

Virtual Reality

Review on Cybersickness in Applications and Visual Displays

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VISUAL DISPLAY SYSTEM CYBERSICKNESS PUBLICATIONS

<i>Author</i>	<i>Display System</i>	<i>Duration in Minutes (Participants)</i>	<i>Item of Examination</i>	<i>Results</i>
(Rebenitsch 2015)	Multiple	24 (24)	Display	No effect of the display if the independent visual background, navigation, and field of view are considered
(Kim et al. 2014)	Multiple	40-70 (53)	Display	HMD worse than CAVE condition, and CAVE worse than desktop
(Vlad et al. 2013)	Multiple	18 (102)	Display	A stereoscopic HMD has higher cybersickness than a stereoscopic monitor
(Moss and Muth 2011)	HMD	12 (80)	Display	No peripheral vision increases symptoms
(Liu and Uang 2011)	Multiple	Less than 15 (60)	Display	HMD worse than regular monitor; No difference between stereoscopic monitor and HMD
(Keshavarz et al. 2011)	Multiple	18 (51,39,20)	Display	A large screen with the same FOV as a HMD results in more cybersickness; peripheral view increases cybersickness
(Sharples et al. 2008)	Multiple	30m(71)	Display	HMD associated with the strongest symptoms
(Villard et al. 2008)	Large screen	4, 10 min. each w/ 2 min. breaks (12)	Real vs. Virtual	Incidence and severity of symptoms in virtual room nearly identical to actual room
(Watanabe and Ujike 2008)	CAVE (4 wall)	10 (18)	Navigation	Disorientation increases with vertical navigation; no significant effect on total SSQ;
(Smart et al. 2007)	Multiple	Varied	Postural	In the moving room 23% became ill, in the simulator 43% became ill, in the projector system, 17% became ill, and 42% percent became ill in a HMD
(Young et al. 2007)	HMD	30 (30)	Questionnaire	Pretests increase post immersion SSQ scores; immersion has a significant effect

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(Duh <i>et al.</i> 2004)	HMD, Dome	Not specified (11, 9, 10)	Rotation	Frequency negatively correlated with instability whether it be screen or screen/chair combination
(Hakkinen <i>et al.</i> 2002)	HMD and Desktop	60 (60)	Display Mode Effects	Postural sway and symptoms higher for HMD stereoscopic game than HMD movie or normal movie. The difference lasted for 30 after the stimulus.
(Draper <i>et al.</i> 2001a)	HMD	30 (11) w/ FOV and (10) w/ lag	Field of View	Decrease in symptoms with correct external and internal fields of view ratio
(Jaeger and Mourant 2001)	HMD	13-23 (60)	Navigation	Walking navigation had significantly less symptoms than mouse navigation
(Lo and So 2001)	HMD	20 (16)	Rotation	Rotation increases symptoms; rotation axis does not matter
(So <i>et al.</i> 2001b)	HMD	30 (96, 12 each)	Navigation	Speed has a main effect but gets overshadowed by duration eventually
(Nichols <i>et al.</i> 2000) (second experiment)	HMD	20 (20)	Symptom Profile	Negative correlation with improving the “interface” and all subscales and total SSQ categories; no correlation with enjoyment
(Stanney <i>et al.</i> 1999)	HMD	30 (34)	Space Judgment	Significant shift error for vertical pointing location but not horizontal