

Witmer, Bob G., and Michael J. Singer. "Measuring presence in virtual environments: A presence questionnaire." *Presence* 7.3 (1998): 225-240.

Presence is defined as the subjective experience of being in one place or environment, even when one is physically situated in another. Presence in a Virtual Environment(VE) depends on one's attention shifting from the physical environment to the VE but does not require the total displacement of attention from the physical locale. In fact, humans experience varying degrees of presence in a physical locale; typically attention is divided between this physical world and the mental world of memories, daydreams, and planned activities.

Involvement is a psychological state experienced as a consequence of focusing one's energy and attention on a coherent set of stimuli or meaningfully related activities and events. Immersion is a psychological state characterized by perceiving oneself to be enveloped by, included in, and interacting with an environment that provides a continuous stream of stimuli and experiences. Both involvement and immersion are necessary for experiencing presence. A valid measure of presence should address factors that influence involvement as well as those that affect immersion. Though the factors underlying involvement and immersion may differ, the levels of immersion and involvement experienced in a VE are interdependent.

Presence Questionnaire (PQ) and Immersive Tendencies Questionnaire (ITQ) were developed to measure the degrees of presence in a VE based on the factors (Control Factors, Sensory Factors, Distraction Factors, and Realism Factors) and the capability of individuals to be immersed.

Table I. *Factors Hypothesized to Contribute to a Sense of Presence*

Control Factors	Sensory Factors	Distraction Factors	Realism Factors
Degree of control	Sensory modality	Isolation	Scene realism
Immediacy of control	Environmental richness	Selective attention	Information consistent with objective world
Anticipation of events	Multimodal presentation	Interface awareness	Meaningfulness of experience
Mode of control	Consistency of multimodal information		Separation anxiety/ disorientation
Physical environment modifiability	Degree of movement perception Active search		

The PQ and ITQ use a seven-point scale format based on the semantic differential principle (each item is anchored at the ends by opposing descriptors). FOur experiments were conducted with 152 students (91 men, 61 women). Two experiments required participants to perform simple psychomotor tasks (moving through doorways, placing a virtual object in a bin using a joystick). The VEs used were visually simple. The other two experiments required participants to learn a complex route through a virtual representation of a complex office building. The VEs used were large and visually complex, requiring up to 40,000

polygons. In each experiment, the PQ scale was administered after participants had completed the experimental task.

11/12 control factors, 8/9 sensory factors, 5/7 realism factors and 4/6 distraction factors correlated significantly with the PQ total score. Scores on 23 of the 29 ITQ items were significantly correlated with the ITQ total score. Reliability analyses were performed on both questionnaires using the combined data from four VE experiments (Lampton et al., 1994; Witmer et al., 1996; Bailey & Witmer, 1994; Singer et al., 1995). Internal consistency measures of reliability (Cronbach's Alpha) for ITQ and PQ yielded reliabilities of 0.75 and 0.81 for the ITQ and PQ, respectively. The ITQ was reduced to 18 items (from 29) and the PQ was reduced to 19 items (from 32).

PQ subscales were also identified - Involved/Control (control and responsiveness of the VE to user-initiated actions & how involved the participant became), Natural (the extent to which interaction felt natural, VE consistent with reality) and Interface Quality (control devices or display devices interfere or distract from task performance). ITQ subscales - Involvement, Focus, and Games (how frequently they play video games & if they get involved to the extent they feel like they are inside the games).

The PQ subscales can be extremely helpful in quantifying social presence in our study. Interface Quality is very appropriate for our study as we can get more input about the Unity environment and how we can improve it. We can have a group of participants where some are familiar with Unity and some are completely new to Unity. The ITQ subscales can be altered or improvised to meet our performance requirements and can focus on both the performer and audience interaction and communication.