The Impact of Transitions on User Experience in Virtual Reality

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ABSTRACT

In recent years, Virtual Reality (VR) applications have become widely available. An increase in popular interest raises questions about the use of the new medium for communication. While there is a wide variety of literature regarding scene transitions in films, novels and computer games, transitions in VR are not yet widely understood. As a medium that requires a high level of immersion [2], transitions are a desirable tool. This poster delineates an experiment studying the impact of transitions on user experience of presence in VR.

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

1 INTRODUCTION

Transitions are essential to most mediums. In film, transitions between each pair of cuts communicate a break in real time action to convey a change in time or place, or both, to the viewer. This possibility allows flexibility within story timeline and locations.

VR is often from a first person perspective and acts both a temporal and spatial medium [3]. As a result, transitions between scenes constitute not only a break in timeline but also a change in world experience, which can draw attention to the virtuality of the experience, and could break presence. Effective use of transitions in VR would control sense of presence, and arguably would be geared towards preservation of presence. This experiment studied the use of different transitions in VR, and their effects on people's experience within the Virtual Environment (VE). This essay focuses on the user's sense of presence in the virtual environment, as affected by the experienced realness, visibility and sensory impact of transitions in VR.

2 RELATED WORK

2.1 Transitions in Film

Transitions in film provide a rich insight into how transitions affect user experience in VR. In contemporary film, individual shots are generally very brief, and the transition between them is a simple cut. Although usually not jarringly noticeable to users, the use of cuts and of other transitions have a very distinct meaning within the effect of the shots [4]. Transitions in film can be understood as punctuation within film grammar [4]. All transitions can be divided to into two broad classes: *Hidden Transitions* and *Visible Transitions* [1]. Different transitions have different effects based on both visibility and cultural understanding, thus are used differently [1][4][6].

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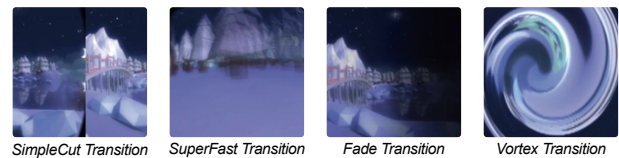Figure 1: A world made of two islands, each has a portal.

SimpleCut Transition   *SuperFast Transition*   *Fade Transition*   *Vortex Transition*

Figure 2: Four ways of transitions.

2.2 Measuring Presence

Presence can be measured both quantitatively, and qualitatively through subjective self-reporting using questionnaires. This latter is a far more common method of measuring presence [6]. The Igroup Presence Questionnaire (IPQ) was built by combining earlier published questionnaires [5]. Three factors of presence are tested in the IPQ: spatial presence, involvement and realness. Participants rate each of these factors and these ratings contribute to an overall presence score.

3 HYPOTHESES

Transitions might affect these aspects of viewer experience:

H1. Viewers' sense of presence (specifically, on its three factors: realness, involvement and spatial presence).

H2. Different levels of perceived realness and visibility.

H3. Generation of sensations in users, here, sense of touch.

4 EXPERIMENT

To explore these hypotheses, a questionnaire-based user experiment was designed. Three elements were created for the experiment: 1. Virtual Environment - A virtual world made up from two islands (Figure 1). Also modeled were two portals. 2. Transitions - Four transitions were programmed. These were *SimpleCut Transition*, *Fade Transition*, *FastMovement Transition*, and *Vortex Transition* (Figure 2). The former two are common in films. 3. Questionnaires - Participants were asked questions relating to their sense of presence before and after the transitions to measure the difference that could be attributed to the impact of the transition. As shown in the left part of Figure 3, Q1, Q2, and Q7 were adapted from the IPQ to measure the impact of transitions on presence. Q3 and Q4 were designed to answer H2, and Q5 and Q6 were set for H3.

The experiment contains two parts: Firstly, each participant roamed freely in the VE so as to adjust to VR. Secondly, the par-

No.	Descriptions
Q1	This teleportation made the virtual world become less real
Q2	This teleportation reminded me that I was in a virtual world
Q3	I have had an experience similar to this in the real world before
Q4	I had a sense of being teleported
Q5	Somehow I felt the wind
Q6	Somehow I felt being pushed or pulled
Q7	I felt I was still in that world when being teleported

	Q1			Q2			Q3			Q4			Q5			Q6			Q7		
	p	z	W	p	z	W	p	z	W	p	z	W	p	z	W	p	z	W	p	z	W
SimpleCut vs FastMovement	0.3847	-0.8692	693	0.1784	-1.3458	665.5	0.3725	-0.8918	693	0.0003	-3.5876	538.5	0.0013	-3.2267	569.5	0.0005	-3.4838	548.5	0.4027	0.8369	788.5
SimpleCut vs Fade	0.0213	-2.3027	611.5	0.2312	-1.1973	674	0.5023	0.6709	778.5	0.6118	-0.5075	713.5	0.233	-1.1926	682.5	0.7236	0	723.5	0.0684	-1.8224	639.5
SimpleCut vs Vortex	0.0239	-2.2591	614.5	0.0199	-2.329	610	0.0249	2.2424	855	0.0035	-2.9166	577	0.6892	-0.4	723	0.3457	-0.943	692.5	0.2621	-1.1214	679.5
FastMovement vs Fade	0.1045	-1.6235	649.5	0.9439	0.0703	747	0.1404	1.4743	822.5	0.0002	3.7063	954.5	0.0278	2.2008	864	0.0006	3.4253	935	0.0209	-2.31	613
FastMovement vs Votex	0.1041	-1.6251	649.5	0.3592	-0.9168	690	0.0033	2.9403	894	0.5342	0.6216	778	0.0043	2.8567	897	0.0134	2.4742	881.5	0.1177	-1.5647	656.5
Fade vs Vortex	0.8467	-0.1933	731	0.2662	-1.1119	679	0.1299	1.5147	815	0.0025	-3.0211	569.5	0.4528	0.7507	781	0.5064	-0.6644	706.5	0.8804	0.1505	751.5

Figure 3: Questionnaire (Left); Results of Wilcoxon Rank Sum Test (Note: red values are significant values where $p < 0.05$) (Right).

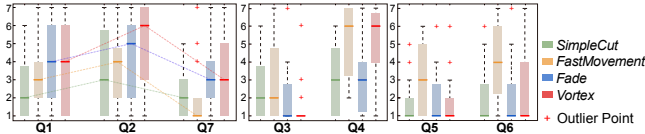Figure 4: Boxplots of the ratings of Q1 - Q7.

ticipant entered the portal and this triggered the transition. All the transitions were triggered in a random sequence to minimize the effect of habituation. After each transition, the same questions were asked orally while the participant wore the headset.

5 PARTICIPANTS

27 participants were then recruited, aged from 22-39, 12 female, 15 male, 14 reported that they had no VR experience.

6 RESULT

Boxplots were drawn (Figure 4) and Wilcoxon Rank Sum tests were run (Figure 3) to compare the transitions against each other.

In Q1 participants rated *SimpleCut Transition* significantly lower than *Fade Transition* ($W = 611.5$; $z = -2.3027$; $p = 0.0213$) and *Vortex Transition* ($W = 614.5$; $z = -2.2591$; $p = 0.0239$), showing a significant smaller impact on the realness aspect of their sense of presence. For Q2, the *SimpleCut Transition*'s rating was significantly lower than *Vortex Transition*'s ($W = 610$; $z = -2.329$; $p = 0.0199$), demonstrating a smaller impact on involvement. For Q7, *FastMovement Transition*'s rating was significantly lower than *Vortex Transition*'s, demonstrating a lower impact on spatial presence ($W = 613$; $z = -2.31$; $p = 0.0209$). The outliers in Q7 indicate *FastMovement Transition*'s impact on a few viewers' spatial presence were more negative than others.

Result of ratings for Q3 (see Figure 3) demonstrates that *Vortex Transition* ratings were significantly lower than *SimpleCut Transition* and *FastMovement Transition* (all $p < 0.05$). All median Ratings of Q3 (Figure 4) $<= 2$, showing all the four transitions share little similarities with the real world, namely low level of realness. However, the outliers in the ratings for Q3 indicate that a few participants had different opinions.

The result of Wilcoxon Rank Sum test for Q4 shows that *SimpleCut Transition* has significantly lower visibility than *FastMovement* and *Vortex* (all $p < 0.01$), but the difference between *SimpleCut* and *Fade* are not statistically significant. *Vortex Transition* has the maximum visibility among three transitions (*SimpleCut*, *Fade* and *itself*) (all $p < 0.01$). The median values in the boxplot indicate the that the *SimpleCut Transition* and *Fade Transition*'s medians (both are 3) are lower than the other two transitions' medians (both are 6), showing the former two are more invisible.

Results (Q5 and Q6 parts of Figure 3) demonstrate that viewers rated *FastMovement Transition* significantly higher than all the other three transitions (all $p < 0.01$, see Figure 3), suggesting that this transition has the biggest potential to trigger a haptic sense. However, this transition's median ratings are only 3 and 4 respectively for Q5 and Q6, see Figure 4, meaning a limited potential. Outliers illustrate that a few subjects held disagreements.

7 DISCUSSION

Result above shows some transitions affect the three factors of sense of presence differently (e.g. *SimpleCut Transition* has lower negative impact on the realness factor of presence than *Fade* and *Vortex*, and has smaller impact than *Vortex* on the involvement factor). This partially support the H1. *FastMovement* and *Vortex* are far more visible than the other two. All transitions have low level of realness and show a poor ability in triggering other sensations. Thus H2 is supported but no significant support for H3 has been found.

Based on these findings, different transitions can be selected upon different requirements:

1. The *SimpleCut Transition* is an appropriate option when a maximum consistent of presence is required, since it is more invisible and has rather limited impact on presence. For instance, hint a continuous timeline in VR storytelling;

2. When trying to break the continuity of experience (e.g. when a new chapter of a story starts in storytelling), the preference should be a more visible transition, e.g. *Vortex Transition*. .

8 CONCLUSION

We studied how the four transitions (*SimpleCut*, *FastMovement*, *Fade* and *Vortex*) differ in influencing users' sense of presence in VE and explored how they vary in realness, visibility and potential of triggering haptic sense. From our findings, we suggest two guidelines that might be used to assist the use of transitions in VR. We suggest that a *SimpleCut Transition* maximizes consistency of presence, while a more visible transition such as a *Vortex Transition* effectively breaks presence.

We would like to expand this research by experimentally studying different transitions in VR, such as a dissolve. We would also like to deepen our knowledge for each transition, by changing transition's parameters (e.g., time length) and see how these might affect user experience.

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