Structuring mechanisms in consumers' responses to augmented reality-based technologies in retailing.

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Cite as:
Sengupta Aniket, CAO LANLAN, Jaidev Uma (2023), Structuring mechanisms in consumers' responses to augmented reality-based technologies in retailing..
Proceedings of the European Marketing Academy, 52nd, (114185)

Paper from the 52nd Annual EMAC Conference, Odense/Denmark, May 23-26, 2023

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Abstract:

The paper explores the specific and functional mechanisms in consumers' responses to AR-based technologies in retail and uncovers the relationship between these mechanisms. The comprehensive literature review enabled us to identify three main mechanisms − interactivity, quality of mental imagery, and immersion. Data was collected through survey research from 150 U.S. consumers. The interrelationship between the three mechanisms were examined and the research findings show that consumers' perceived interactivity of AR-enabled tool positively influences their perceived quality of mental imagery, and further the latter positively influences consumers' perceived immersion. However, consumers' perceived interactivity does not directly influence their perceived immersion. Therefore, the effect of interactivity on immersion is fully mediated by the quality of mental imagery. The theoretical implications and directions for future research are discussed.

Keywords : augmented reality, interactivity, retail, consumer response.

Track : Retailing & Omni-Channel Management.

1. Introduction

One new emerging technology that has been receiving enormous traction from many companies and researchers is Augmented Reality (AR) (Dacko, 2017; Poushneh and Vasquez-Parraga, 2017; Yim et al., 2017; Park et al. 2020). AR is defined as "the superposition of virtual objects (computer generated images, texts, sounds etc.) on the real environment of the user" (Faust et al. 2012, p. 1164). Thus, AR allows consumers to view themselves wearing diverse virtual products without physically trying them on in a store (Verhagen et al., 2014). In this way, AR improves consumers' understanding about products, provides them with enjoyment of seeing themselves wearing the item, and saves them transportation and shopping time, presumably resulting in its popular utilizations in e-commerce (Pantano and Servidio 2012; Baek et al., 2015). AR also adds values to retailers by being able to influence customer engagement (Jessen et al., 2020) and purchasing decisions (Pantano et al., 2017; Poushneh, 2021).

Despite increased attention, the theoretical and empirical knowledge about how customers respond to AR remains limited. Three particular problems exist with the previous literature. First, most of studies are descriptive (Javornik, 2016; Feng and Mueller, 2019). Second, various studies have widely employed constructs such as (tele)presence, flow, mental simulation, and transportation in revealing their mediating role in explaining the effectiveness of new technologies like AR (Yim and Chu, 2012). Yet these constructs− emerged from technological perspective− do not provide direct explanations with respect to customers' responses to AR. Third, recent research (Yim et al. 2017; Park et al. 2020) has started to investigate functional mechanisms− associated with AR's specific features− in customers' response to AR. However, Park et al. (2020) have focused only on two mechanisms − interactivity and mental imagery. Even though Yim et al. (2017) extends the study scope by adding a mechanism of immersion, they have not yet explored the interrelationship between the mechanisms. Therefore, a deeper understanding of the mechanisms is required as it is helpful for retailers to fine-tune their marketing strategy while they use the AR.

The objective of this study is thus to answer our research questions: 1) what are the main specific and functional mechanisms in customers' responses to AR-based technologies in retailing? 2) how are these mechanisms related?

2. Literature Review

2.1 Conceptualization of AR: critical analyses on the AR's definition in the literature

AR is a technology which consists of the overlaying of computer-generated virtual information (such as digital images and video stream) with physical objects of the real-world environment (Nabiyouni et al., 2017), which allows real time interactions (Carmigniani et al., 2011). In the retail context, the aim of AR is to create immersive brand experiences, interactive marketing campaigns, and innovative product experiences (mental imagery and embodiment) for consumers (Scholz and Smith, 2016). A popular method for AR implementation is smart-phones, which makes it the ideal platform for retailers aiming to connect with consumers and the increasing market penetration of smart-phones. AR enabled apps improves the customers' perception of the shopping experience (Cuomo, Tortora, and Metallo, 2014). Furniture stores such as IKEA and Wayfair have adopted AR applications because of its ability to measure the physical environment and apply the graphic overlay accordingly (Rese et al., 2017).

2.3 Consumers' responses to AR: four main mechanisms

From the existing literature, we identify three main mechanisms in customers' responses to AR-based technologies: 1) interactivity, 2) mental imagery, and 3) immersion.

2.3.1 Interactivity

Interactivity has been known to influence consumer shopping behaviors positively and studies have suggested that digital retailers should consider including interactive features in their shopping sites/apps to provide consumers with desirable shopping experiences (Poushneh and Vasquez-Parraga, 2017; Cowan and Ketron, 2019). So, this study defined interactivity as consumers'' responsiveness and the communication between consumers and manufacturers and between consumers and advertisers (Pantano et al., 2017; Park and Yoo, 2020). For this study, we adopted the common components of interactivity are bidirectionality, synchronicity, and controllability (Mollen and Wilson, 2010; Yoo et al., 2010).

2.3.2 Mental Imagery

Mental imagery enables consumers to experience a sensory stimulus in the absence of the true stimulus (Heller et al., 2019). In the literature, two characteristics of mental imagery, elaboration, and quality, have been associated with individual differences in creative ability. Elaboration refers to the capacity of evoking clear, colourful, and well-defined mental images (Bogicevic et al., 2019; Iachini et al., 2019). The quality of mental imagery is important because it assesses the ability of transforming mental images. We can control our images reflects the capacity to retain, actively manipulate, and intentionally transform mental images

(Iachini et al., 2019). For this study, we have adopted quality of mental imagery as our construct as we are concerned with AR-enabled app.

2.3.3 Immersion

Immersion has been understood to be enhancing a variety of virtual experiences to affect performance of AR-enabled medium. As with other popular constructs in AR research, the level of immersion consumers experiences in AR enabled apps is dependent upon their subjective evaluations (Yim et al., 2017). To feel immersed, consumers need to navigate vividly and realistically interactive virtual product images from diverse three-dimensional perspectives (Faust et al., 2012).

3. Hypotheses

3.1 From interactivity to immersion

To feel immersed, consumers need to be able to inspect vividly more freely interactively and realistically generated virtual product images from diverse three-dimensional perspectives (Bonetti et al., 2019). Therefore, depending on how well AR provides fast responses and highly realistic visualizations of virtual products (i.e., interactivity) (Kowalczuk et al., 2021), consumers will appear to perceive virtual products as a part of their real world (a high immersion state). Therefore, we can propose this hypothesis,

H1: *Perceived interactivity of AR-enabled tool positively influences perceived immersion.*

3.2 From interactivity to quality mental imagery

Previous studies evidenced that interactivity in an online environment activates mental imagery (Kiss and Esch, 2006; Rodríguez-Ardura and Martínez-López, 2014). Overall, there is much research evidence on the positive relationship between interactivity and mental imagery (Kiss and Esch, 2006; Park and Yoo, 2020). Therefore, we can propose this hypothesis,

H2*: Perceived interactivity of AR-enabled tool positively influences quality of mental imagery.*

3.3 From quality of mental imagery to immersion

Quality of mental imagery influences cognitive functions such as memory, attention, and perception. It is possible that mental imagery exerts an influence on yet other domains, namely immersion. Imagery abilities may play a role when sensorial cues are less available, and they can—at least to some extent— stand in for the missing perceptual information (Ji et al., 2016). According to simulation theory (Goldman, 2005), the story becomes convincing and enjoyable because the consumers create the plot in their mind based on their own

experiences. So, we can conclude that mental imagery has some effect on immersion. Therefore, we can propose this hypothesis,

H3*: Quality of mental imagery positively influences perceived immersion in using AR enabled tool.*

3.4 From interactivity to immersion via quality of mental imagery

There is ample research indication on the positive relationship between interactivity and quality of mental imagery (Rodríguez-Ardura and MeseguerArtola, 2014; Park and Yoo, 2020). Quality of mental imagery also influences immersion into the augmented reality environment for consumers with any level of involvement (Overmars and Poels, 2015). To investigate this relationship between quality of mental imagery, interactivity, and immersion, we propose this hypothesis,

H4: *Quality of mental imagery plays a mediating role between interactivity and perceived immersion in using AR enabled tool.*

4. Method

This study adopts measurements with appropriate reliabilities from the existing literature because all Cronbach's αs are higher than 0.80. All items were assessed on a seven-point Likert-type scale (1= "strongly disagree" to 7= "strongly agree"). Perceived interactivity was measured using 9 items: three items each for controllability, synchronicity, and bidirectionality (Yoo et al. 2010; Yim et al. 2017). Measurements of quality of mental imagery were adopted from the studies by Overmars and Poels (2015) and Park and Yoo (2020) and modified for the current study. Three items were used to measure immersion (Yim et al., 2017). Décor Matters was chosen as the AR-enabled mobile application for this study. A total of 150 respondents from United States participated in the online survey. Participants were offered a remuneration as an incentive for completing the study. The average age range of respondents was 35-44, 52.7% of whom were males.

5. Data Analysis

To empirically test the proposed hypotheses on interactivity, immersion, and quality of mental imagery in explaining mechanisms of AR features, a structural equation model (SEM) analysis (i.e., mediation) was conducted using R statistical software.

Empirical tests found the proposed model to be acceptable with respect to goodness-of-fit measures (SBχ2= 1.361 with 84 *df*; Robust CFI= 0.964; TLI= 0.954; Robust RMSEA= 0.061; SRMR = 0.045). These fit indexes match the established thresholds (Bagozzi and Yi 1988; Hu and Bentler 1995).

The direct effects of interactivity on quality of mental imagery (β = 0.642, *p*-value < 0.001) and of quality of mental imagery on immersion (β = 0.872, *p*-value <0.001) are significantly different from zero, while the direct effect of interactivity on immersion does not significantly differ from zero (β = 0.112, *p*-value = 0.239). Therefore, H2 and H3 are supported, while H1 is not supported.

The mediator provides significant mediation effect between the independent variable and the dependent variable if the absolute z-value of a mediator is > 1.96. The indirect and total effects were significant at p value 0.001 respectively and absolute z-value of mediator (i.e., Quality of mental imagery – QMI) is >1.96. The Sobel value is 0.56. Thus, we can infer that Hypothesis H4 was proven by this testing of mediation effects.

6. **Discussion**

First, three constructs pass discriminant validity. That means in customers' mind, they are distinct concepts. This finding is in line with the literature (Yim et al., 2017; Park and Yoo, 2020). Second, H2 is supported. This result shows that customers' perception of the AR's interactivity improves their quality of mental imagery while experiencing AR. According to the simulation theory (Goldman, 2005), we found that the story (i.e., AR enabled app) becomes convincing and enjoyable because the consumers create the plot in their mind based on their own experiences. Interactive AR apps enables consumers to become involved, use cognitive efforts for information processing, and finally experience mental imagery that effectively leads to attitude formation and behavioral intentions (Kiss and Esch, 2006; Beuckels and Hudders, 2016). So, we can say that perceived interactivity of AR-enabled app positively influences quality of mental imagery. Third, H3 is supported. This result suggests that higher quality of consumers' mental imagery increases their perception of immersion to the world created by AR. Simultaneously mental simulations run on consumers' minds while experiencing AR app, and imagined worlds are created, which allow for immersion in the narrative. Fourth, H1 is not supported but H4 is validated. These results indicate that the impact of AR's interactivity on customers' perception of immersion is fully mediated by the quality of the mental imagery.

6.1 Theoretical Implications and Future Research

Based on comprehensive literature review, this research identifies three main functional mechanisms and reveals the interrelationships between them by empirical studies. This study deepens understanding of the effect of new technologies like AR on customers' perception and behavior response. This research has employed quality of mental imagery in a mediating role to explaining the effectiveness of AR from a consumers' POV (i.e., point of view), rather

than the technology POV (Dacko, 2017; Scholz and Duffy, 2018). This study defined precisely what these three AR constructs (interactivity, immersion, and quality of mental imagery) are and how they interplay with each other. This study can be replicated utilizing the proposed model using a broader, more representative, and random sample of subjects along with more diverse AR-enabled apps working both on Android as well as iOS systems. Examining other interesting variables like embodiment would contribute to the existing literature. Constructs such as emotional needs may also be interesting to explore with respect to our model. There is also an option to examine whether AR is related, directly or indirectly, to increased product sales or improved brand value of retailers. Future research can also examine the role of AR in retail in persuading consumers to shop more online without visiting stand-alone retail stores.

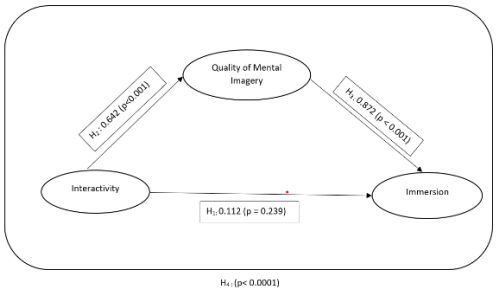

Figure 1. Theoretical Model

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