Mitigation of motion sickness symptoms by Adaptive Perceptual Learning: Implications for space and cyber environments.

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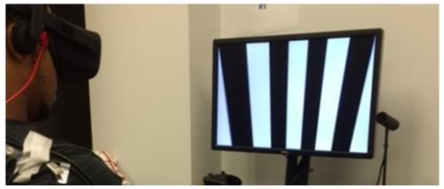
A phenomenon regarding motion sickness mitigation, documented infrequently in the scientific literature on motion countermeasures, involves pre-exposing individuals to unusual motion, resulting in reduced symptoms on subsequent exposures to similar or even dissimilar motion events. The phenomenon does not seem to have the attention that a drug free and rapidly applied technique deserves in motion mitigation.

This phenomenon was designated as Adaptive Perceptual Learning (APL) to highlight the idea that some, as yet unexplained, perceptual learning is involved in pre-adapting individuals to motion sickness. The experience of new motion environments that could greatly benefit humanity, such as space travel and cyberlearning, are hampered by symptoms of motion sickness. These environments would benefit from APL if a milder means to induce motion sickness could lessen the symptoms of another, more severe environment. We conducted a study to test APL using visually induced motion sickness (VIMS).

A VR version of the traditional B&W stripe pattern on an optokinetic –Nystagmus (OKN) drum was compared to a traditional drum for differences in SSQ symptoms. Both are shown below.

Participant wearing EOG electro-oculogram electrodes sitting in the Drum OKN device while the B&W stripes rotate around them.

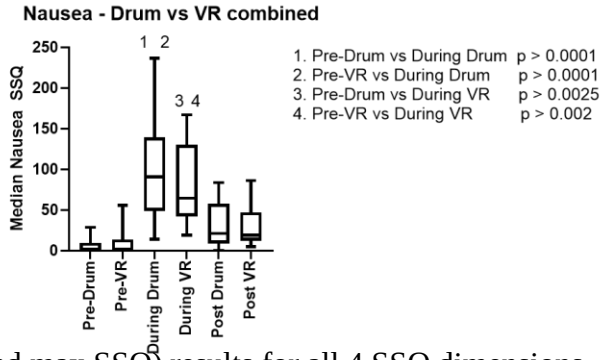


Participant wearing EOG electro-oculogram electrodes and the VR OKN head mounted display while the B&W stripes rotate around them. The image on the screen is a 2D representation of the 3D HMD.

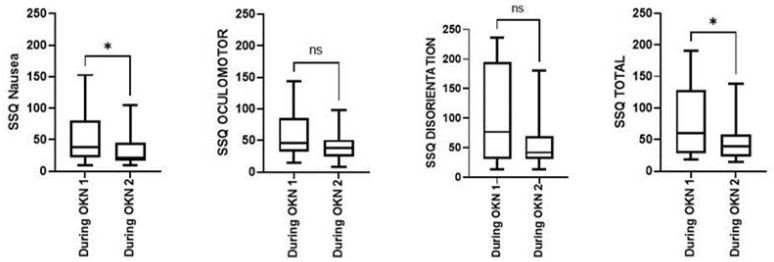
A standard test of motion sickness symptoms, called the Simulator Sickness Questionnaire (SSQ), was used. It consists of 16 symptoms that were rated by the 12 students tested in terms of degree of severity. They completed an SSQ before, during and after the exposure to the OKN devices (VR and Drum) in a counter balanced manner. Six received VR first and 6 received drum first. The second exposure was reversed, one week later.

There were no differences between VR OKN and Drum OKN but both showed significant effects compared to pre-OKN SSQ scores as shown in the figure below. There are four dimensions to the SSQ results but only those for Nausea are shown.

The procedures allowed us to compare first OKN, either VR or Drum, as the pre-exposure training of APL. The second OKN would give us an indication if APL worked (the SSQ scores should decrease on the second OKN) or not (the SSQ scores would remain the same between VR and Drum OKN.



The figure below shows box plots (median ± min and max SSQ) results for all 4 SSQ dimensions. Only the Nausea and Total dimensions that occurred during the OKN were significantly decreased ($p<0.032$) on the second OKN exposure following a one tailed, Wilcoxon matched pairs signed rank test. The other two dimensions, Disorientation and Oculomotor can be seen in the figure to be in the same direction but not significant from first OKN to second.



The SSQ results for the four dimensions of the SSQ. Box plots show median scores ± max and min scores after 30 minutes in the OKN devices the first and second time. * = $p< 0.03$

Our results showed that APL preadaptation VIMS training in both the virtual and drum OKN environments reduced SSQ scores in subsequent exposures in a clear indication of perceptual adaptation. We are currently testing if these effects can be found in a shorter delay between first and second OKN exposures. We believe these results will help mitigate cybersickness and other forms of motion sickness.