Vection induced re-orientation in a visually evoked sway response

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Introduction

For visual control of posture to be successful there must be a compensation for any change in position of the eyes relative to the feet. A previous study (Wolsley et al. 1996) showed that a visually evoked postural response (VEPR) to roll-plane visual-motion was reoriented both by head-on-trunk and eye-in-head rotation. Thurrell et al. (2000) extended these results to show that this reorientation was not dependent on cognitive knowledge of environment geometry. During viewing of large moving scenes subjects may perceive themselves to be moving (vection) or the scene to be moving, perception alternating spontaneously between these two states. It has been shown (e.g. Kuno et al. 1999) that the degree of vection correlates with the **magnitude** of visually induced postural sway. We suspected that the **accuracy** of the orientation of this visually induced postural response to the direction of the driving visual stimulus would be increased during periods of vection relative to those periods during object motion perception.

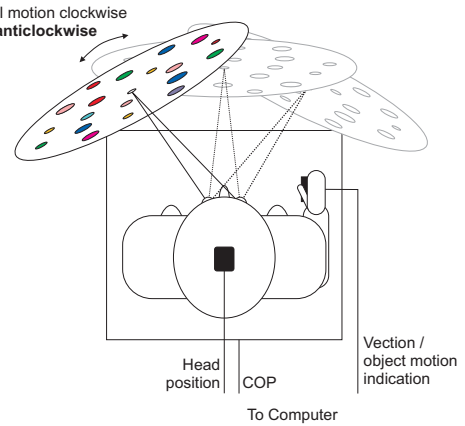

Figure 1 The experimental set-up showing the three disk positions. Data from the **left disk** position **rotating anticlockwise** used in Figures 2 and 3.

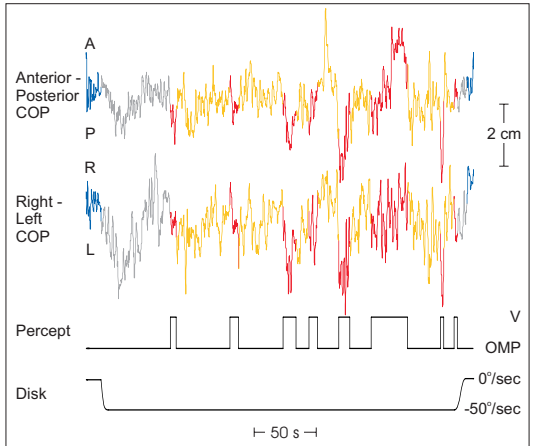

Figure 2 Raw signals from a single trial (with the disk 30° left, rotating anticlockwise) showing periods of vection and object motion perception signalled by the subject to be compared to the stationary periods.

Methods

- Subjects were required to stand, looking either straight ahead or ~30° to the right or left using only horizontal eye rotation at the centre of a large rotating (±50°/sec about the visual axis) disk (see Fig. 1).
- Trials were conducted either monocularly or binocularly.
- Posture was measured via the **head position** (Polhemus Fastrack) and the **centre of foot pressure (COP)**.
- Alternations between **vection** and **object-motion perception** were indicated using a hand-held **push button**.
- The position of the head and the COP was averaged during periods of: disk stationarity (baseline); vection and object motion (see Figs. 2 and 3).
- The errors between the direction of disk motion and the directions of sway from baseline to vection and object motion positions were calculated (see Fig. 3b).

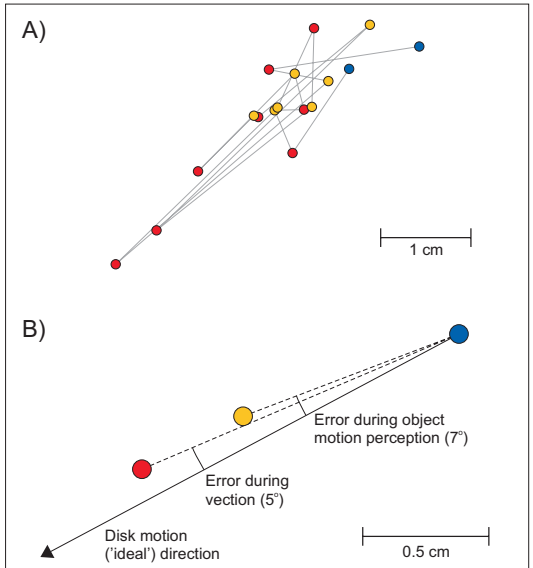

Figure 3 Data (same trial as figure 2) plotted showing the direction and increased magnitude of sway during vection compared to object motion perception. a) Average positions during **each** periods of stationarity, vection or object motion perception. b) Positions averaged over **all** periods of stationarity, vection or object motion perception, showing directions of sway and errors with respect to disk motion direction.

Results

- ANOVA indicated that sway orientation was **more accurate** with respect to disk orientation **during vection** than during object motion perception (13° vs. 19° mean direction error; $P < 0.05$).
- There was no statistically significant difference between monocular and binocular viewing.
- Visually induced sway amplitude was larger during vection than object motion perception ($P < 0.05$; see Fig. 3b).

Discussion

These results show a significantly more accurate reorientation of visually evoked postural sway during vection than object motion perception. The increased accuracy observed during vection suggests that conscious perception of self-motion, presumably at a cortical level, may interact more effectively with gaze position signals. This indicates that visual control of body sway is **improved when vision signals self-motion!**

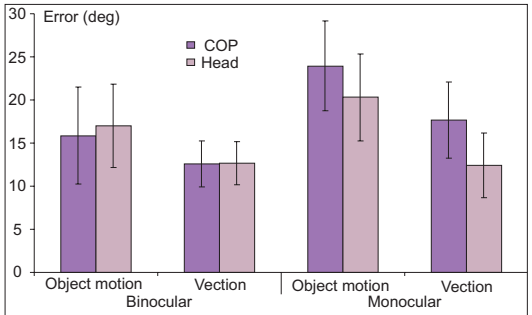

Figure 4 Mean (± standard error) of directional errors showing greater accuracy of sway during vection vs. object motion perception and during binocular vs. monocular viewing (expected due to additional depth cues from stereopsis, but not statistically significant).

References

Wolsley CJ, Sakellari V, Bronstein AM. Reorientation of visually evoked postural responses by different eye-in-orbit and head-on-trunk angular positions. Exp. Brain Res. 1996; 111; 283-288

Kuno S, Kawakita T, Kawakami O, Miyake Y, Watanabe S Postural adjustment response to depth direction moving patterns produced by virtual reality graphics. Japanese Journal of Physiology 1999; 49: 417-424

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