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Study on the Mechanism of AR's Influence on Consumer Shopping Decisions in Online Retailing

Yanan Tian
Shanghai University, Shanghai, China
yanantyn@163.com

Abstract

The rise of augmented reality (AR) technology offers online retailers a great opportunity to engage consumers and transform their brand experience. At the same time, the impact of AR adoption on consumer behaviour has attracted academic attention. From a contextual cognitive perspective, this study develops a conceptual framework to empirically investigate how AR facilitates product evaluation in the online purchase process and translates into positive purchase behaviour. Using a shopping platform to conduct an experiment, this study finds that AR can increases consumers' confidence in their choices and translates into positive purchase intentions. AR was most effective when product uncertainty was high, demonstrating that the technology increases consumer purchase intentions by reducing uncertainty and instilling purchase confidence. To encourage more impactful research in this area, we discuss the theoretical and practical implications of this study.

Keywords

Augmented Reality; Choice Confidence.

1. Introduction

As a key link between production and consumption, online and offline, urban and rural, domestic and international, e-tailing continues to play an active role in building a new development pattern. In recent years, as a typical representative of the new digital economy, China's e-tailing has been maintaining rapid growth and has become an important force in promoting the expansion of consumption. At the same time, the scale of China's online shopping users has gradually increased, and the transaction scale of the online shopping market has maintained a rapid growth trend, with online retail becoming a new engine of consumption. According to statistics from the National Bureau of Statistics, China's national online retail sales reached RMB13,088.4 billion in 2021, a cumulative increase of 14.1% over 2020, and the scale of online shopping users reached 842 million, an increase of 59.68 million over 2020, accounting for 81.6% of Internet users as a whole. While fast-growing e-tailing has provided consumption convenience for the nation, it has also intensified competition among e-retailers. As the younger generation, who have grown up in a digital environment and embraced digitalisation more in terms of awareness, interest, purchase and loyalty, become the mainstay of consumption, it has become increasingly difficult for retailers to acquire customers and cultivate loyalty. Coupled with the impact of the new crown pneumonia epidemic, consumer propensity to spend has declined significantly in recent years. According to the national resident calibre, the expenditure-to-income ratio for China's residents will be 65.9% and 68.6% in 2020 and 2021 respectively, and 63.7% in the first half of 2022, both of which are significantly lower than in 2019. As a result, consumers are now taking a more cautious approach to spending than they did before the epidemic, and competition among retailers for a share of consumers' wallets is exceptionally fierce.

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Furthermore, in contrast to shopping in offline brick-and-mortar shops, consumers can only obtain product information when shopping online by reading product descriptions and reviews from the rest of consumers, or by interacting with products virtually through images or videos. While secondary information about product attributes is sufficient for searching for products, consumers need a more direct product experience to fully assess the quality of a product (Weathers et al., 2007). However, the inability to touch the product during the online shopping process limits the extent to which consumers can feel and experience the product, increasing the barriers to consumer perception and creating a 'distance' between the consumer and the product (Verhagen et al., 2014), making it impossible for consumers to assess the product's suitability and use in real-life scenarios. This creates uncertainty about the product they are buying and a lack of confidence in their choices, creating barriers to making informed purchasing decisions. This range of responses can lead to consumer dissatisfaction with the online shopping experience (Hong et al., 2014) and reduced purchase intentions. In addition, the high return rates and offline purchases faced by online retailers are partly attributed to the lack of direct product experience when shopping online. Therefore, it has become a common challenge for online retailers to leverage the convenience of online shopping and provide consumers with a product experience similar to that of offline shopping in order to increase consumer satisfaction with the online shopping experience and thus increase sales revenue.

Augmented reality (AR) bridges the gap between offline and online shopping (Baek et al., 2018), offering the possibility to support a virtual product experience where the process of feeling, touching and testing the capabilities of a product is simulated online by the consumer (LIU et al., 2019).AR enables consumers to virtually try out products in real time on their own face or in their surroundings (for example,cosmetics clothing, furniture, etc.), thus providing a more direct product experience (Verhagen et al., 2014) . In addition, AR is easier to integrate into consumers' daily activities than other technologies such as virtual reality (VR), as it can be easily integrated with the devices consumers are currently using, especially smartphones. Goldman Sachs Investors reports that the AR market is expected to reach US$35 billion by 2025, with the adoption rate of AR technology on par with that of smartphones. As a result, AR is emerging in a variety of industries, such as education, engineering, healthcare, military, real estate, retail and video games. Of these industries, retail is expected to be the first market to use AR frequently, with the exception of video games (Goldman Sachs, 2016). Platform parties such as Taobao Tmall, DeWu and Jingdong and retailers such as Adidas, IKEA and Sephora are already offering AR on their mobile sites and allowing consumers to browse and interact with products by touching, swiping and dragging them on the touchscreen of their electronic devices.

By helping consumers visualize products and simulate interactions with them in their consumer environment, AR enhances consumers' online shopping experience and increases their confidence in their choices, thereby increasing their willingness to buy (Heller et al., 2019). However, AR may also deter consumers from making a purchase if they believe the product may not fit when they interact with it using AR. The impact of AR on the sales revenue of online retailers may also be negligible as the technology is unable to communicate certain experiential product attributes that may be important to the purchase decision (e.g., product texture or smell) (Tan et al., 2021). It is also unclear if and how the impact of AR will vary across products or consumers. Therefore, a more nuanced understanding of how AR affects consumers' online shopping decisions would help online retailers determine when to use the technology most effectively.

Given that in the retail segment, AR is mainly used on mobile apps (eMarketer, 2020), this study uses the DeWu APP to analyse the mechanism of AR's effect. DeWu is a multi-category product shopping platform and a trendy lifestyle community for young people. DeWu APP provides AR services to its consumers to help them realistically imagine what they would look like using different products. We conducted a study using the DeWu App to provide preliminary evidence

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for our findings, which suggest that the use of AR has a positive impact on consumers' online shopping experience and shopping decisions. These findings provide consistent evidence that AR is most effective when product uncertainty is high, implying that reducing uncertainty may be a possible mechanism for AR to increase sales.

Given the late research and application of AR technology in China and the superficial use of AR products, people rarely translate AR experiences into actual purchase behaviour. Therefore, understanding the factors that influence consumers' use of AR is beneficial for retailers to take effective measures to promote consumer purchase conversion behaviour. In the next section, we provide an overview of AR and its features, and elaborate on the consumer choice confidence associated with consumers' online purchase decisions from a consumer perception perspective. Next, we will analyse how AR affects consumer choice confidence. Finally, to encourage marketing scholars to further engage in relevant research in this area, we dissect the implications of this study from theoretical and practical aspects respectively, and analyse the shortcomings of this study to provide ideas for subsequent related research.

2. Literature Review

2.1. Augmented Reality and its Features

AR can overlay virtual elements directly into the consumer's real environment through a screen or projector (Javornik, 2016). Unlike virtual reality (VR), which directly overlays real-world elements with virtual elements, AR does not alter or replace the user's real world, but rather enriches the consumer's online shopping experience by integrating other information (e.g., product visualization) into the consumer's real environment (Yim and Park, 2019). For example, the IKEA Place APP allows consumers to place virtual furniture in any corner of their home to select the right furniture; the Sephora APP allows makeup to be reflected on the user's virtual face to see how it looks; and the DeWu APP measures the size of the consumer's feet and allows them to view the realistic fit of shoes. By integrating virtual visualisations of products into the consumer's real world, AR enables consumers to imagine the experience of using products in real-life scenarios, thus giving them greater confidence in their purchases (Kowalczuk et al., 2020).

Previous scholars have proposed many different definitions of AR based on its key features, but most studies agree that the important characteristic of AR is reflected in its ability to embed and enable interaction with virtual content in reality. For example, Azuma (1997) emphasises that AR has three key features; firstly, AR combines the real world and the virtual world, thus constantly providing users with unique and novel experiences tailored to their behaviour; secondly, AR is interactive in real time and thus provides an interactive experience.;thirdly, AR is presented in 3D, thus providing a vivid visual experience .Huang and Liao (2015) suggest that the technical quality of AR can be measured in terms of realistic presence and can be used to assess the perceived benefits of AR to users .Yim and Park (2019) systematically compare AR-based product displays in terms of vividness and interactivity with traditional web-based.Kowalczuk et al. (2020) argue that AR has four important characteristics, namely interactivity, system quality, informativeness and reality consistency, and that these four characteristics will influence consumers' emotional responses (immersion, entertainment, etc.) and thus their behavioural intentions (reuse intentions and purchase intentions). Using contextual cognitive theory, Hilken et al. (2017) suggest that the value of AR lies in its ability to help customers visually integrate virtual products into real-world environments (environmental embedding) and use physical actions to control how products are presented (simulated physical control). The unique combination of these two characteristics creates the perception that the virtual product is physically present in the real world, thus creating a realistic product experience.

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Contextual cognitive theory states that information processing occurs within a person's environment and actively uses the environment to represent it, rather than as an abstract activity in the mind (Semi and Smith, 2013). Laroche et al. (2004) suggest that by enabling consumers to have a mental grasp of the quality and value of a product, for example through product visualisation, consumer perceived risk can be reduced. Imagining oneself wearing a particular pair of shoes may be somewhat complex for consumers, but because AR has the unique attributes of embedding and control, it enables consumers to evaluate the product as if they were interacting with the actual product, thus mitigating this psychological intangibility and uncertainty for consumers and influencing their subsequent purchase behaviour. Therefore, evaluating AR's environmental embedding (EE) and simulated physical control (SPC) capabilities will provide useful insights for retailers seeking to improve profitability.

2.2. Choice Confidence

Choice confidence reflects the clarity with which consumers understand their preferences and the extent to which these preferences are perceived as correct (Andrews, 2013). That is, choice confidence reflects the level of certainty that consumers have made the best choice for themselves. Although previous research has extensively examined consumers' perceived risk in online retail environments, choice confidence has not been fully researched.Kowalczuk et al. (2020) found that the reality congruence of augmented reality affects consumers' choice confidence, which in turn affects consumers' purchase intentions. Javornik et al. (2021) further suggest that in an augmented reality environment, the consistency between consumers' ideal and real selves also affects consumers' confidence in product choice. In an online retail environment, consumers seek as much information as possible to reduce uncertainty and increase their choice confidence related to their purchase decisions (Song et al., 2019). Therefore, it is important and relevant for both academics and marketers to explore the antecedent mechanisms that influence consumer choice confidence.

3. Hypothesis Development

3.1. The Positive Effects of Environmental Embedding and Simulated Physical Control

It is difficult for consumers shopping online to imagine how a product will fit into their personal environment, which can lead to a lack of confidence in their choices and force negative attitudes towards the product. Phillips et al. (1995) state that consumer visions can help consumers imagine future consumption of and interaction with a particular product, which in turn increases confidence in choosing the right product. Although consumer visions are thought to be perceived mentally. However, AR environmental embedding can provide consumers with an instant view of their natural compatibility and coherent overlap with their surroundings (Petit et al., 2019) , and consumers no longer need to imagine the suitability of a product based on previous experiences, which can effectively reduce consumer online shopping risk and uncertainty and aid consumer decision making and product quality judgement (Bec, 2018) .Rosa and Malter (2003) suggest that consumers need instant online simulations of using or manipulating products in order to understand exactly how each movement and posture will feel and the dynamic effects of using the product. By simulating physical control through AR, consumers can move, manipulate and rotate virtual products through their bodies or gestures, thus shaping the concrete sensation of manipulating the product, making it feel like shopping in a physical shop and reducing uncertainty when consumers shop online. Furthermore, Hilken et al. (2017) propose that environmental embedding and simulated physical control make the virtual experience of shopping online similar to the real-world service experience, allowing consumers to make decisions with confidence. Therefore, we argue that AR provides a service experience that projects virtual products into the consumer's real environment and allows the

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consumer to simulate real interactions with the product, thereby alleviating uncertainty about the product, increasing consumer confidence in choice, and translating into positive behavioural intentions. Therefore, we propose the hypothesis that

H1a: Environmental embedding of augmented reality increase consumer purchase intention.

H1b: Simulated physical control of augmented reality increase consumer purchase intention.

3.2. The Mediating Role of Choice Confidence

One of the main differences between online and offline retail environments is undoubtedly the lack of a true multisensory experience, given that in online retail environments consumers focus primarily on the visual features of products (Petit et al., 2019), and in particular an important aspect of consumer decision making when purchasing products online, namely the ability to touch the product to obtain information, is missing (Krishna et al., 2011). Consumers perceive touch as a sense of discovery, and virtually touching an object often creates a sense that the object is more tangible than a merely visible object (Heller et al., 1982). Augmented reality allows consumers to virtually touch a product during online shopping and overlays a virtual image of the product into the real environment, thus enhancing the tangible feel of the product (Vonkeman et al., 2017). Thus, although there is no actual sense of touch, by virtually overlaying the product into the consumer's real use scenario and allowing the consumer to control the virtual product using gestures, it creates a tangible sensation for the consumer. Most mobile AR applications today allow users to control products by swiping their finger or turning their phone using a touchscreen after superimposing a real environment, creating a satisfying alternative to the direct experience of the product and diminishing the psychological intangibility of consumers who are deprived of a full sensory experience. We argue that when consumers perceive product performance as tangible, they feel more confident in their decision to purchase the product and have greater confidence in their choice. Therefore, we propose the hypothesis that

H2a: Environmental embedding of augmented reality will increase consumers' choice confidence and thus increase their purchase intention.

H2b: Simulated physical control of augmented reality will increase consumers' choice confidence and thus increase their purchase intention.

4. Model Study and Hypothesis Testing

We conducted a study to empirically test our hypotheses (see Figure 1 for an overview). We asked participants to use the DeWu APP to experience the potential of AR to influence consumers' choice confidence and purchase intention.

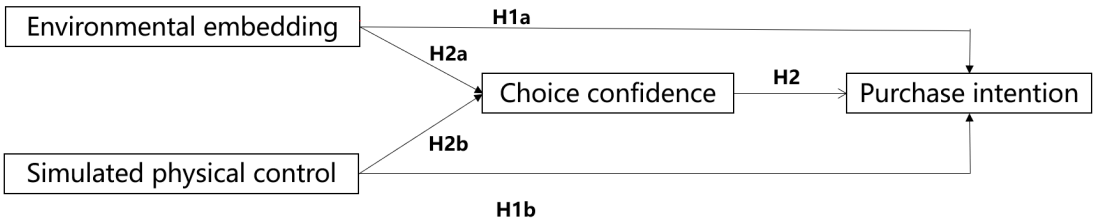

Figure 1. Overview of model assumptions

4.1. Participants and Procedure

We recruited 120 participants from a leading Chinese university to participate in this study. We divided the participants into four experimental groups of 2 (low environmental embedding * high environmental embedding) * 2 (low simulated physical control * high simulated physical control) and asked them to experience and fill out questionnaires according to the design within the experimental groups. At the end of the study, we gave participants small gifts as a

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reward for their participation. In all studies, we applied the same set of pre-specified quality criteria and if participants encountered technical difficulties or provided incomplete responses (4), they were excluded from further analysis. In addition, we removed two univariate outliers (1.7%). This left 114 participants (56 female and 58 male) in the final sample. The sample statistics of the participants are presented in Table 1.

Table 1. Sample statistics

Category		Frequency	Percentage
ender	Male	58	50.9%
	Female	56	49.1%
Age	<18	2	1.8%
	19-25	98	86%
	26-35	14	12.3%
Education	Bachelor	43	37.7%
	Master	71	62.3%

4.2. Measurement

We used three items from Bearden et al. (2001) (α = 0.911) and three items from Chang and Wildt (1994) (α = 0.951) to assess choice confidence and purchase intention, respectively. We used a five-point Likert scale and asked participants to rate all measures (from 'strongly disagree' = 1 to 'strongly agree' = 5). We provide the test items for all variables in Appendix A.

4.3. Results

4.3.1. Reliability Tests

Reliability is used to determine whether a measure can reliably measure the variables in the study. We used Cronbach's α coefficient and composite reliability (CR) scores to assess the reliability of the measures. As shown in Appendix A, Cronbach's α and CR scores both above the acceptable threshold of 0.7. Thus indicating a high degree of reliability of the data.

Aggregate validity was assessed by consistency across multiple items and confirmed using the extracted mean variance (AVE) and factor loadings. All variables should have an AVE greater than 0.5 and each item should have a factor loading greater than 0.7. As shown in Appendix A, the variables all had an AVE greater than 0.5, which indicates that the variables capture more structurally relevant variance than error variance. In addition, the factor loadings were also all above the threshold of 0.7. Therefore, the validity of the data is also good.

4.3.2. Manipulation Checks

To test the success of the manipulation, we asked participants to answer two questions on a five-point Likert scale (from 'strongly disagree' = 1 to 'strongly agree' = 5). The data proved that our manipulations were effective as expected for the arrangement. Participants in the high simulated physical control condition reported significantly higher simulated physical control than participants in the low simulated physical control condition ($M_{High\ SPC}$ = 4.35, $M_{Low\ SPC}$ = 1.44, t(112) = 25.09, p < 0.001), and participants in the high environmental embedding condition reported significantly higher environmental embedding than participants in the low environmental embedding condition ($M_{High\ EE}$ = 4.37, $M_{Low\ EE}$ = 1.51, t(112) = 23.45, p < 0.001).

4.3.3. Main Effects Test

To demonstrate H1a and H1b, a stepwise regression was used to conduct a validation analysis of the role of simulated physical control and environmental embedding on consumer purchase intentions, as shown in Table 2, where both simulated physical control and environmental embedding had a significant effect on purchase intentions. The results support both H1a and H1b.

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4.3.4. Measurement Mediation Analysis

To validate H2a and H2b, we used SPSS PROCESS 3.3 in bootstrap analysis using 5000 replicate extracted samples to construct 95% confidence interval values to test the mediating effect of choice assertiveness. As shown in Table 3, the results of the mediation test indicated a significant effect of path environmental embedding→choice confidence→purchase intention (β= 0.17, 95% CI = [0.09, 0.25]) and a significant effect of path simulated physical control→choice confidence→purchase intention (β= 0.16, 95% CI = [0.10, 0.24]), indicating support for H2a and H2b.

Table 2. Regression results

Variable	Purchase intention		Purchase intention		Purchase intention	
	β	T	β	T	β	T
Gender	-0.02	-0.21	-0.05	-0.60	-0.03	-0.47
Age	-0.04	-0.43	-0.03	-0.44	-0.02	-0.23
Simulated physical control			0.60	7.94***	0.58	8.12***
Environmental embedding					0.30	4.15***
F	0.11		21.13		22.48	
R^2	0.00		0.37		0.45	

Note: ***p<0.001, **p<0.01, *p<0.05

Table 3. Mediation effect results

	Effect	BootSE	Boot LCI	Boot UCI	Percentage
Path environmental embedding →Choice confidence → Purchase intention					
Indirect effect	0.17	0.04	0.09	0.25	78.63%
Direct effect	0.05	0.05	-0.06	0.16	21.42%
Total effect	0.21	0.06	0.09	0.33	
Path simulated physical control →Choice confidence → Purchase intention					
Indirect effect	0.16	0.04	0.10	0.24	44.43%
Direct effect	0.21	0.04	0.12	0.29	55.57%
Total effect	0.37	0.05	0.28	0.46	

4.4. Discussion

By mapping virtual products into consumers' surroundings and providing consumers with the ability to interact with them virtually, AR provides online retailers with the means to pursue innovative service enhancement strategies.We demonstrate that AR's environmental embedding and simulated physical control increase consumers' confidence in their online choices and thus increase their purchase intention.

5. Contributions and Shortcomings

5.1. Theoretical Implications

First, most previous studies have examined the effects of AR's features on consumers' hedonic experiences or utilitarian values from the perspective of technology acceptance. For example, Mclean and Wilson (2019) used a technology acceptance model to point out that the interactivity, vividness and novelty of AR affect consumers' perceived ease of use, perceived usefulness and perceived entertainment, which in turn affect consumers' product engagement. This study extends this area of research by examining the factors that influence consumer decisions in the online retail environment from the perspective of consumer perceptions.

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Secondly, we reveal how AR's environmental embedding and simulated physical control increase consumers' choice confidence in online shopping environments. There is little research in the existing literature on choice confidence in the AR domain. For example, Kowalczuk et al. (2020) demonstrate that the interactivity of AR affects consumer liking of products and thus consumer choice confidence from the perspective of consumer response processes, while Javornik et al. (2021) argue that consumers compare their personal image in the AR environment with their desired personal image, and that this gap between desired and realistic images affects consumers' self-compassion and confidence in their choices. This study extends related research in this area by examining the effects of environmental embedding and simulated physical control on consumer choice confidence.

5.2. Practical Implications

First, we argue that AR can increase consumers' confidence in their choices by helping them visualise products and simulate interactions with them in their consumer environment. We therefore recommend that retailers use AR as an important extension of their marketing strategy. While maintaining the convenience of online shopping, retailers offering products such as furniture, clothing and cosmetics can use AR to integrate the feel of in-store shopping into their online channels and offer consumers the possibility to directly experience and interact with virtual products. This could go some way to addressing the difficulty for consumers in online retail environments to imagine how products will really be used, reduce consumer uncertainty about products, and help consumers make more informed decisions when shopping online, with the resulting positive word-of-mouth and purchase intentions potentially increasing online conversion rates and reducing virtual shopping cart abandonment (Janakiraman et al., 2016). At the same time, app developers should further optimise the performance of AR technology by integrating more options to position, adjust and rotate the products shown, allowing for more realistic surroundings and smooth manipulation of products by consumers.

5.3. Limitations and Future Research

First, for convenience, our sample was drawn from university students at a particular college, as this group is more inclusive of new technologies and more likely to have used AR, but this limits the generalisability of the findings. Although homogeneous samples improve internal validity (Chuah et al., 2016), differences with other age groups may lead to external validity issues (Yim et al., 2017). Therefore, future studies should investigate age-related differences. Relatedly, future research could also identify additional customer characteristics that may explain changes in the value generated by AR-based service enhancements.

Secondly, the experiment in this study was manipulated using DeWu APP, thus limiting the manipulation of the degree of AR experience, environmental embedding and simulated physical control. Therefore, this study focused on participants' ratings of environmental embedding and simulated physical control and verified their effects on choice confidence and purchase intention. But the findings may still be influenced by factors such as consumer attitudes towards the platform and the technological maturity of the platform. Future research is encouraged to create AR stimuli that can manipulate levels of environmental embedding and simulated physical control, as well as to offer products without any brand attributes, in order to control for individual differences in perception while also allowing for rigorous testing of the role of environmental embedding and simulated physical control on purchase intention.

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Appendix A

Table 4. Overview of constructs and measurement item

Variables	Scale	Factor Landings	AVE	CR
Choice confidence (α=0.911)	1. I still have doubts about my choice of product	0.927	0.780	0.914
	2. I would like to know if I have chosen the right product	0.866		
	3. I have not chosen the right product for myself	0.854		
Purchase intention (α=0.951)	1. I would like to buy the product I have chosen	0.928	0.856	0.947
	2. I would like to buy this product in the near future	0.933		
	3. Next time I need shoes/lipstick, I will buy the product of my choice	0.915		

Appendix B

Figure 2. Overview of stimulus materials and manipulations