OBJECTIVE MEASUREMENT OF SIMULATOR SICKNESS AND THE ROLE OF VISUAL-VESTIBULAR CONFLICT SITUATIONS: A STUDY WITH VESTIBULAR-LOSS (A-REFLEXIVE) SUBJECTS

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Introduction

Driving simulators are being used increasingly for research and development purposes as it is generally easier to evaluate new design or control principles in a controlled environment than in the field. However, high-fidelity simulators have become increasingly realistic and have allowed researchers to explore the complex interactions between visual, vestibular, and autonomic effects. Understanding these interactions is crucial for improving simulator design and for developing effective countermeasures. This study aimed to evaluate the objective measurement of simulator sickness and the role of visual-vestibular conflict situations. A group of vestibular-loss subjects was recruited, and their sickness responses were compared to those of normal subjects. The results showed that the vestibular system plays a significant role in the generation of simulator sickness, and the findings have implications for the design of future simulators.

Methods

Physiological data were recorded using commercially available sensors, and sickness scores were assessed using a validated questionnaire. The driving data (including the sickness score) were resampled to 10 Hz and normalized across subjects. The sickness score was calculated as the difference between the normalized sickness score and the baseline activity. This sequence was designed to elicit sickness: to this end, we chose a visual analog scale to assess sickness perception. The cursor was placed in the center of the scale, and the subject could move it to the left or right. The sickness score was calculated as the difference between the baseline activity and the sickness score. The data were analyzed using a 2 (gender) × 2 (age group) × 3 (simulator condition) repeated measures ANOVA, and the results showed a significant effect of gender and age group on the sickness score. Post-hoc tests revealed that females had higher sickness scores than males, and the younger age group had higher sickness scores than the older age group. The findings highlight the importance of considering gender and age factors in the design of simulators.

Results

Physiological correlates to simulator sickness were identified using a validated questionnaire and physiological sensors. The data were analyzed using a 2 (gender) × 2 (age group) × 3 (simulator condition) repeated measures ANOVA, and the results showed a significant effect of gender and age group on the sickness score. Post-hoc tests revealed that females had higher sickness scores than males, and the younger age group had higher sickness scores than the older age group. The findings highlight the importance of considering gender and age factors in the design of simulators.

Discussion

The findings of this study suggest that the vestibular system plays a significant role in the generation of simulator sickness. Future simulators should consider the visual-vestibular conflict situations to minimize sickness responses. Further studies are needed to explore the potential use of vestibular sensors in the design of simulators to reduce sickness responses.

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