THE EFFECT OF VISUAL SCENE ON MOTION SICKNESS INDUCED BY LATERAL OSCILLATION

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Introduction

Exposure to travelling around corners in a car can cause motion sickness, with the variation in severity of sickness influenced by the visual scene (1). Cornering produces lateral oscillation which can trigger nausea (5). A few laboratory studies have investigated the influence of the visual scene on motion sickness caused by lateral oscillation (2,3); however, none have examined motion sickness experienced by subjects with normal and virtual viewing conditions. In the last decade, virtual reality technologies became a common approach that utilized in various applications within industry and education. Therefore, this study investigates the effect of the visual scene (including normal and virtual visual conditions) on motion sickness induced by low frequency lateral oscillation. It was hypothesized that a virtual visual condition using head mounted display (HMD) would result in less sickness relative to other visual conditions involving an internal view and no view (blindfolded).

Methods

Subjects were exposed to lateral oscillation at 0.25 Hz with an acceleration magnitude of 0.61 ms−2 r.m.s. (a displacement of ± 248 mm). Subjects experienced up to 30 minutes of motion with a different visual condition each session. The three visual conditions involved in the experiment: i) an internal view (viewing a video on a monitor in a closed cabin), ii) a virtual view using HMD, and iii) no view (blindfolded). Subjects provided ratings of motion sickness at 1-min intervals during the 30-min exposure to motion based on an illness rating scale. This illness rating scale is used to measure motion sickness experienced by subjects during motion exposure on seven-point scale (from 0 to 6).

Results

There was a significant difference (Friedman: $p < 0.001$) between the mean illness ratings reported by the subjects in the three visual conditions. The blindfolded condition significantly reduced sickness relative to internal and HMD conditions (Wilcoxon: $p < 0.001$ for both). The mean illness ratings for every minute during the 30 minutes exposure to motion (Figure 1).

Discussion and Conclusion

The significant difference between the blindfolded and internal view found in this study may be explained by that a beneficial effect of eye closure (blindfold) compared to eyes open with having an internal view of a moving cabin (6). Internal view in a car may

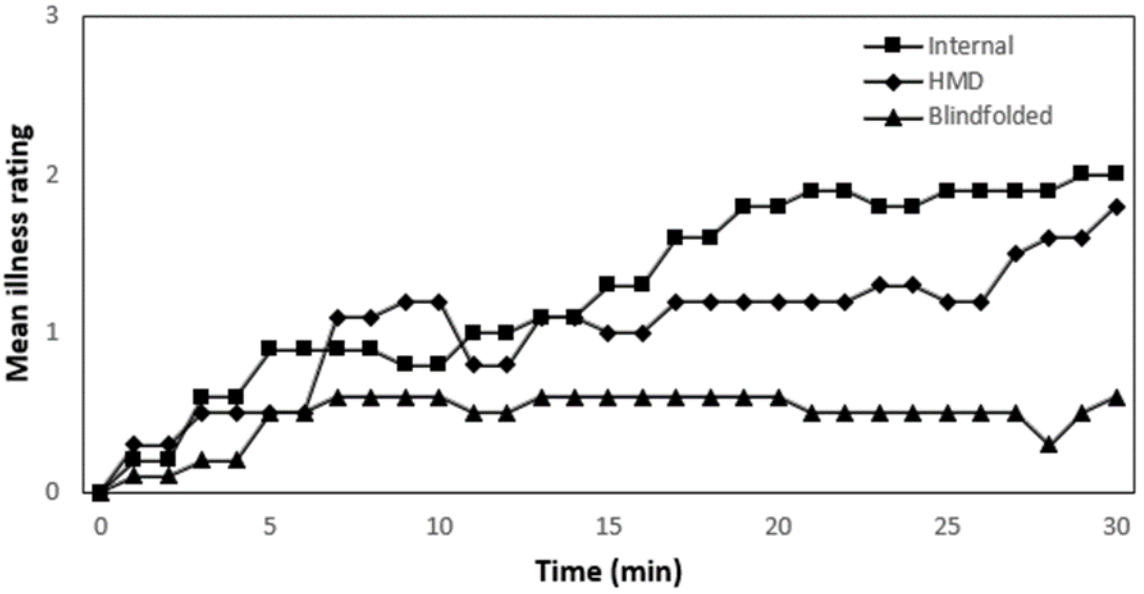

Figure 1 Mean illness ratings during the 30-min exposure to lateral oscillation in the three visual conditions.

include a visual task (i.e. watching a video as in the current study) which may trigger motion sickness more than having a static visual view due to eye movements. The study also found that the blindfolded condition significantly produced less sicknes compared to the HMD condition. No previous studies have compared the effects of these two conditions on the severity of motion sickness. However, several factors may be accountable for the variation in severity of sickness experienced by users when wearing the HMD device (i.e. content being experienced) (4). Differences between the three visual conditions (an internal view, HMD, and a blindfold) had a significant effect on motion sickness induced by 0.25 Hz lateral oscillation with an acceleration magnitude of 0.61 ms−2 r.m.s. (a displacement of ± 248 mm). The blindfolded condition was beneficial in reducing motion sickness relative to the other two visual conditions. Further research is needed to enable the use of HMD device during travel (especially in autonomous vehicles).

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