Kinetosis, Virtually Induced Motion Disorder and Cybersickness and its Relations with the 3D Virtual Immersion

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Abstract

As a vestibular relation failure, ocular movements in association with head control, this clinical characteristic known as the virtually induced movement disease arises. It may occur by real stimuli or not and is an uncomfortable and functionally limiting condition to the affected patient. Years ago, it was only treated with drugs that reduced the vestibular system activity, now the patients may count with a range of resources that may deal, from virtual training activities to the vestibular system accommodation, relaxation techniques and even virtual reality treatments. The present study shows some differences between close clinical entities and their treatment approaches.

Keywords: Visual disorders; Vertigo; Postural instability; Three Dimensional; Environment

The vestibular system consists of bony labyrinth and internally membranous labyrinth located specifically in the temporal bone petrous part. The system functional region is located in the membranous labyrinth which is formed by semicircular canals (anterior, posterior and lateral or horizontal), the utricle and the saccule. The system functions are based on transforming the forces provoked by the head acceleration and gravity into a biological signal, inform the nervous centres on the head speed and its position in space, initiate some necessary reflexes for the gaze, head and body stabilization, which are important in balance [1,2]. The inadequacy between the vestibular, proprioceptive and visual sensory systems is commonly observed during movement or in the virtual environment, since it is something that occurs with healthy individuals, therefore, it is a physiological response when the individual is in some circumstance
where this inadequacy occurs between the above-mentioned systems, what is observed in kinetosis, and more specifically in cybersickness [3,4].

Kinetosis, according to the most accepted theory, consists of a sensory conflict between the vestibular, proprioceptive and visual systems during motion, whether real or virtual, such as occurs with individuals on trips within cars, buses, ships, or be embedded in a virtual environment in which simulation of such trips occurs [5]. This change is characterized by triggering a cascade of signs and symptoms, such as nausea, vomiting, cold sweating and pallor. The sensory conflict theory elucidates on kinetosis to be caused by the incompatibility between the perceived movement through the vision, and the signals received through the vestibular system, taking as base the previous experience of the movement [6].

Visually induced motion sickness (VIMS) is conceptualized as a Kinetosis type of a specific occurrence in the virtual environment due to the similar symptomatology and the same physiological explanation for its occurrence. Some divisions regarding different nomenclatures for VIMS types classifies as cybersickness, the VIMS in a virtual environment, VIMS during a video game, known as game illness, and simulator disease when this VIMS occurs within a simulator [7,8]. VIMS is correlated specifically to the sensory conflict occurring in the virtual environment. Its typical symptoms are related to kinetosis include drowsiness, dizziness, fatigue, pallor, cold sweat, oculomotor disorders, nausea and vomiting more rarely, so that is the same kinetosis symptomatology [9,10].

Yet, among risk factors, the physiological response due to unfamiliar stimuli that characterizes VIMS is justified, therefore, the phenomenon of adaptation and habituation occurs, since the individual who triggers this sensory conflict symptomatology, the more the individual is exposed to the triggering stimulus tends to adapt to it until the maximum extent of no longer presenting it [11]. The vestibular system is a neuro-sensory system that has characteristics of modifying its behaviour through habituation due to the suppression exerted by repetitive stimuli and dependents of neural adaptations, sensorial substitutions, functional recovery of vestibulo-ocular and vestibulo-spinal reflexes [12,13]. Therefore, age is one of the factors that influence the susceptibility to this sensory conflict, since children are more likely to have the symptomatology during virtual immersion [14].

Gender is a factor that may also influences, as men are less affected than women, and pregnancy and menstruation aggravate symptoms. Regarding the menstrual period, differences in susceptibility are observed at cycles specific periods, so that period close to menstruation and during menstruation, women become more susceptible to sensory conflict, observed in VIMS differently from what occurs in the ovulation period and in their vicinity, which is justified due to the endocrine differences of one period compared to the other [15]. Migraine individuals are also more susceptible to nausea than healthy individuals for this change because migraine is associated with vestibular disorders as well as low thresholds for vomiting, commonly causing headaches associated with nausea [16].

Studies have shown that 3D films induce the existing symptoms in cybersickness, becoming a problem for movie viewers of this type. Entertainment becomes a discomfort for those who trigger the cybersickness symptomatology [17]. In addition to the cybersickness immediate effects, other symptoms occur up to twelve hours after immersion in the virtual environment, such as visual flashbacks, disorientation, and balance disorders. A study used the pupillary movement during the accommodation to find fatigue and visual discomfort caused by 3D films. In some cases, eye blink quantification has been used to measure the eye strain that 2D and 3D videos induce. Cybersickness is reported as significantly higher after watching moving pictures compared to still images. Some researchers are trying to create visual parameters, with vergence response. These studies are important, mainly due to the relation of cybersickness with the virtual immersion [18,19].
Bibliography


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