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PERCEPTION

DEPTH FROM PERSPECTIVE MODULATES THE HUMAN CORTICAL REGIONS INVOLVED IN EXTRACTING DEPTH FROM MOTION

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Introduction

Recently the cortical network involved in extracting depth from motion was identified using random line stimuli that appear 2D or 3D from motion [Orban et al. 1999]. The purpose of the present fMRI study was to investigate the modulation of this cortical network when a) the extraction of depth from motion is supplemented with depth from perspective, i.e. line stimuli that appeared 3D from static cues, and b) when the depth from motion is conflicting with the depth cue from perspective.

Materials & Methods

Six right-handed subjects were imaged on a 1.5 T Siemens Vision Imager using GE-EPI T2*w functional scans (TR/TE=3025/40ms, FOV=200^2 mm^2, matrix=64^2, 32 transversal slices of 5 mm thickness). Subjects viewed the stimuli monocularly (dominant eye) and fixated a central red fixation dot.

In experiment 1 the conditions were organized in a 2X2 factorial design with 2 levels of object type (random lines objects that appeared 2D when static and rectangular polyhedra that appeared 3D when static) and 2 levels of depth from motion (2D and 3D). The static presentations of both object types were 2 additional control conditions. In a second experiment 4 conditions were alternated: a) rectangular polyhedra with depth from motion and depth from perspective in agreement, b) polyhedra with depth from motion in conflict with depth from perspective obtained by non-rigid deformation of the object, c) static display of the rectangular polyhedra and d) fixation only. In both experiments conditions were randomly alternated in presentation blocks of 30 seconds. Finally in all subjects, also motion sensitive regions were visualized by contrasting a moving random textured pattern minus a stationary [Sunaert et al 1998].

Image analysis was performed with SPM96 and consisted of a) image realignment, b) normalization to standard MNI space, c) smoothing and d) individual/group statistics. Statistical threshold was $p<0,05$ corrected for multiple comparisons.

Results

Experiment 1:

The main effect of dimensionality (3D-2D, i.e. depth from motion irrespective of object type) significantly activated hMT/V5+, hV3A, and a collateral sulcus focus bilaterally, as well as a right lateral occipital region and three regions along the right intraparietal sulcus. This replicates our previous findings [Orban et al 1999] in 6 new subjects. Testing for the interaction between dimensionality and object type revealed that depth from motion for random line objects involved significantly more processing in right hMT/V5+, hV3A, TRIPS and collateral sulcus than depth from motion processing for rectangular polyhedras. The opposite showed a non-significant trend in the left collateral sulcus.

Experiment 2:

The contrast cue conflict minus cue agreement was significant in a focus close to hMT/V5+ and in a dorsal postcentral region. The opposite contrast showed no significant activation. Probing the MR signal change in the regions identified in experiment 1 by the main effect 3D-2D, showed an increase in activity when depth cues are in conflict relative to cues in agreement.

Conclusion

When depth from motion is supplemented with depth from perspective (and cues are in agreement) processing in the regions involved in extracting depth from motion diminishes. When cues are in conflict, activity in these regions again increases.

References

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