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In a virtual world, users experience compelling illusions, allowing them to become a part of an electronically generated environment. In the world of Virtual Environments, presence refers to such compelling sense of being in a computer generated environment. In spite of the importance of users' perceptual experience, however, only limited consideration has been given to the experiences users encounter when interacting with the virtual interface. This research is therefore to investigate the impact of interface design on the sense of presence. In particular, this study attempts to examine whether the degrees of presence are enhanced by navigational affordances supported by a sign system.

A controlled experiment with between-subject factorial design will be conducted to examine the effects of a sign system on users' perceptual experience. Forty participants will be asked to accomplish two sets of seven comparable tasks (total 14 tasks) with and without a help of signs. Upon completion, participants will be asked to complete a post-test questionnaire on the sense of presence on 1-to-7 Likert type scales. For the two sessions of trial, two virtual universities were constructed with ActiveWorlds (http://www.activeworlds.com). ANOVA repeated measure and correlation analysis will be used for the data analysis.

Introduction: Three Dimensional Interface Design and the Sense of Presence

In a virtual world, users experience compelling illusions, allowing them to become a part of an electronically generated environment (Biocca, 1997). According to Riva (Riva, 1999), the soul of virtual reality (VR) is a perceptual experience, which enables users to believe that they are "being there" in the virtual world. In the world of VEs, presence refers to such compelling sense of being in a computer generated environment (Biocca, 1997),

which occurs when users react as though a medium is not present due to the perceptual failure of the medium in the environment (Mania & Chalmers, 2001).

In spite of the importance of users' perceptual experience, however, only limited consideration has been given to the experiences users encounter when interacting with the virtual interface. Therefore, this is certainly an area in which much work needs to be carried out, and the main focus of this paper is to investigate the impact of interface design on the sense of presence.

Wayfinding and Sign System

Spatial movement called navigation consists of both cognitive and motor components. Cognitive part of navigation is named as wayfinding and defined as "the cognitive process of defining a path through an environment, using and acquiring spatial knowledge, aided by both natural and artificial cues" (Bowman et al., 2005, p. 227).

One possible way to support navigational affordance is to add perceptual cues, that is, to enhance perceptual affordance of an existing environment (Bowman et al., 2005). Previous research shows that a compass in combination with a map is a very effective wayfinding tool to a trained navigator such as a pilot (Bowman et al., 2005). However, in real-world situation, a sign, instead of a compass, is more extensively used to provide spatial knowledge and direction (Bowman et al., 2005). In this sense, this study attempts to examine whether the degrees of presence are enhanced by wayfinding affordances supported by signs.

Research Questions

1. What is the relationship between wayfinding affordances enhanced by signs and users' perceptual experience in terms of presence?
2. What is the relationship between the sense of presence and wayfinding task performance?
3. What are the users' personal characteristics that determine their perceptual experience?

Methodology

Forty participants will be recruited at the University of Texas at Austin and from online community websites. The research will employ a controlled experiment with between-subject factorial design.

The participants will be asked to accomplish two sets of comparable tasks in two sessions of trials with different conditions; one session in control condition (C) and another session in experimental condition (E). In the control condition, participants will perform their tasks with a support of signs whereas in experimental condition,

they will complete the tasks without signs.

For the two sessions of trial, two virtual universities (university 1 and university 2) will be built with ActiveWorlds (<http://www.activeworlds.com >). The combinations of experimental conditions and university models for the two sessions result in four different treatment groups. In four groups, the order of universities and experimental conditions will be counterbalanced.

Table 1 Experimental Design for Testing VE Wayfinding Affordances

Group (N of participants)	Session1	Session2
Group1 (10)	C, virtual university 1	E, virtual university 2
Group2 (10)	C, virtual university 2	E, virtual university 1
Group3 (10)	E, virtual university 1	C, virtual university 2
Group4 (10)	E, virtual university 2	C, virtual university 1

Participants will receive total 7 tasks on a condition. Once the 7 tasks are completed, participants will start the second session after 5 minutes break time. When participants complete all the tasks in each session, they will be asked to complete a post-test questionnaire on the sense of presence on 1-to-7 Likert type scales. The presence questionnaire has been developed based on Slater and colleagues (1998), and Witmet and Singer (1998).

Table 2 Procedures and Data Collected from Each Procedure

Procedures	Pretest(step 1)	Session1(step 2)	Posttest1(step 3)	Break(step 4)	Session2(step 5)	Posttest 2(step 6)
Collected Data	Personal Characteristics	TaskPerformance	Presence & playfulness		TaskPerformance	Presence & playfulness

The task performance will be measured with navigation duration, task completion and accuracy, and users' personal characteristics will be recorded from the pre-questionnaires asking age, gender, computer skills and previous experience with VEs.

Data Analysis

ANOVA repeated measure will be used to identify if there is difference between the control and the experimental conditions in terms of 1) the sense of presence and 2) task performance. Correlation analysis will be also conducted to examine the relationship between users' personal characteristics, the sense of presence and task performance.

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