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ABSTRACT

We examine gender differences in 2D versus 3D media perceptions. Using the Hunter-Gatherer Theory of Spatial Gender Differences and Jung's Theory of Psychological Types, we hypothesize differences in men's and women's perceptions of skill, challenge, telepresence, and satisfaction with online experiences in 2D versus 3D media interaction. The findings suggest that even though women perceive lower skill levels and greater challenges in using 2D and 3D media than men, women's sense of telepresence is higher than men in both 2D and 3D media. Women are also more satisfied with their interaction in 2D and 3D media than men.

Keywords

Gender differences, media, virtual worlds, skill, challenge, telepresence, satisfaction

INTRODUCTION

The impact of gender differences has been widely acknowledged in the MIS literature (e.g., Gefen and Straub, 1997; Hubona and Shirah, 2006; Nicovich et al., 2005). However, what is not clear is how men and women may differ in their perceptions of 2D versus 3D media. Considering the nature of the 3D environment, gender differences may exist in comparison to a 2D environment. However, we did not find any prior studies in the MIS literature that have examined or studied such differences between 2D and 3D environments.

Therefore, our research question is: Do men and women perceive 2D and 3D environments differently?

BACKGROUND

Evolutionary psychology argues that early gender roles have affected the development of men and women, which has led to gender differences in many contexts, including differences in perceptions, preferences, and performance. Various theories have been used to explain such differences. One such theory is Hunter-Gatherer Theory of Spatial Gender Differences, which focuses on the characteristics of men and women in prehistoric times. The theory suggests that these characteristics are an outcome of evolution which arises from a clear division of labor and differentiated roles that occurred (Silverman and Eals, 1992). More specifically, the theory suggests that men possess greater spatial and cognitive abilities to aid in hunting, whereas women have better emotional and perceptual abilities to aid in gathering food and raising children.

Linn and Petersen (1985) conducted a meta-analysis to examine gender differences in spatial abilities. They found large gender differences in spatial abilities favoring men, small gender differences in spatial perception favoring men, and no difference in spatial visualization between men and women. Hyde's (1981) meta-analysis of gender differences in mental abilities also suggests a slight advantage for boys in spatial abilities.

Another theory that has identified differences between men and women is Jung's Theory of Psychological Types (Jung, 1971). One aspect of this theory, the thinking-feeling index, indicates that a person's preference for making judgments can range from one end that is primarily driven by thinking or the basis of logical consequences to the opposing end that is primarily driven by feelings or the basis of personal or social values. Research findings suggest that men are more utilitarian or driven by thinking whereas women are more affective or driven by feelings (Seegmiller and Epperson, 1987; Woehlke and Piper, 1980).

Gender differences have also been recognized and acknowledged as important considerations for the design of user interfaces (Hubona and Shirah, 2006). Differences in perceptions and preferences can also produce different user experiences and outcomes in human-computer interaction (Lockheed, 1985; Shneiderman, 2000). Nicovich et al. (2005) argue that women are better at using low richness communication systems, such as e-mail, and that women are able to feel presence more easily than men.

THEORETICAL FOUNDATION

We draw upon Hunter-Gatherer Theory of Spatial Gender Differences and Jung's Theory of Psychological Types on Gender Differences to hypothesize gender differences in 2D versus 3D media perceptions. Hunter-Gatherer Theory is based on the paradigm of evolutionary psychology (Tooby and Cosmides, 1992) that males functioned primarily as hunters and females as gatherers of plant food (Eals and Silverman, 1994; Silverman and Eals, 1992; Silverman et al., 2007). Hence, from an evolutionary perspective, males possess stronger spatial skills to increase their abilities to hunt while females possess peripheral perceptual abilities and incidental location memories to forage (Jardin and Martin, 1983; Silverman and Eals, 1992). Jung's Theory of Psychological Types on Gender Differences is also based on evolutionary psychology where males in pre-historic times had to apply and rely heavily on rules of logic to hunt while females took care of the young by displaying their affections and empathy. The thinking-feeling (T-F) index remains relevant in explaining gender differences.

Hunter-Gatherer Theory of Spatial Gender Differences predicts that men will be better at hunting adaptation abilities, such as 3D navigational abilities and mental rotations. Meta-analyses by Linn and Petersen (1985) and Voyer et al. (1995) also indicate large differences in spatial abilities between men and women. Since men have higher spatial abilities than women (Chen et al., 2008; Geary and DeSoto, 2001; Stumpf and Elliot, 1995), we expect women to perceive relatively lower skill levels and higher challenges than men when navigating in 3D media than 2D media.

H1: Women will self-report lower skill levels than men in 3D than 2D media.

H2: Women will self-report higher challenge faced than men in 3D than 2D media.

Hunter-Gatherer Theory of Spatial Gender Differences suggests that males prefer to use cardinal directions and orientations in navigation whereas female rely on relative directions (e.g., left, right) and landmarks (Dabbs et al., 1998; Lawton, 1994, 1996; Lawton & Kallai, 2002; Moffat et al., 1998; Schmitz, 1997, Silverman et al., 2007). In other words, men tend to use an orientation strategy, whereas women tend to use a route strategy (Lawton, 1996). Hence, when applying these gender differences to the computer-mediated environment, the 3D media which apply a spatial orientation approach to navigation are perceived to be more conforming to the natural inclinations of men than women. However, the 2D media, which offer a more route-oriented approach to navigation, are perceived as being more conforming to the natural inclinations of women than men. Hence, we expect men and women to perceive different levels of presence in 2D and 3D environments.

The experience or sense of presence in computer-mediated environment is referred to as telepresence (Steuer, 1992). Given the preferred strategies of men and women, we expect women to perceive higher telepresence than men in a 2D medium and men to perceive higher telepresence than women in a 3D medium. For example, Gefen and Straub (1997) and Nicovich et al. (2005) found that women felt more social presence than men when using e-mail. Savicki and Kelley (2000) found that female dyads were able to feel more social presence in computer-mediated communication than male dyads. Waller, Hunt, and Knapp (1998) suggest that the transfer of spatial knowledge to the 3D virtual environment is responsible for males outperforming females in computer-generated environments, thus suggesting that men are able to achieve higher levels of telepresence than women in the 3D virtual environment. Thus, we hypothesize an interaction effect of gender and media type (i.e., 2D versus 3D) on telepresence.

H3: There will be an interaction effect of gender and media type on telepresence.

Jung's Theory of Psychological Types on Gender Differences suggests that women are more affective and exhibit higher empathy than men. Hence, we expect women to exhibit higher satisfaction with media interaction than men. However, we expect such gender differences to be greater in the 2D than 3D environment due to their different levels of cognitive demands on the users. In other words, according to Hunter-Gatherer theory, men exhibit higher spatial abilities than women. Since the 3D environment is expected to be cognitively more demanding to navigate than the 2D environment, women may face greater challenge in navigating in the 3D environment, thus reducing their heightened satisfaction with 3D media as compared to 2D media. Thus, we hypothesize the following:

H4: There will be an interaction effect of gender and media type on satisfaction with media interaction.

RESEARCH METHODOLOGY

A between-subject experimental design was used to compare gender differences in media perceptions of 2D versus 3D environment, where each subject experienced only one type of environment, either 2D or 3D. The virtual world environment has emerged as a powerful 3D environment. To test our hypotheses, we used a state-of-the-art 3D site called Palomar West Hospital in Second Life (i.e., http://slurl.com/secondlife/PalomarWest%20 Hospital/33/127/34/) to operationalize the 3D medium where visitors to the site follow a standard tour to enjoy an immersive 3D experience of the facilities. We developed a 2D informational equivalent site by capturing snapshots of the entire 3D tour as well as the audio clips that go along with them to produce a user-controlled audio slideshow in 2D.

Subjects and Research Procedures

The subjects were business undergraduate students who were enrolled in MIS classes in a large Midwestern university. The subjects carried out the experiment in a university computer lab. First, they filled out a pre-study questionnaire to capture their demographic information. Next, they were given a short training session on the system. After the training session, they were asked to complete a tour of the site facilities. After completing the tour, subjects filled out a post-study questionnaire regarding their experiences (i.e., perceived skill, perceived challenge, telepresence, and satisfaction with experience).

Measurement

The dependent variables are perceived skill, perceived challenge, telepresence, and satisfaction with online experience. Perceived skill was assessed using three items from Skadberg and Kimmel (2004), whereas perceived challenge was measured using two items from Novak et al. (2000). Perceived telepresence was assessed using four items from Kim and Biocca (1997) and Klein (2003). Satisfaction with online experience was measured using five items from McKinney et al. (2002). Perceived skill, challenge, and telepresence were assessed on a seven-point Likert scale, with 1 being Strongly Disagree and 7 being Strongly Agree. Satisfaction with online experience was measured on a seven-point semantic differential scale.

DATA ANALYSIS

The sample size was 481, with 307 subjects assigned to the 3D medium and 174 subjects to the 2D medium. The demographics of the subjects are shown in Table 1.

Gender	
Male	295 (61.3%)
Female	185 (38.5%)
Unknown (not provided by respondent)	1 (0.2%)
Age	
19-25	435 (90.4%)
26-35	33 (6.9%)
36-45	7 (1.5%)
Over 45	0 (0.0%)
Unknown (not provided by respondent)	6 (1.2%)

Table 1. Demographic Information of Subjects

Using SPSS 17.0, factor analysis and reliability analysis were performed on the dependent variables: Skills, Challenge, Telepresence, and Satisfaction. All items load onto their own factor with a loading of at least .73. Convergent and discriminant validity is supported. Cronbach's Alpha coefficients are: 0.85 for (Perceived) Skills, 0.88 for (Perceived) Challenge, 0.88 for Telepresence, and 0.96 for Satisfaction.

Table 2 shows the means for perceived skills. Table 3 shows the ANOVA results for perceived skills. H1 hypothesizes that women perceive relatively lower skill levels than men in 3D than 2D media. As presented in Table 3, H1 is not supported (p=0.160). The results show a universal main effect where women perceive lower skills levels than men in both 2D and 3D media.

	2D	3D	Gender Means
Female	4.21	4.13	4.16
Male	4.42	4.66	4.57
Medium Means	4.33	4.46	

Table 2. Means for Perceived Skills

Effect	p-value	Significant?
Main effect – Female/Male	.001	Yes
Main effect – 2D/3D	.465	No
Interaction	.160	No

Table 3. Results of ANOVA for Skills

Table 4 shows the means for perceived challenge. Table 5 shows the ANOVA results for perceived challenge. H2 hypothesizes that women perceive relatively higher challenge than men in 3D than 2D media. As presented in Table 6, H2 is not supported (p=0.182). The results show a universal main effect where women perceive higher challenge than men in both 2D and 3D media, and 3D is a more challenging environment than 2D for both men and women.

	2D	3D	Gender Means
Female	2.81	3.70	3.36
Male	2.40	2.97	2.77
Medium Means	2.57	3.24	

Table 4. Means for Perceived Challenge

Effect	p-value	Significant?
Main effect – Female/Male	.000	Yes
Main effect – 2D/3D	.000	Yes
Interaction	.182	No

Table 5. Results of ANOVA for Challenge

Table 6 shows the means for telepresence. Table 7 shows the ANOVA results for telepresence. H3 hypothesizes an interaction effect of gender and medium on telepresence. As presented in Table 7, the interaction effect, H3, is not supported (p=0.255). The main effects are significant where women perceive higher telepresence than men in both 2D and 3D media. In addition, users perceive higher telepresence in 3D than 2D media.

	2D	3D	Gender Means
Female	3.40	3.79	3.64
Male	2.89	3.58	3.34
Medium Means	3.10	3.66	

Table 6. Means for Telepresence

Effect	p-value	Significant?
Main effect – Female/Male	.007	Yes
Main effect – 2D/3D	.000	Yes
Interaction	.255	No

Table 7. Results of ANOVA for Telepresence

Table 8 shows the means for satisfaction with online experience. Table 9 shows the ANOVA results. H4 hypothesizes an interaction effect of gender and medium on satisfaction with online experience. As presented in Table 9, H4 is not supported (p=0.620). The results show a universal main effect where women perceive higher satisfaction with online experience than men in both 2D and 3D media, and 3D produces more satisfied user experience than 2D.

	2D	3D	Gender Means
Female	4.03	4.77	4.48
Male	3.70	4.57	4.26
Medium Means	3.83	4.64	

Table 8. Means for Satisfaction with Online Experience

Effect	p-value	Significant?
Main effect – 2D/3D	.000	Yes
Main effect – Female/Male	.046	Yes
Interaction	.620	No

Table 9. Results of ANOVA for Satisfaction with Online Experience

CONCLUSION

The results are very interesting. Based on Hunter-Gatherer theory of Gender Spatial Differences and Jung's Theory of Psychological Types on Gender Differences, we hypothesize interaction effects between gender and media types (2D versus 3D) on users' perceptions of skill, challenge, telepresence, and satisfaction with online experience. Even though none of the hypothesized interaction effects are present, we found universal main effects of gender across all four dependent variables – skill, challenge, telepresence, and satisfaction with online experience. The results suggest that neither 3D nor 2D offers an advantage to one gender over another.

Instead, such gender differences are universal across 2D and 3D media. Hence, Hunter-Gatherer Theory of Gender Spatial Differences can be used to explain differences in perceived skill and challenge across genders although it may not be applicable for predicting gender differences in media perceptions. Instead, Jung's Theory of Psychological Types is more appropriate for predicting gender differences in media perceptions. Because Jung's theory suggests that females have higher 'feeling' or 'emotional' personality than males, females exhibit higher perceptions such as telepresence and satisfaction than males in 2D and 3D environments.

This research has shown that there are gender differences with respect to skill, challenge, telepresence, and satisfaction of media experience. By building on this

study in future research, academics can further the work in identifying sources of gender biases and develop cognitive or design strategies to overcome these biases.

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