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Ways of Seeing Matter: The Impact of a Naturally Mapped Perceptual System on the Persuasive Effects of Immersive Virtual Reality Advertising

Dai-Yun Wu & Jih-Hsuan Tammy Lin

This study examines whether the naturalness of a device's perceptual system, which defines the way users look around in the virtual environment, influences the persuasive effects of immersive virtual reality (IVR) advertising. In a between-subject experiment (N = 115), participants watched a 360-degree advertisement using one of three devices with different perceptual systems (a head-mounted display [HMD], a tablet, or a desktop computer, representing high, medium, and low naturalness respectively). The results revealed that participants who watched IVR advertising using a more naturally mapped perceptual interface (i.e., an HMD) reported higher levels of perceived naturalness than did those who used devices lower in naturalness (i.e., a tablet or a desktop computer). The use of a perceptual system with a higher level of natural mapping positively affected the sense of presence, which in turn enhanced advertising enjoyment and further improved the effects of IVR advertising, thereby yielding a three-step serial mediation model.

Keywords: *Enjoyment; Immersive Virtual Reality; Natural Mapping; Persuasive Effect; Presence*

With immersive virtual reality (IVR) technology becoming increasingly more accessible in recent years, various virtual reality head-mounted displays (HMDs), such as

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the HTC VIVE and Oculus Rift, are now available at affordable prices. Meanwhile, video-sharing websites such as YouTube and Facebook have successively launched support for 360-degree videos, thereby allowing users to enjoy immersive videos on their personal devices. Combined with 360-degree videos, IVR technology can virtually teleport users to a different location and enable them to explore the environment as if they are actually present. This technology offers new opportunities for brands to engage consumers through immersive and entertaining experiences.

Although the application of IVR technology in marketing seems promising, studies that compare the effectiveness of video advertising provided by highly IVR devices such as HMDs and other devices are relatively rare. Thus, the actual effects of this technology on persuasion and the underlying mechanism are unclear. A key feature of the highly IVR system is its kinesiic natural mapping system. *Natural mapping* generally refers to the ability of a system to map the user's actions to changes in the mediated environment in a natural and predictable way (Steuer, 1992). Although studies have examined the influence of controller naturalness on gaming experiences (McGloin, Farrar, & Krcmar, 2011; Skalski, Tamborini, Shelton, Buncher, & Lindmark, 2011), few studies have explored natural mapping in terms of advertising effects because traditional video advertisements are rarely interactive. In IVR advertising, however, audiences can choose where to look while watching 360-degree advertisements. The perceptual system of the medium, defined here as the interface that supports the visual perception and actions used to control visual perspective, might affect the viewing experience. Therefore, how naturally audiences can control their point of view should be considered when attempting to ascertain the effectiveness of IVR advertising. Accordingly, this study examines how a naturally mapped perceptual system might influence audience responses to IVR advertising and the persuasive outcomes.

The Naturalness of the Perceptual System in IVR Devices

Unlike playing video games, watching 360-degree videos does not involve complicated actions; it simply requires audiences to “watch” the content, and the only interaction involves controlling viewing directions. Therefore, in IVR advertising, the sensorimotor contingencies (SCs)—the actions that we carry out to perceive (Slater, 2009)—supported by a perceptual system determine how audiences visually perceive in the virtual environment.

How closely the SCs in the virtual environment match the SCs used in the real world determines the naturalness of the perceptual system (Tamborini & Bowman, 2010). Thus, the perceived naturalness might vary with the perceptual systems of the devices used to watch 360-degree videos. On a desktop computer, users must click and drag the video with a mouse to change the viewing angle. This type of perceptual system represents a basic form of natural mapping (Skalski et al., 2011). The use of a mobile device allows users to look around by moving the device, an action that corresponds to real life movement. Therefore, users feel more natural using this

system than they do using a desktop system. Nonetheless, users are required to hold and pan the device, and the presence of the object in the hands might weaken the perceived naturalness to some extent (Shafer, Carbonara, & Popova, 2014). With head-tracking systems, HMDs integrate the displays and the controllers, thus ensuring that the images change according to the orientation of the user's head. When a user turns his head, he can see things behind him as he does in physical reality without tangible controllers. The SCs approximate the actions in real life and therefore will feel more natural than those of other perceptual systems (Skalski et al., 2011; Slater, 2009). Accordingly, we expect that users who watch IVR advertisements with an HMD experience a higher level of perceived naturalness than users who watch IVR advertisements with other mapping systems (H1).

Natural Mapping, Presence, and IVR Advertising Enjoyment

Research has indicated that advertising avoidance behaviors will decrease if the audience perceives an advertisement as fun, enjoyable, and pleasurable to watch (Chang, 2014). Thus, enhancing advertising enjoyment, the pleasurable response to advertising exposure, has been deemed a significant strategy for capturing audiences' attention and optimizing advertising effectiveness (Madden & Weinberger, 1982). This consideration should also apply to gauging the effectiveness of IVR advertising.

A system supporting SCs that approximate those of physical reality can induce a strong illusion of being physically located within the virtual environment, which is referred to as *presence* or *spatial presence* (Slater, 2009; Wirth et al., 2007). This illusion occurs because the actions users take in the virtual environment match users' mental representations of how they would expect to experience it in real life (McGloin, Farrar, & Fishlock, 2015; McGloin, Farrar, & Krcmar, 2013; Wirth et al., 2007). Thus, these actions increase the probability that users will perceive themselves as located in the virtual environment and positively contribute to the sense of presence (Shafer et al., 2014). Namely, a highly natural mapped perceptual system simulating SCs in real life should result in a higher level of presence.

Furthermore, presence should cause users to feel the experience as it occurs, resulting in responses similar to those in a direct experience and accordingly in more physical arousal and greater enjoyment (McGloin et al., 2013). Consequently, we hypothesize that greater perceived natural mapping of a system will have a positive and indirect influence on advertising enjoyment because it enhances the sense of presence (H2).

Impacts of Natural Mapping on IVR Advertising Effectiveness

The relationship between presence and entertainment has been well documented (Hartmann, Klimmt, & Vorderer, 2010). Based on dual processing theory and the feeling-as-information model, people in a positive mood lack the motivation to process persuasive messages critically and tend to think and act in an open way

(Turner, 2010). Hence, advertising enjoyment plays the greatest role in accounting for audiences' attitudes toward an advertisement (Shavitt, Lowrey, & Haefner, 1998). Moreover, audiences' cognitive responses to the persuasive message will mirror the valence of their emotional state (Bower, 1981). Advertising enjoyment enhanced by the level of presence will put the audience in a positive mood and encourage them to evaluate the advertisement and brand positively (Owolabi, 2009). The favorable brand attitude will further increase purchase intention (Shimp, 1981).

Consumer sharing behavior is another important indicator of advertising effectiveness because it helps advertising content reach more potential consumers effectively. Previous studies indicate that the entertainment value of content positively predicts audiences' sharing intentions (Taylor, Strutton, & Thompson, 2012). Accordingly, we expect that the level of presence has a positive, indirect effect on (a) attitude toward advertising, (b) attitude toward the brand, (c) purchase intention, and (d) sharing intention through advertising enjoyment (H3).

Moreover, because hedonic enjoyment is likely intensified by the presence-inducing attributes of an immersive device (Tamborini & Bowman, 2010), we further hypothesize that the perceived naturalness of a perceptual system has positive, indirect effects on IVR advertising effectiveness first through presence and then through advertising enjoyment, yielding the three-step serial mediation model depicted in Figure 1 (H4).

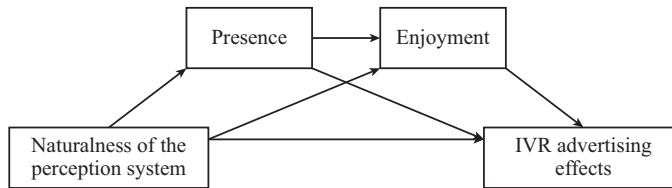


Figure 1 A theoretical serial multiple mediation model with presence and enjoyment as proposed mediators of natural mapping effects of the perception system on IVR advertising results.

Method

Participants and Design

In the between-subject experiment, we manipulated the perceptual systems used to watch 360-degree video advertising and compared the effects on audiences' feelings of presence, enjoyment, attitudes, and behavior intentions. The devices used in the three treatment conditions were an HMD, a tablet, and a desktop computer, which represent a high-naturalness mapped perceptual system, a moderate-naturalness mapped perceptual system, and a low-naturalness mapped perceptual system respectively.

In the high-naturalness condition, the participants stood in a space measuring 3 × 2.5 meters and watched advertising using an hTC VIVE HMD that allowed them to move and turn freely. In the moderate-naturalness condition, participants stood in the same space and watched the advertising using a tablet held in their hands. They could pan the device to

see any angle in the video. Participants in the low-naturalness condition sat at a table and watched the video by clicking and dragging a mouse cursor to the desired angle. An ASUS Transformer Pad TF300T, which includes a removable docking keyboard, was used in both the low- and moderate-naturalness conditions. In the low-naturalness condition, the pad was used as a desktop; in the moderate-naturalness condition, the keyboard was removed, and the pad was used as a tablet. In this way, the screen size was consistent throughout the conditions.

All participants watched the same 360-degree advertisement, *Hog Riders*, of a popular mobile game, *Clash of Clans*. A total of 115 students (80 females; $M_{\text{age}} = 21.3$, $SD = 2.10$, Range 18–29) recruited from a national university in northern Taiwan by a schoolwide invitation e-mail participated in the study. Students who had played *Clash of Clans* were screened out to prevent a confounding effect of game preference.

Participants were randomly assigned to one of three conditions. After signing the consent form, participants were given a brief explanation of the control scheme to which they were assigned. They then watched the advertisement and completed a postexperiment questionnaire.

Measurements

All variables were measured on 7-point Likert scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

Perceived naturalness ($M = 5.23$, $SD = 0.97$, $\alpha = .85$) was rated on a revised eight-item scale adopted from Skalski et al. (2011) and McGloin et al. (2011), including “The actions used to look around in the virtual environment were similar to the actions that would be used to visually perceive in the real world.”

Presence ($M = 4.68$, $SD = 1.04$, $\alpha = .94$) was measured using a 14-item scale adapted from the MEC Spatial Presence Questionnaires (Vorderer et al., 2004). The original scale contained 16 items; two of these items were omitted because they did not fit the context of the current study. A sample item was “I felt like I was a part of the environment in the presentation.”

Enjoyment ($M = 5.73$, $SD = 0.93$, $\alpha = .88$) was assessed through a three-item hedonic enjoyment subscale from the audience response scale (Oliver & Bartsch, 2010), such as “This advertising video was entertaining.”

Attitude toward the advertising ($M = 5.63$; $SD = 0.98$; $\alpha = .92$) and *attitude toward the brand* ($M = 4.71$, $SD = 0.84$, $\alpha = .87$) were both measured using four 7-point items anchored by *like/dislike*, *favorable/unfavorable*, *good/bad*, and *positive/negative* (Folse, Netemeyer, & Burton, 2012).

Regarding *download intention* ($M = 3.85$, $SD = 1.42$, $\alpha = .96$), to fit the advertised product, a mobile game, we modified the three-item purchase intention scale (Bruner & Kumar, 2000) to a download intention scale (e.g., “I am very likely to download this mobile game”).

Intention to share ($M = 5.13$, $SD = 1.13$, $\alpha = .91$) was measured using the scale from Peng, Lee, and Heeter (2010), which included items such as “I would share this experience with my friends or family.”

Results

The one-way ANOVA indicated that the manipulation of naturalness was successful, $F(2, 112) = 15.87$, $p < .001$, $\eta^2 = .22$. Pairwise comparisons showed that participants in the high-naturalness group reported significantly higher naturalness ($M = 5.75$, $SD = 0.86$, $N = 39$) than did participants in the moderate-naturalness group ($M = 5.28$, $SD = 0.95$, $N = 37$, $p = .02$) and participants in the low-naturalness group ($M = 4.66$, $SD = 0.76$, $N = 39$, $p < .001$). Furthermore, participants in the moderate-naturalness group reported higher naturalness than did those in the low-naturalness group, $p = .002$. Hence, H1 was supported.

The PROCESS macro (Hayes, 2017) was used to test all the mediation models with 5,000 bootstrap resamples. To test H2, we used dummy codes, setting the low-naturalness condition as the reference group (Hayes, 2017). The results indicated that compared with the participants in the low-naturalness condition, the participants in the high-naturalness condition perceived a higher level of presence, which enhanced their enjoyment of the advertising ($b = 0.36$, $SE = 0.12$, 95% CI: 0.160 ~ 0.627). Regarding the indirect effects of high naturalness compared with moderate naturalness, we conducted the same analysis but changed the reference group to the moderate-naturalness condition. The results indicated that the indirect effects of high naturalness relative to moderate naturalness were also significant ($b = 0.30$, $SE = 0.13$, 95% CI: 0.071 ~ 0.588). Thus, H2 was supported.

We then conducted a series of single-step mediation analyses to test H3a through H3d. The results showed that with advertising enjoyment as the mediator, a higher level of presence improved viewers' attitude toward advertising (H3a), $b = 0.31$, $SE = 0.07$, 95% CI = 0.182 ~ 0.445; the brand (H3b), $b = 0.11$, $SE = 0.05$, 95% CI = 0.017 ~ 0.229; and increased their intention to share the advertisement (H3d), $b = 0.18$, $SE = 0.08$, 95% CI = 0.033 ~ 0.370. The indirect effect of presence on download intention through enjoyment was not significant ($b = 0.02$, $SE = 0.09$, 95% CI = -0.150 ~ 0.186). Hence, H3a, H3b, and H3d were supported, while H3c was not.

To test H4, we examined the serial mediation model by sequentially including presence and enjoyment as mediators, using level of naturalness as the independent factor (i.e., low-, moderate-, and high-naturalness conditions, coded as -1, 0, and 1 respectively; Liu & Gal, 2011). We performed simultaneous tests of specific indirect effects for each mediator independently and of specific indirect effects through both mediators (Figure 2).

The paths from naturalness to attitude toward advertising through both mediators ($b = 0.10$, $SE = 0.04$, 95% CI = 0.045 ~ 0.194) and through presence alone ($b = 0.11$, $SE = 0.05$, 95% CI = 0.039 ~ 0.249) were significant. The indirect effect through enjoyment ($b = 0.06$, $SE = 0.06$, 95% CI = -0.056 ~ 0.187) was not significant.

Regarding attitude toward brand, both the paths from naturalness through both mediators ($b = 0.04$, $SE = 0.02$, 95% CI = 0.006 ~ 0.101) and through presence alone

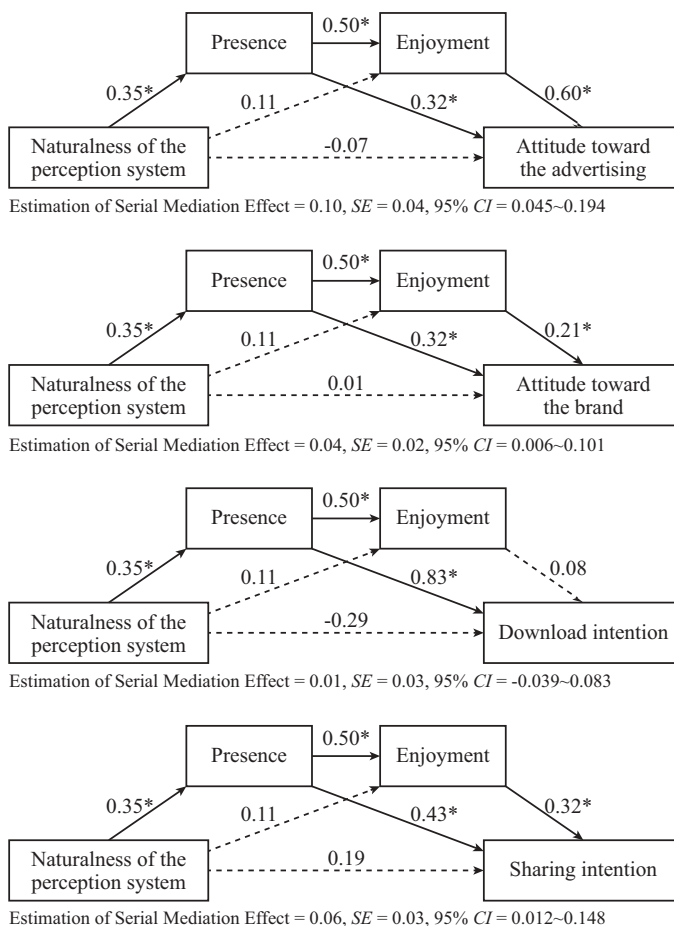


Figure 2 Path coefficients and indirect effects for serial mediation model of natural mapping on IVR advertising effectiveness through presence and enjoyment.

($b = 0.11$, $SE = 0.04$, 95% CI = 0.043 ~ 0.220) were significant, whereas the path through enjoyment ($b = 0.02$, $SE = 0.02$, 95% CI = -0.013 ~ 0.091) was not.

Regarding download intention, the path through presence alone ($b = 0.29$, $SE = 0.10$, 95% CI = 0.124 ~ 0.519) was significant. However, the indirect effects through both mediators ($b = 0.01$, $SE = 0.03$, 95% CI = -0.039 ~ 0.083) and through enjoyment alone ($b = 0.01$, $SE = 0.03$, 95% CI = -0.022 ~ 0.095) were not significant.

Significant indirect effects of naturalness on sharing intention were observed through both mediators ($b = 0.06$, $SE = 0.03$, 95% CI = 0.012 ~ 0.148) and through presence alone ($b = 0.15$, $SE = 0.06$, 95% CI = 0.056 ~ 0.318). The indirect effect through enjoyment ($b = 0.03$, $SE = 0.04$, 95% CI = -0.018 ~ 0.130) was not significant. H4 were partially supported.

Discussion

This study began with the expectation that the perceptual system of a device would affect audience experiences of IVR advertising, including perceived naturalness, presence, enjoyment, and persuasive outcomes. Specifically, we argued that the perceptual system determines how users visually perceive the virtual environment as they watch a 360-degree video and that the naturalness of the ways of seeing will positively affect audience experiences. As expected, those who watched the IVR advertising using an HMD reported a higher level of perceived naturalness than did those who used a tablet or a desktop. The highly natural mapped perceptual system was positively linked to the sense of presence, which in turn enhanced advertising enjoyment and further improved the effects of the IVR advertising. The results highlight the role of presence in mediating IVR advertising effectiveness. The naturally mapped perceptual system did not influence advertising enjoyment and advertising effectiveness directly. The sense of presence completely mediated the impact of the perceptual system on the effects of advertising.

Enjoyment also played an essential role in determining the effects of the naturally mapped perceptual system on attitude toward advertising, attitude toward the brand, and sharing intention. However, the indirect effects of the perceptual system on download intention were only mediated through the sense of presence. One possible explanation is that the effect of positive feeling on purchase intention was completely mediated by attitude toward the brand (Batra & Ray, 1986). The impact of enjoyment on purchase intention could not be discerned, likely because the relationship between attitude toward the brand and purchase intention were excluded from the analysis model. Another possibility is that the screening process eliminated some actual mobile gamers. Consequently, many of the participants may not have been the target audience for mobile games, and thus, their download intentions could not be easily elevated.

This study has limitations that deserve consideration. First, because of the hardware limitations, potential confounding factors should be noted. For instance, although we used the same device in both the moderate-naturalness and low-naturalness conditions to control for screen size, the screen size of the HMD could not be controlled in the same way. To better control for the screen size, it might be better to use HMDs in all conditions and vary control schemes only. The different postures when participants watched the advertising—namely, standing or sitting—might also generate different feelings and produce an undesired confounding effect. There might be alternative explanations can be further explored. Second, compared to people who have experienced virtual reality or 360-degree videos before, inexperienced users might see this IVR advertising experience as more novel. It could result in different experiences for experienced versus inexperienced users. Future research should take these factors into account. Third, this study only compared the persuasive effects after the participants watched the advertising; however, some potential covariates might affect outcomes, including initial attitudes toward the game or brand and the overall game experience or general attitudes. Future studies should

examine these factors as the potential covariates. Another limitation concerns generalization. The data are from a convenience sample of college students. The fact that only one advertisement was used might also limit the generalizability of the findings. The model requires robust evidence using multiple advertisements from different product categories and with different samples.

The current study has three theoretical implications. First, it examines the naturalness of the virtual reality system and its impacts on user experiences, which is recognized as an important topic of previous study (Bowman, Pietschmann, & Liebold, 2017). The results of this study suggest that with the head-tracking system, HMDs integrate some of the functions of the controller into the display, and therefore, users can change their viewing direction in the most intuitive way without needing an additional controller in their hands. This result dovetails nicely with the model matching hypothesis (McGloin et al., 2015, 2013; Wirth et al., 2007), showing that the close match between the visual SCs in HMDs and the SCs in real life allows users to rely on their preexisting mental models of ways of seeing and makes them feel as if they are looking around in the real world.

Second, this study applies the concept of natural mapping to the IVR advertising context and suggests that mapping may also be a powerful determinant of responses to IVR advertising. We propose and examine a serial mediation model to illustrate the mechanism underlying the influence of natural mapping on advertising effects. The findings are consistent with the prediction of dual processing theory and the feeling-as-information model and demonstrate that the sense of presence enhanced by natural mapping makes the advertising experience more entertaining and therefore prompts the audience to respond to the advertisement and the brand positively.

Lastly, the findings are helpful for understanding the conflicting results of previous research regarding user experiences of naturally mapped controllers. Traditional gamepads were perceived as more natural than natural user interfaces in some studies (Bowman et al., 2017). Previous studies of natural mapping mainly considered gameplay experiences, and the perceived naturalness of the actions depended greatly on the actions involved and players' video game experience. However, many actions in video games have no analogue in the physical world. Due to a lack of real-world experiences as the reference, players are likely to access previous gameplay experiences as the mental models (Rogers, Bowman, & Oliver, 2015). The findings of this study support the viewpoints of Rogers et al. (2015), as demonstrated by the fact that in 360-degree videos, the only action is "looking around," and the mental model of the way of looking in the physical world is well developed; that is to say, the perceived naturalness of a system depends mainly on the matching of the actions that need performing and the preexisting mental models. The results of this study also provide preliminary support for the benefits of adopting IVR technology to create a more immersive, compelling, and effective consumer experience and may offer guidance on designing IVR advertising.

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