POSTURAL INSTABILITY FOLLOWING IMMERSION IN A VIRTUAL ENVIRONMENT DRIVING SIMULATOR

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Introduction: Postural instability following immersion in virtual environment (VE) simulators (i.e. aviation and driving) is well documented (Kennedy et al., 1996; Stoffregen et al., 2000). However, the mechanism by which VE exposure influences postural control is unknown. Many believe that postural instability is the result of a sensory conflict between visual and vestibular systems produced by virtual environment simulators with a fixed base. This mechanism has also been proposed to play a role in the adverse physiological responses (i.e. disorientation and nausea) experienced by a number of individuals, collectively referred to as simulator adaptation syndrome (SAS). Some researchers have proposed that postural instability is in fact a precursor of SAS, in that individuals who display reduced postural control before immersion are predisposed to experiencing SAS symptoms (Smart et al., 2002). If this was the case, then the severity of SAS symptoms would be directly scaleable to an increased magnitude of postural instability (Kennedy et al., 1996). However, conclusive evidence to support this theory has not been found, and continued research has produced conflicting results (Cobb, 1999). The purpose of the current study was to determine whether postural instability increases in proportion to increased severity of SAS symptoms following immersion in a virtual driving simulator. A secondary purpose to this work was to test if galvanic vestibular stimulation (GVS), which stimulates vestibular afferents and provides a sensation of lateral motion while driving in the simulator, could reduce post-VE postural instability and severity of SAS symptoms. Methods: Participants drove in two twenty-minute rural road scenarios. Each scenario contained two types of turns: eight gradual curves and eight 90-degree intersection turns. All turns were lined with lampposts along the edge of the road providing a high visual cue environment. GVS was applied while negotiating each turn in one of the drive scenarios (counterbalanced between participants). Postural stability and self-reports of SAS symptoms were measured following each twenty-minute driving scenario. Participants adopted single leg stance with eyes open followed by eyes closed for a maximum of 30 seconds on a force plate. Magnitude of postural stability was measured using a root mean square (RMS) of the centre of pressure (COP) in both the anterior-posterior and medial-lateral direction. SAS was evaluated using the Simulator Sickness Questionnaire (SSQ; Kennedy et al., 1993). Results: Preliminary results indicate that GVS does not influence COP RMS following immersion in a virtual environment. Following immersion in the driving simulator, increased COP RMS was observed in the eyes closed condition only, and was more prominent to occur on the participant’s non-dominant leg. However, this was not found to occur in all participants. A number of participants produced no observable increase in COP RMS following the driving simulation. Surprisingly, it was these latter individuals who were found to report the greatest severity of SAS symptoms. Discussion: Contrary to some published work, our results suggest that an inverse relationship exists between COP RMS and SAS symptom severity. It is possible that adaptations made to facilitate sensory integration while immersed in virtual environments have a lasting effect that results in postural instability when participants return to the real world environment (Kennedy et al., 1996).