Can Immersive Systems Improve Creativity Performance? An Exploratory Study

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Philip Tin Yun Lee
The University of Hong Kong
phil0127@connect.hku.hk

Michael Chau
The University of Hong Kong
mchau@business.hku.hk

Abstract

Ways to support employees' performance of creativity tasks are critical of sustainable business competitiveness. Since many existing creativity software applications make use of pictures to uplift users' creativity performance, immersive systems should potentially achieve similar beneficial effects. This study adheres to several theories and concepts, including Amabile's (2011) componential theory of creativity, Csikszentmihaly's (1996) flow theory and Jansson and Smith's (1991) design fixation. The study aims to explore whether and how individual immersive VR systems can enhance creativity performance. The results of the study will shed light on the underlying mechanism through which immersive systems render impacts to individual creativity performance. A better understanding of creativity performance on individual level facilitates future exploration of how collaboration work in the immersive systems can be improved. On practical implication, it will contribute to the expanding interests in the use of immersive systems in business training contexts.

Keywords

Virtual reality, immersive systems, creativity, design fixation, priming

Introduction

Creativity has been an essential factor for the success in the business world (Amabile, 1998). Ways to support employees' performance of creativity tasks are critical of sustainable business competitiveness. Information systems can help individuals to generate more creative and novel responses, compared to pens and papers (Massetti, 1996). Studies in Information Systems (IS) have explored the use of creativity support systems in order to enhance performance of creativity tasks such as brainstorming (Elam and Mead, 1990; Marakus and Elam, 1997). A number of studies have suggested that pictorial stimuli in these systems are conducive to users' creativity performance (Malaga, 2000; Kerne et al., 2008).

Since many existing creativity software applications make use of pictures to uplift users' creativity performance, immersive systems should potentially achieve similar beneficial effects. Compared to static pictures or non-immersive systems, immersive virtual reality (VR) systems deliver stronger stimuli and present richer visual information which enhance creativity performance (Alahuhta et al., 2014, Bosch-Sijtsema & Sivunen, 2013; Rahimian & Ibrahim, 2011). Moreover, immersive VR systems provide users with immersive experience which, according to flow theory (Csikszentmihalyi, 1975) and componential theory of creativity (Amabile, 1997), enhances engagement and creativity. Several studies have explored the positive effects of immersive systems. However, the majority of these studies focused on collaborative performance of groups in the virtual environment (e.g. Bhagwatwar et al., 2017; Kohler et al., 2011). Few studies have examined individual performance.

This study adheres to several theories and concepts, including Amabile's (2011) componential theory of creativity, Csikszentmihaly's (1996) flow theory and Jansson and Smith's (1991) design fixation. The study aims to explore whether and how individual immersive VR systems can enhance creativity performance. On the bright side, immersive systems generate users' immersion and enjoyment which lead to stronger motivation and better performance of creativity tasks (Amabile, 2011; Csikszentmihaly, 1996). On the dark side, users may be obsessed to ideas attached to immersive stimuli. The attachment may limit output

quality of creative ideas (Jansson & Smith, 1991; Youmans, 2011). Two dimensions are therefore used to measure creativity performance: the breadth of ideas and the depth of ideas. By the breadth of ideas, it refers to the number of topics generated. By the depth of ideas, it means the persistence made in each topic. It is measured by the average number of ideas in each topic (Bhagwatwar et al., 2017; De Dreu et al., 2008; Nijstad et al., 2010). The results of the study will shed light on the underlying mechanism through which immersive systems render impacts to individual creativity performance. A better understanding of creativity performance on individual level facilitates future exploration of how collaboration work in the immersive systems can be improved. On practical implication, it will contribute to the expanding interests in the use of immersive systems in business contexts. The affordability of immersive system instruments offers an economical way to improve workers' creativity performance.

Theoretical Background and Hypotheses

Design Fixation

Design fixation is defined as "a blind adherence to a set of concepts limiting the output of conceptual design" (Jansson & Smith, 1991, p.3). It is "an obstacle, often self-imposed by the problem-solver, which blocks successful completion of a problem" (p.4). Compared to long-term functional fixedness (Maier, 1931), design fixation is induced by situations (Luchins & Luchins, 1959). When a possible solution is shown to problem solvers, design fixation may occur and inhibit the problem solvers from thinking to concepts that are not shown in the solution. Some studies in IS have indicated the possible inhibiting effect of prior examples (e.g. Cheung et al., 2008). Thus, in this study, the creativity performance is measured by two dimensions, namely the breadth of ideas and the depth of ideas. Particularly, the former one emphasizes on the inhibiting effect of design fixation. If the effect of design fixation is strong, the breadth of ideas should be low.

Componential Theory of Creativity

The Componential Theory of Creativity, proposed by Amabile (1997), sheds light on the drivers of individual creativity. The theory assumes that every reasonable person should be able to achieve some creative work in somewhere and at sometime. According to the theory, three main components of individuals, namely expertise, creative-thinking skill and intrinsic task motivation, are necessary for creativity. Expertise and creative-thinking skill determine the creativity ability of an individual, whereas intrinsic task motivation determines the intention of an individual on a particular creativity task. Amabile (1997) further argued that strong intrinsic motivation sometime can compensate a deficiency of creativity ability. The environment can help foster intrinsic motivation of an individual. Thus, we hypothesized that:

H1 (a): People who have stronger task motivation will perform better in the breath of ideas.

H1 (b): People who have stronger task motivation will perform better in the depth of ideas.

Flow Theory

Various studies have demonstrated that flow experience fosters individuals' motivation in activities (Csikszentmihalyi, 1975). However, there is apparently no strong consensus on the full set of well-defined constructs of flow experience (Koufaris, 2002; Agarwal & Karahanna, 2000). Some researchers considered immersion and enjoyment as the most consistent and common constructs to measure flow experience among the relevant studies (Zaman et al., 2010). In the context of creativity, Csikszentmihaly (1996) further noted that the work of creativity starts with a period of preparation when people get immersed into problem sets. The immersion into the problem sets then leads to flow experience and strengthens intrinsic motivation in creatively solving the problem sets.

Immersive systems immerse users into the virtual environment. Users can observe the surroundings in the virtual environment as if they did in the real environment, and can acquire relevant information from the surroundings for creativity problem solving. Empirical studies have showed that immersive systems provide users with more persistent immersive experiences than traditional creativity support systems (e.g. Koutsabasis et al., 2012; Suh & Lee, 2005). Therefore, we posited that:

H2: People who have higher immersion will have stronger task motivation.

H3 (a): Immersive systems lead to stronger users' immersion, compared to non-immersive systems.

The flow theory suggested that enjoyable flow experience leads to stronger intrinsic motivation (Csikszentmihaly, 1996). Also, enjoyment derived from solving creativity task can lead to stronger intrinsic motivation (Amabile, 1988; Lepper et al. 1973; Deci 1971). The experience of immersive systems is of fun and enjoyment. Experience of immersive systems may render users recall past fun game-play experience (Grove & Williams, 1998). Some studies also showed that fun is generated by a virtual learning environment (Lau & Lee, 2015). Thus, we posited that:

H4: People who have higher enjoyment will have stronger task motivation.

H3 (b): Immersive systems lead to stronger users' enjoyment, compared to non-immersive systems.

Priming

Priming is defined as "the incidental activation of knowledge structures, such as trait concepts and stereotypes, by the current situational context" (Bargh et al., 1996, p. 230). The presence of an image is adequate to render priming effects. Bhagwatwar et al. (2017) suggested that priming effects of three-dimensional subjects in the virtual environment enhances group performance of creativity. Task absorption and target concept activation mediate the priming effect in the virtual environment. Their items measuring task absorption shared high similarity with immersion and enjoyment. Target concept activation, on the other hand, leads to our suspicion of unintended effect of design fixation. The presence of the objects activates concepts in long-term memory and stimulates brainstorming, on one hand. The presence may inhibit people from thinking of solutions out of the concepts shown by the objects, on the other. We expect that a stronger immersion into the environment render a stronger priming effect. Yet, the priming effect should not affect the depth of ideas. We therefore posited that:

H5: The priming effect of immersive systems on breadth of ideas is mediated by immersion.

The proposed research model is as follows:

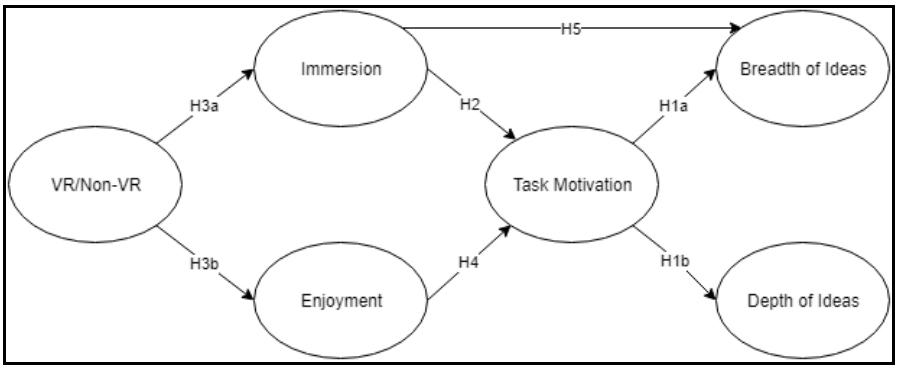

Figure 1: Research Model

Experimental Design and Methods

Two hundred undergraduate students will be recruited to participate in the experimental study. They will receive monetary rewards after the study. Adapted from Dennis et al. (2013), the creativity task in the study is related to tourism promotion. Participants will be divided randomly into two groups. One group will use VR headsets to perform the task, whereas another group will use typical desktop computers to complete the task. The participants will first receive a document which describes a hypothetical scenario about tourism promotion. The description is as follows: People have been looking forward to trips to outer-space planets. Thanks to the technological advancement, the ticket costs to those planets now become more affordable. As a marketing officer in a travel agency which is specialized in outer-space tourism, you want to propose activities in which travelers can engage during the trips to the outer space. These activities should be as creative as possible. If not, customers can simply stay on the Earth.

A 360 (~2 minutes) video of the scenic landscapes of the Planet K will then be shown to the participants via VR headsets or typical screens of desktop computers. Following Dennis et al. (2013), the participants

will have 15 minutes to finish the creativity task. After the participants submit their work, they will be required to fill out questionnaires which measure their immersion, enjoyment, task motivation, and some other control variables such as their creative self-efficacy and ease of use. Questions are adapted from Agarwal and Karahanna (2000), Amabile (1983), Tierney and Farmer (2002) and Hender et al. (2002).

Since we aim not to validate the model but to explore the relationships among these constructs, the mediation effects will be analyzed by PLS-SEM (partial least squares structural equation modeling) approach (Hair, et al., 2017; Nitzi et al., 2016). Given the use of immersive systems (the construct) is observable and represented by a single item (i.e. whether participants use VR headsets = 1; otherwise = 0), the binary item of the use of immersive systems is equivalent to a theoretically meaningful variable. The use of the binary variable is reasonable (Bodoff & Ho, 2016). Three criteria, namely the sample size, the convergent validity and the discriminant validity, will be checked to justify the use of PLS-SEM.

Discussion and Limitations

There are several limitations of our study. First, the effect we observe will be short-term. Longitudinal study should be conducted to demonstrate the long-term effect. Moreover, immersive systems involve not only visual stimuli but also sound stimuli. Sound stimuli may affect telepresence which was shown to have strong correlation with immersion (Jelfs & Whitelock, 2000).

More recent papers, perhaps due to the emergence of the Internet, examined creativity support systems in the context of groups. This study shifts the focus back to the individual use of information systems. Many empirical studies have shown the positive impacts of immersive systems to creativity performance on group levels. If the effect of design fixation is found, this implies that group brainstorming may have a moderating effect on the relationship between immersive systems and creativity performance. The moderating effect will encourage further examination of how the reduction of design fixation on the individual level can facilitate creativity performance on the group level in immersive systems.

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