interaction between dimension change and perceptual organization
- Interspersed width-only change equivalent to difficult versions in either aspect ratio or area change conditions.
- Poor performance in width-only condition indicates inability to judge width and height dimensions separately.

NEUROIMAGING METHODS

- Functional activations displayed on suface projection of spherical surface maps.
- Multi-voxel pattern analysis
- Pixel values indicate significantly negative correlation coefficients between regions; ANOVA effects of visual condition as a factor with 1 df for 3 df for 3 factors.

Effects of attention on shape selectivity

- Red pixels: AR selectivity
- Green pixels: Area selectivity
- Cyan: conjunction (single subject: AR > area)
- Black: non-significant

3 definitions of shape

- Red pixels: AR vs. area
- Green pixels: AR vs. area
- Cyan pixels: AR vs. area

CONCLUSIONS

- Aspect ratio selectivity depends on attention in most regions; LOC, posteromedial fusiform are exceptions.
- Many distinctions between regions selective for different varieties of “shape” information.
- Widespread selective activation for disjoint shapes, including aspect ratio-selective regions, and parahippocampal gyrus.
- Single-dimension change condition activates distinct regions, evidence for distinct pathway representing separable dimensions of simple shapes.

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