

Imagine yourself flying in MRI: disagreement between visual scene and supine position during fMRI

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Introduction

We measured brain activation of subjects, in a supine position, viewing a ground scene that could be viewed from the sky. Thus, the orientation of the visual scene was opposite to the body position. Such a disagreement between the perceived vestibular/proprioceptive sensory and visual information sometimes induces a spatial disorientation syndrome during flights in aircrafts or in spaceships. In such situations, flyers have to ignore their own sensations for safe flight maneuvers.

Materials and Methods

Twenty healthy normal volunteers participated in this study (age 20-47, F/M = 5/15, all right-handed, all gave written informed consent). Two fMRI experiments were conducted in a block manner (five rest blocks and four task blocks, each 30 sec, total 4 min 30 sec). In one experiment (Supine), volunteers viewed a plane crossing horizontally in the sky in the task blocks (Fig. 1). They pressed a button under their right index finger when the plane came to the middle of the sight. In the other experiment (Prone), they viewed a plane crossing over the ground. An EPI sequence was used on a 1.5 T GE scanner (Signa Infinity Twin Speed with Excite XL) using the following parameters: TR 3000 ms, TE 60 ms, FA 90 deg, FOV 220 mm, 64x64 matrix, slice thickness 3 mm with 1 mm interval, 30 axial slices, 90 images per slice. After realignment, spatial normalization and smoothing, the signal intensity during the task blocks was compared with that of the rest blocks using SPM2. A random-effect group analysis was employed to compare the two experiments ($p < 0.005$, uncorrected).

Results and Discussion

The Prone experiment augmented activation around the visual cortex and parahippocampal gyrus bilaterally as compared with the Supine experiment (Fig. 2). There was essentially no relative increase during the Supine as compared with the Prone. A large cluster in the visual cortex during the Prone was consistent with a similar activation during an object-motion perception as compared with an illusory self-motion (vection) [1]. Parahippocampal activation was also found in an object-based spatial decision as compared with an egocentric spatial decision [2].

Conclusions

The intense activation in the visual and parahippocampal areas during the disagreement between visual and somatosensory information suggested an increased neural demand for object-based visual processing of displayed scenes in disregard for the subjects' own proprioceptive /vestibular information.

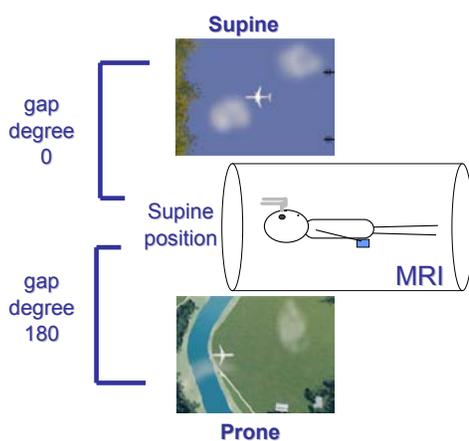


Fig. 1 Two of the fMRI conditions that were the same except for the orientation of the visual scenes.

References

- [1] Kleinschmidt et al., *NeuroImage*, 16, 873-882, (2002)
- [2] Galati et al., *Exp Brain Res*, 133, 156-164, (2000)

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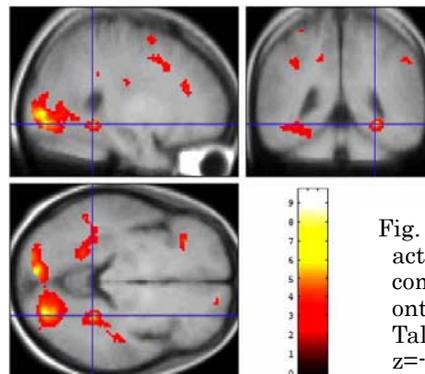


Fig. 2 The visual and parahippocampal activation during the Prone as compared with the Supine rendered onto the averaged T1 images ($N = 20$, Talairach coordinates $x=28$, $y=-43$, $z=-5$ at the intersection.)