Information Recall in VR Disability Simulation

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Abstract

The purpose of this poster is to explain our study on the effect of the sense of presence on one aspect of learning, information recall, in an immersive (vs. non-immersive) virtual reality (VR) disability simulation (DS). We hypothesized that a higher level of immersion and involvement in a VR disability simulation that leads to a high sense of presence will help the user improve information recall. We conducted a between subjects experiment in which participants were presented information about multiple sclerosis (MS) in different immersive conditions and afterwards they attempted to recall the information. The results from our study suggest that participants who were in immersive conditions were able to recall the information more effectively than the participants who experienced a non-immersive condition.

Keywords: Virtual Reality, Immersion, Presence, Learning, Information Recall, Disability Simulation

Index Terms: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems—Artificial, augmented and virtual realities

1 Introduction

The advantages of using virtual reality (VR) to facilitate teaching educational objectives are analogous in many ways to the advantages of using an interactive three dimensional (3D) computer simulation. While many studies found that the usage of VR in education is helpful [2, 3], it is not known if immersive VR technology is necessary or beneficial over 3D computer simulation for such learning-based applications. Evaluating learning in VR is a difficult problem to approach directly, especially because measurement of conceptual learning is not well defined. Rather than attempting the evaluation of conceptual learning as a whole, in this poster we investigate the impact of immersive VR displays and interfaces in an information recall task as a more achievable and quantifiable example of the learning activity. We use a disability simulator style virtual environment (VE).

Specifically, this study focuses on how presence, involvement, and flow in immersive VR disability simulation affect information recall. Presence, involvement, and flow are three common user experience factors that can be affected by immersion. The Presence-Involvement-Flow Framework (PIFF^2) [5] is a psychological research framework to study presence, involvement and flow in VR.

Educating people without disabilities using accurate information is one of the approaches used to encourage or promote the development of more positive attitudes toward people with disabilities. According to Flower et al. [1] DS is "an approach to modifying attitudes regarding people with disabilities is to place people without disabilities in situations that are designed for them to experience what it is like to have a disability".

Figure 1: Participants playing the game in three conditions (i.e. Oculus-WC, MergeVR-GP, and Desktop-WC) and their view in the VR taken at a random time.

However, it is unclear how presence, involvement, and flow affect learning. Previously, researchers have found that feeling high sense of presence greatly improves learning outcomes and participants perform better in procedural memorization task when using a highly immersive VR system [4].

In this poster, we investigate the effect of presence on information recall, using a video game like disability simulation setup. From the literature review, and also from the result of our pilot study, we hypothesize that there is a significant effect of the user's sense of presence on the user's information recall. The results in this paper show improved information recall when users feel a higher degree of presence in virtual environment (VE).

2 Virtual Multiple Sclerosis Walk

Multiple sclerosis (MS) is an incurable disease of the central nervous system that can affect the brain, spinal cord and optic nerves. People with MS often face problem in moving i.e. walking from one place to another. The National MS Society organizes many social events throughout the country. One of the most popular events is called "WalkMS". WalkMS encourages walkers to team up with

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2017 IEEE Symposium on 3D User Interfaces (3DUI)
March 18-19, 2017, Los Angeles, CA, USA
978-1-5090-6716-9/17/$31.00 © 2017 IEEE

friends, loved ones and coworkers to change the world for everyone affected by MS. Towards this goal, we built a virtual walk which serves as a disability simulation in our study.

3 User Study

We invited 35 undergraduate students to participate in our experiment. The participants experienced the virtual representation of the San Antonio AT&T center, one of the many places where actual WalkMS takes place. Participants had to navigate around the AT&T complex and listen to the information (about multiple sclerosis) presented in their path. The VE experience lasted about 30–35 minutes for each participant.

There are three conditions in our study - Wheelchair interface with Oculus (Oculus-WC), Wheelchair interface without Oculus (Desktop-WC), and MergeVR with Samsung Galaxy S4 and a gamepad interface (MergeVR-GP). Oculus-WC and MergeVR-GP are the two immersive conditions and Desktop-WC is the non-immersive condition. The participants navigate in the VE by using an actual wheelchair (in case of two WC conditions) and using a gamepad (in case of GP condition). The path of the participants contains information about Multiple Sclerosis presented as audio at several places, which are clearly marked by a sign in the VE. We chose audio as the means of presenting the information because it would add minimal cognitive load and it feels more natural in our VE to hear the information as opposed to reading text.

4 Metrics

The Multiple Sclerosis Questionnaire (MSQ) consists of 11 questions to determine how well the participants can recall the information presented in the VE. Every correct answer carries equal weight towards their MSQ score. To measure presence, involvement and flow of the participants in VE, we used PIFF^2 questionnaire which consists of 14 questions. Each question can be rated from "None" to "Severe" where "None" quantifies as 0 and "Severe" quantifies as 3 towards the calculation of scores in PIFF^2.

Pearson Correlation was used to see how the two variables were correlated i.e. presence vs information recall, involvement vs. information recall etc. We compared the MSQ and PIFF^2 data of participants for all three conditions. We used a Mixed Model ANOVA and then used one tailed Paired Sample t-tests with p values adjusted with Tukey for post hoc analysis of within group comparisons.

5 Results

We ran ANOVAs on four dimensions of PIFF^2 (i.e. presence, involvement, cognitive evaluation and emotional outcome). These four dimensions contributes to the scores to calculate subscale presence, involvement and flow. Table 1 shows descriptive statistics for PIFF^2 data. There was a statistically significant difference between groups as determined by one-way ANOVA ($F(2, 32) = 4.866$, $p = 0.014$). A Tukey post-hoc test revealed that the score was significantly higher by the participants with Oculus-WC (240.46 ± 41.06, $p = 0.022$) and MergeVR-GP (239.10 ± 20.36, $p = 0.042$) compared to the participants with Desktop-WC (203.35 ± 31.11).

In our analysis using Pearson Correlation, we found that there was a significant positive correlation between presence ($M = 11.68$ $SD = 1.62$) and information recall ($M = 220.86$ $SD = 44.90$) , $r = 0.77$, $p \leq 0.001$, $n = 35$.

6 Discussion and Conclusion

Results from the MSQ score suggest that in both Oculus-WC and MergeVR-GP conditions - which are more immersive - participants were able to recall the information more effectively than the Desktop-WC condition, which is non-immersive.

There are several potential reasons why this may have occurred. First, in both immersive conditions, the HMD gave a strong sense of presence of being "there" in VR. Secondly, this increased sense of presence may also have helped the participants to involve or focus on their VE more. We think the compelling sense of presence and the involvement in VE combinely empowered the participants to do well in their information recall task. Another reason could be the unique experience participants had in two immersive conditions where they could watch their virtual avatar on the wheelchair in VE. This unique experience may have enabled them to connect with people with MS and remember the information more easily. The feelings of being connected with the people with MS might also be true for the participants in Desktop-WC condition but they lack the sense of presence in VE which may hamper their concentration on the information presented in VE. This explains their poor result in MSQ compared to the participants in two immersive conditions.

In conclusion, the results from our study suggest that the participants in two immersive conditions were able to achieve improved information recall than the participants who used a desktop display.

Table 1: Descriptive statistics for PIFF^2

Dimensions	Oculus-WC Mean (SD)	Desktop-WC Mean (SD)	MergeVR-GP Mean (SD)	p
Presence	12.29 (1.541)	10.67 (1.557)	12.40 (1.350)	0.013
Involvement	6.57 (1.222)	5.42 (1.804)	6.80 (1.135)	0.015
Cognitive Eval^n	9.57 (1.869)	9.75 (2.527)	9.40 (1.647)	0.924
Emotional Outcome	15.21 (2.392)	12.83 (2.082)	15.30 (2.359)	0.019

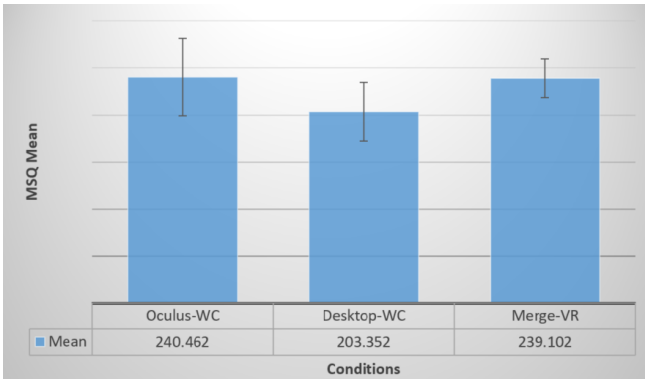

Figure 2: MSQ score comparison among participant groups.

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