Throwing vs. Walking as Indicators of Distance Perception in Real and Virtual Environments*

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In order for humans to act effectively in their environment, it is important for the visual system to determine the absolute size and distance of objects. Some measures of distance perception, characterized as visually directed walking tasks [Rieser et al. 1990; Loomis et al. 1992], indicate that humans are good at solving this problem given distances ranging from 2 to 25 meters in full-cue real-world environments. One example of this type of task is direct blind walking, in which observers walk without vision to previously viewed targets on the ground. Despite accurate behavior in the real-world, recent research in immersive virtual environments (VEs) using head-mounted displays (HMDs) has consistently found compression of distance to targets on the floor given the same blind walking tasks [Loomis and Knapp 2003; Thompson et al. in press].

A number of possible explanations for the consistent compression of distance found in VEs such as display effects, the lack of body-based scaling, and limitations in graphical realism have been tested and shown to explain little of the effect [Creem-Regehr et al. 2003; Thompson et al. in press]. The present study aimed to examine the potential influence of the response measure, rather than perceptual variables, on absolute distance perception in real and virtual environments. The standard blind walking measure used in real and virtual environment studies involves locomotion and the egocentric updating of the environment with ones own movement. We compared this measure to blind throwing, an action task that involved the initiation of a movement directed by vision, but no further interaction within the real or virtual space. Blind throwing has been shown to be accurate in the real world in several studies (e.g. [Eby and Loomis 1987]).

We used two environments (a real and virtual hallway) and two measures (throwing and walking) in a mixed between- and within-subject design. Participants judged distances of 3, 4, 5, and 6 m in either the real or virtual hallway with both blind walking and blind throwing measures. In blind throwing, participants viewed a target on the ground and then threw a bean bag while blindfolded to directly hit the target on the ground. In blind walking, they viewed the same targets and then walked while blindfolded until they determined that they were standing at the target location. Both throwing and walking measures were compressed in the VE but accurate in the real world. A 2(environment) x 2(measure) x 4(distance) ANOVA indicated that there was a significant effect of environment, in which performance was more accurate in the real world than in the VE, F(1,22) = 16.15, p < .001, but that there was no difference between the measures themselves (p = .63), see figure 1. Our results demonstrate that two different visually directed actions show similar results in real and virtual environments. The compression seen with blind walking judgments in VEs was replicated with blind throwing. These findings suggest that distance compression found in VEs may be more of a result of a general perceptual bias rather than specific to the response measure.

References


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