

Exploring the Effects of Display Characteristics on Presence and Emotional Responses of Game Players

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ABSTRACT

Large displays are becoming ubiquitous and one important property of large displays is that they afford larger visual angles and physically larger screen sizes. However, there has been little investigation of the effects of large displays on users; furthermore, few studies have employed physiological measures, nor isolated the effects on presence and emotional responses of large visual angle and physically large screen size. This study, then, examines specifically the effects of these two properties of large displays on presence and emotional responses, using physiological as well as subjective methods. The results indicate that the larger visual angle offered by a large display can increase the sense of presence, engagement, and emotional responses when players are playing games. More interestingly, the physically larger sizes offered by a large display seem to also be able to affect these player experiences, even at identical visual angles with small displays.

Keywords: Large Display, Physical Screen Size, Physiological Measures, User Experience, Visual Angle

INTRODUCTION

Recent advances in technology have made large displays ever more ubiquitous. There are various areas in which the use of a large display can be appealing or even critical, such as visual surveillance, air traffic control, design, visual

analytics, presentations, collaboration work, and entertainment. Large displays possess two unique and potentially important properties: larger visual angle and physically larger screen size. However, the two characteristics of large displays are often ignored by HCI (human-computer interaction) researchers. Research on user response to media information is usually performed using screens of average size; the results are then generalized, perhaps

DOI: 10.4018/jthi.2013010104

unwittingly, to all screen sizes. This neglects the important possibility that different display characteristics may significantly affect the psychological importance of the information displayed (Ravaja, Turpeinen, Saari, Puttonen, & Keltikangas-Jarvinen, 2008). Also, interaction design philosophies based on average screen size uniformly applied to newer displays may also lead to unintended consequences because screen size could augment or diminish expected effects (Ravaja et al., 2008). Recent studies (e.g., Detenber & Reeves, 1996; Elliott & Hearst, 2002; Mary et al., 2006; Tan, Gergle, Scupelli, & Pausch, 2006; Tan, Gergle, Scupelli, & Pausch, 2004) have already begun to isolate certain interesting characteristics of large display, but most of them have assumed that larger display fill a greater percentage of the viewer's visual field, and physical size is often confused with visual angle. In fact, although researchers have studied the effects of display characteristics such as visual angle, resolution, brightness, contrast and color, little has been done to systematically isolate the effects of physical sizes and visual angles on user experiences.

The long-term goal of our research aims to isolate and study characteristics unique to large displays so that we form a theoretical basis for understanding how different display characteristics affect user experience. We believe that taking a bottom-up approach and understanding each of these fundamental characteristics in isolation rather than taking a top-down approach and studying how one display technology differs from another will be much more productive in the long term. Such an approach will allow us to build a general theory that explains effects induced by various display technologies simply by recombining our understanding of display characteristics and then studying their specific interactions (Tan, 2004).

The present study focuses specifically on game players; their presence, engagement, perceived challenge, emotional arousal, and emotional valence are measured. Based on previous empirical studies and theory from

psychophysiology, we evaluate the following two main experimental hypotheses using subjective and physiological measures:

- H1:** Larger visual angles offered by large displays will induce greater presence, engagement, emotional arousal, and emotional valence as compared to small displays when game players are playing a 3-D game.
- H2:** Physically larger screen size offered by large displays will induce greater presence, engagement, emotional arousal, and emotional valence, even at identical visual angles with small displays, when game players are playing a 3-D game.

RELATED WORK

Effects of Large Display on Users

Robertson et al. (Robertson et al., 2005) document a series of user studies demonstrating productivity benefits from using large displays with an eye toward novel software applications that might better support the way information workers multitask between their projects and applications. These studies showed a significant performance benefit as well as a satisfaction preference for large displays.

In addition to productivity benefits, Czerwinski et al. (Czerwinski et al., 2003) also document results showing that larger displays lead to improved recognition memory and peripheral awareness. Tan et al. (Tan, Czerwinski, & Robertson, 2003) reported a series of studies demonstrating the advantages of large displays on 3D navigation in virtual worlds. They suggested that while large displays increase performance for all users on average, females improved so much that the normal advantage male users have over females in virtual 3D navigation disappears when using large displays. These studies revealed that the wider fields of view provided by large displays lead to increased ability to process optical flow cues

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