How Augmented Reality Affects People’s Perceptions: Adoption of AR in Product Display Improves Consumers’ Product Attitude

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Abstract. Augmented reality has emerged as a novel communication tool which adds virtual computer-generated information to viewers’ real life. Although a wealth of research has investigated the effect of AR technology on consumers’ attitude, little is known about the underlying mechanism of how it influences consumers’ attitude. The purpose of this paper is to address the problem. Two experiments were performed to test the effect of AR based product display on consumer’s attitude and the underlying mechanism of the effect. Specifically, in Experiment 1, the authors presented a bottle to 92 participants (43 women, 39 men, mean age = 25.78) via three different methods: AR based display, non-AR based display without background, and non-AR based display with a background to verify the main effect. Additionally, another 100 volunteers (65 women, 35 men, mean age = 24.16) participated in Experiment 2 to verify the mediating effect. The results have demonstrated that the effect of AR based display on consumers’ product attitude is mediated by Self-referencing reality simulation. The current research suggests that managers should develop and adopt AR technology in their product display which can improve consumers’ product attitude.

1. Introduction

In recent years, many companies such as Nike, Ikea, Google and Nintendo have been adopting AR technology in developing interactive games, designing an advertisement and enhancing consuming experience. Through AR technology, companies allow consumers to view virtual objects superimposing onto their real world without placing the objects physically in front of them (Yim et al., 2017). In many cases, consumers view virtually displayed objects by scanning an icon on the package of products. For example, customers can scan the logo of Starbucks by their smart devices to learn brand stories which are displayed as a virtual form. In addition, marketers have also tried to represent products in a virtual format, such as Ikea produced the virtual furniture which customers can move on the screen of their mobile devices to anywhere they want rather than arranging them physically. So far, various forms of AR have been used in people’s daily life to assist viewers to understand products (Scholz and Smith, 2016).

While prior research has extensively examined consumers’ responses to characteristics of AR technology such as interactivity (Yim et al., 2017), vividness (Schlosser, 2006), playfulness (Huang and Liu, 2013), little is known about the mechanism of how consumers view and perceive a virtual object overlaying upon the real world and how the new form of product display method affects viewers’ attitude toward the object. Existing literature revealed that people extend the real self to the virtual images or avatars in virtual spaces (Belk,2014; Jung and Pawlowski,2014). However, little research has investigated how the virtual products or images connect to the self in real spaces and how this connection between the virtual product and the self affects the product attitude. We attempt to address the three research questions in this study: (1) how does AR based display, a novel presentation form
affects viewers' attitude toward the product, (2) what is the underlying mechanism of the effect; and.

To address these issues, we firstly review the previous research of AR technology adoption in the field of marketing which helps to understand the core features and advantages of AR based display comparing to traditional displays. Due to its supposition of virtual images upon the real world, AR based display augments the consumers’ personal experience and enhance their product attitude. Different from other traditional displays, the increased persuasion effect may result from a unique and personal simulation experience consumer generate in the use of AR. Based on the self-reference literature, we then investigate the mediating effect of self-referencing reality simulation, mental imagery of how the self-processing and consuming the product in the physical environment, on the increased persuasion effect. Finally, theoretical and practical implications are discussed.

2. Ar Based Product Display in Marketing

AR is defined as “a real-time direct or indirect view of a physical real-world environment that has been enhanced/augmented by adding virtual computer-generated information to it “(Carmigniani et al, 2011).

AR technology is increasingly adopted by marketers as a tool of product display. For instance, in the virtual fitting rooms, the screen with AR displays both the clothing items and images of the consumers wearing them in their surroundings; with AR apps on smart devices, products can be displayed as if they were situated in the real environment where the consumer is; through scanning a QR code that transforms into at an AR based display, tourists can be presented with historic buildings or events on the scene.

In terms of media communication, interactivity is considered as one of the crucial characteristics of AR technology. AR based product display enables consumers to engage in computer-mediated communication and interact with the interface, which increase perceived interactivity. Research has examined that perceived interactivity can further impact satisfaction, immersion, attitude of consumer (Gao et al., 2009; Hoffman & Novak, 2009; Song & Zinkhan, 2008).

Although AR is one of the interactive technologies, some research on AR identified other characteristics such as virtuality (Blascovich and Bailenson, 2011), mobility (Vardarajan et al., 2010), synchronization (Huang and Liao, 2015), location-specificity (Vardarajan et al., 2010). Huang and Liao (2015) concluded that, unlike virtual reality (VR), where the user is completely immersed in a virtual environment, AR allows the user to interact with the virtual images using real objects in a seamless way. In this way, AR based display aligns real and virtual objects with each other in real time, which offers consumers both utilitarian and hedonic values and thus may enhance consumers’ attitudes towards the product displayed (Fiore et.al, 22).

Augmentation is further proposed by Javornik (2016) as a unique media feature that emphasizes the AR display can augment or superimpose the surrounding space with virtual elements in real time. The concept highlights the perception of the augmented physical environment which AR based display creates through synchronizing virtual product image with specific place consumers located and even updating the information with the movement of consumers. Javornik (2016) found that AR features had no significant effect on perceived interactivity, while perceived augmentation was the most salient characteristic of AR applications which impacts people’s affective responses, cognitive responses and behavioral intention.

In sum, when AR is employed to be as a unique communication tool for product display, it enables consumers to experience a product virtually in a specific context. This will increase consumers’ product attitude since the AR based product display helps to reveal more product attributes and produce more experiential value than traditional online product displays in the form of picture and text (Li et al, 2001).

H1: In comparison to a non-AR based product display, AR based product display enhances the consumers’ product attitude.

3. The Mediating Effect of Self-referencing Reality Simulation

Although AR is regarded as a unique tool for mediated communication, little research has investigated the mechanism of how it influences consumers’ attitude. From the perspective of media characteristics, Javornik (2016) proposed that flow experience mediates the effect of perceived augmentation resulting from the AR apps on consumer affective, cognitive and behavioral response towards the brand. However,
flow experience also mediates the effects of other media characteristics such as telepresence, vividness, and interactivity on consumers’ product attitude. It may not reflect the essence of the ways in which AR based display affects consumer response.

Due to superimposing virtual product upon the real world, the AR based display creates an interactive simulation experience that helps people rehearse a consumption scene. Based on Fogg’s (2003) points of view, Huang and Hsu (2013) distinguished three types of simulative experience—object simulation, environment simulation, and cause and effect simulation—formed by AR technology. In essence, the three types of simulation experience cannot be separated from each other. They put together to form the entire experience of simulation: object, environment and the causal relationship between the object and environment. However, this still cannot identify the profoundly different nature of AR based display in relative to other interactive technology. For example, consumers watching a commercial advertisement can also gain access to the three types of simulation experience.

The simulative experience created by AR based display, by its very nature, implies mental imagery of how the self-interacting with the product in the real-life scenarios, which is referred to self-referencing reality simulation. For example, AR apps with smartphone render consumers to view a virtual product in their real environment such as home or office. The familiar life scenario provides diverse cues that enable consumers to visualize themselves in the specific context for product use.

The self-reference literature has argued that people show more recall, evaluation and liking of self-related objects than the objects that are not associated with the self. The reason that the use of self as a positive source to generate changes in attitude toward an object is people transfer their liking from the self to an object that is in conjunction with the self. For example, consumers perceive a product in the store as more desirable and attractive when the product (such as taste or smell) evokes the personal moments in consumers’ memory and becomes part of their personal stories (Ardelet et al., 2015; Kleine et al., 1995).

Given that augmentation (superimposition of the real environment with virtual elements in real time) is the most unique feature of AR technology, self-referencing reality simulation may account for the effect of AR based display on consumers’ product attitude. First, AR based display is able to simultaneously reflects the movement of the product on the screen when consumers’ finger moves the product, providing a precise response to consumers in real time. This increases consumers’ behavioral control and makes them feel like an actor rather than an observer in the simulation of product use. Second, AR based display simulates the product interacting with the physical environment in which consumers are living, allowing consumers to take a first-person perspective to visualize how it would be if they consumed the product in their real life. This activates a self-centric mental simulation of product use. Third, AR based display connects the product with consumers’ real life, prompting consumers to generate self-related product stories. In the self-related product stories, consumers match the product displayed with episodes recollected from their life history to comprehend new information (Ardelet et al., 2015).

According to the self-reference literature, the effect of AR-based display on product attitude results from consumers’ imagery of real-world scenarios, in which the positivity from the sense of self (evoked by the real environment) is transferred to the product connected to the scenarios. Thus, we proposed that,

H2: Self-referencing reality simulation mediates the effect of AR based product display (versus non AR based product display) on the consumers’ product attitude.

4. Experiment

Three different lab experiments were conducted to examine the positive effect of AR based product display on consumers’ product attitude. In our experiments, we asked participants to report their attitude toward the product displayed on the screen of smart devices. In experiment 1, we explored whether AR based product display can induce a more positive attitude. To examine the underlying mechanism of the effect, participants in experiment 2 were required to report whether they felt linking with the displayed product.

4.1. Experiment 1

Experiment 1 aimed at testing whether AR based product display triggered a more positive attitude
toward the product than non-AR based product display. All participants in this experiment were requested to evaluate a nice white bottle and reported their attitude toward it. In addition to AR based display group, we also set two different non-AR based display conditions as control groups: a picture of the product without any background and a picture with background. Also, AR based display group was set for participants to report their attitude toward the bottle. See Appendix for an example of AR and non-AR based display groups.

4.1.1. Method and procedure. Ninety-two volunteers (53 women, 39 men, mean age = 25.78) participated in this experiment. Upon arrival at the lab, all the participants were randomly assigned to the three different conditions, and they were told that the experiment was interested in collecting consumers' evaluation for a newly designed bottle. In the AR based display condition, participants were asked to use their phone to download an AR application which could display the bottle in a virtual form. And participants in each of the two-picture display group were presented with three pictures of the bottle from different angles.

Next, all participants were requested to read a general description of the bottle and complete the following questionnaire. After that, participants need to report their attitude toward the bottle along with four semantic differential items (bad-good, dislike-like, unfavorable-favorable, and unappealing-appealing), and all the items were on 7-point scales. The attractiveness of the display method was assessed as a control variable by asking whether they felt the display method was attractive (1 = Not at all, 7 = completely). As an additional control, participants also need to report the extent to which they felt happy and arousal (1 = Not at all, 7 = completely).

At the end of the experiment, participants reported demographic information, such as age and gender. Then they were thanked, and no one guessed the purpose of the experiment correctly.

4.1.2. Results. Results showed that participants reported no differences in emotional (MAR = 5.29, MWithout B = 5.26, Mwith B = 5.10, F(2, 89) = 0.224, P=0.800) and arousal state (MAR = 5.32, MWithout B = 5.16, Mwith B = 5.33, F(2, 89) = 0.220, P=0.803). Also, participants in AR condition did not report higher or lower interested in AR based display than participants in the two non-AR condition (MAR = 5.74, MWithout B = 5.48, Mwith B = 5.37, F(2, 89) = 0.610, P=0.545). However, participants in AR condition reported more positive attitude toward the bottle than participants in control conditions (MAR = 5.46, MWithout B = 4.24, Mwith B = 4.38, F(2, 89) = 6.69, P < 0.01), see figure 1.

Therefore, although AR based product display improved participants’ product attitude, it did not affect emotional and arousal state and their interested in the display method.
4.1.3. Discussion. As expected, Experiment 1 showed that different product display could impact people’s attitude toward the displayed object. If a product was displayed via AR technology, it would induce a more positive attitude from consumers. However, one limitation of the findings in this experiment was that the participants in AR condition downloaded the AR app and viewed the displayed product via their own phone, which created a connection between the displayed product and viewers. The other limitation is that although we had examined the effect of AR technology on consumers’ attitude, we did not verify the underlying mechanism of this effect. In experiment 2, AR devices were provided for all participants to avoid utilizing personal phone. More importantly, the mediated effect of Self-referencing reality simulation would be examined.

4.2. Experiment 2
The goals of Experiment 2 were to replicate and substantiate the results of Experiment 1 by using a different object and test underlying mechanism of the effect. In this experiment, all participants were requested to report their attitude toward a wastebasket.

4.2.1. Method and Procedure. One hundred volunteers (65 women, 35 men, mean age = 24.16) participated in this experiment. Like experiment 1, all participants were randomly assigned to three different conditions: AR, non-AR based product display with background, and non-AR based product display without background. The only difference was that a smart phone has been pre-placed on each table. All participants were requested to unlock the phone and reported their attitude toward the wastebasket which was displayed on the phone screen. In AR condition, participants need to view an AR based wastebasket via AR app as same as experiment 1. To control the effect of difference between smart phone and pictures, the images of wastebasket were shown on smart phone as well. In addition, a general description of the wastebasket was provided for all participants.

After reading the description, participants were asked to complete the following questionnaire. Like experiment 1, participants need to report their attitude toward wastebasket along four semantic differential items (bad-good, dislike-like, unfavorable-favorable, and unappealing-appealing) on 7-point scales. In addition to this, Self-referencing reality simulation that participants felt to the product was measured by rating the extent to which they agreed with three statements (e.g. “I feel attached to wastebasket.”) on 7-point scales (1 = strongly disagree, 7 = strongly agree). Also, all participants were told to report how much interest they held in display method and their emotional and arousal state.

At the end of the experiment, the participants reported demographic information, such as age and gender. Then they were thanked, and no one guessed the purpose of the experiment correctly.

4.2.2. Results. The participants reported more positive attitude toward AR displayed wastebasket than non-AR based product display method (M_{AR} = 5.43, M_{Without B} = 4.32, M_{with B} = 4.21, F(2, 97) = 12.42, P<0.001), implying that adopting AR technology in displaying product results more positive attitude rather than traditional method, see figure 2. We observed no difference based on display method on emotional (M_{AR} = 5.30, M_{Without B} = 5.38, M_{with B} = 5.24, F(2, 97) = 0.12, P=0.890) and arousal state (M_{AR} = 4.97, M_{Without B} = 4.68, M_{with B} = 4.45, F(2, 97) = 1.32, P=0.273). And the participants reported no difference on their interested to the method (M_{AR} = 5.61, M_{Without B} = 5.24, M_{with B} = 5.15, F(2, 97) = 1.17, P=0.314). Therefore, although AR based product display induced more positive attitude toward the product, it did not affect participants’ emotional and arousal state, as well as their interested to the product.

In order to test our hypothesis that Self-referencing reality would mediate effects of AR based product display on people’s attitude toward product, we followed Hayes and Preacher’s (2012), mediation script to calculate direct and indirect effects. Bootstrap results showed that Self-referencing reality simulation fully mediates the AR’s effect on product attitude (indirect effect = -0.2638, 95% confidence interval: -0.45, -0.11), and the direct effect of AR based product display on product attitude was no longer significant (direct effect = 0.2138 CI: -0.45, -0.11).

The present results indicated that the effect of AR based product display on product attitude was mediated by Self-referencing reality simulation which supported our hypothesis.
4.2.3. Discussion. As expected, Experiment 2 has examined that AR technology bridged the connection between consumers and product which affected consumers’ attitude toward the product. Moreover, in this experiment, we have controlled the effect of holding a personal smart phone by providing a smart phone for each participant to view the AR and non-AR based product display.

5. Conclusion

5.1. Theoretical Contribution
The primary goal of this study was to explore the impact of adopting technology in marketing on consumers and how this effect could be strengthened or eliminated. Therefore, the current study reviewed previous research on AR technology, self-reference and perceived objectivity, which offered support for our hypotheses. Then, three laboratory experiments were conducted to verify these hypotheses. Specifically, we had examined the positive effect of AR technology on consumer attitude toward the displayed product (Experiment 1 and 2). Further, the mediated (Experiment 2) effects had been examined. Overall, three key contributions can be derived from our study.

The first finding concerns the underlying mechanism of the effect which contributes to the literature on self-referencing. AR technology bridges the gap between virtual products and real life, and it also links the target products to consumers (Azuma 1997; Verhagen et al. 2014), which generates more self-reference in judging the products. In addition, AR technology can also create the connection between target products and consumers. And self-referencing is one of the most important factors that influencing people’s attitude (Gawronski, Bodenhausen &Becker, 2006; Ardelet, Slavich & Kerviler, 2015; Fennis & Wiebenga, 2017). As results of these, consumers report more positive attitude toward the AR displayed products.

Second, our finding also has important implications for the effect of high technology on consumer behaviors. We find that adoption of AR technology on product display could positively affect consumers’ attitude towards displaying product. Currently, limited research has focus on the effect of high technology on consumer behaviors, this study adds to the literature on consumers’ attitude in the context of high technology.

5.2. Practical Meaning
The current research suggests that managers should develop and adopt AR technology in their product display. Although the development of AR application costs much currently, it still worthy for attracting consumers and improving their product attitude. With the help of AR technology, products could be displayed in consumers’ real life which link both products and brands with consumers.

5.3. Limitations and Future Research
Nevertheless, there are still several limitations of current research. Due to the limitation of the laboratory, all target virtual products must be the common items placed on the desk, such as a lamp. Displaying furniture or a car on the desk break the link of target objects with the real surrounding. Future research could adopt different types of target objects and further verify the effect of AR technology on product display.
attitude. Second, as a result of experiment sample (college students), the external validity of the effect was not fully considered. Future research could focus on other population and validate the applicability of the findings.

Our findings also provide several directions for future research. For the study of AR technology, future research could view the relevant questions from a different perspective. It is because AR technology is not just a medium, but also a displayed method or even some other tool. More importantly, the combination of two kinds of technology, rather than adoption of single technology, will affect consumers’ behavior, such as adoption of AR and artificial intelligent in online shopping.

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7. References

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