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Using augmented reality to reduce cognitive dissonance and increase purchase intention

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ABSTRACT

Augmented reality: (AR) has been shown to improve consumers' shopping decisions and experiences. Based on a theoretical stimulus-organism-response model and cognitive load theory, this research examines the effects that AR has on cognitive variables related to cognitive load, hitherto scarcely considered. Specifically, this research examines the impact of perceived similarity among options, confusion caused by overchoice and prepurchase cognitive dissonance on purchase-related behavioral intention variables such as purchase intention and willingness to pay for products. The study is based on consumers' AR web shopping experiences of an online cosmetics store which offers a wide assortment of products. The mixed-method research combines two focus groups and an experiment. This combination allows triangulation of the findings to provide corroboration. The results showed that AR reduces cognitive dissonance through its effects on perceived similarity and confusion caused by overchoice. Furthermore, lower cognitive load enhances purchase intentions, resulting in greater willingness to pay more for the product. The research extends knowledge of the benefits provided to consumers by AR in their decision-making through its impacts on perceived similarity, confusion by overchoice and prepurchase cognitive dissonance. The application of web AR in e-commerce shops is particularly useful when a wide assortment of similar products is offered. Online retailers can use AR to improve their economic performance both by increasing their sales' volumes and their margins.

1. Introduction

In recent years, e-commerce has become increasingly important and is expected to grow further. Technological advances are breaking down barriers in the online environment, thus increasing online shopping (Deloitte, 2019). These advances have addressed one of the main limitations of online commerce, the consumer's inability to test products before purchase. *Augmented Reality* (AR) allows virtual elements to be merged with the real world. That is, consumers can see aspects of products integrated with other elements of the environment, which facilitates their decision-making (Dacko, 2016). Thus, using AR, consumers can see what products look like in context. For example, in the furniture sector, consumers can view on their mobiles/tablets how articles might look when integrated with other domestic elements. In the beauty sector, consumers can examine products before purchase by viewing them using the AR-based *Virtual Try-On* (VTO) function.

AR-focused research into purchasing decisions and willingness to pay more has found that AR improves aspects of the consumer experience, such as usefulness, ease of use, satisfaction, engagement and attitude (see Table 1). However, negative aspects that may arise during the decision-making process deserve attention. Some recent studies have found that AR might decrease uncertainty, focusing on how doubts about product quality/product fit affect attitudes toward products, but they did not examine its effects on purchase intentions (Sun et al., 2022). In addition, factors that reduce prepurchase cognitive dissonance, such as choice confidence (Kowalczuk et al., 2021), decision comfort (Heller et al., 2019; Hilken et al., 2017; Wang et al., 2021) and product risk have been studied (Bonnin, 2020; Zhang et al., 2019). The present study aims to follow the unexplored path of how AR affects prepurchase cognitive dissonance by reducing the impact of perceived similarity and confusion by overchoice. Some qualitative studies have postulated that using AR can lead to higher cognitive dissonance because more products can be evaluated due to the ease with which they can be tested, and the enjoyment that can be derived from using the relevant apps (Romano et al., 2021). However, quantitative research has shown that prepurchase cognitive dissonance-related variables are generally reduced due to the greater ease of viewing products through the filters provided by AR, among other factors (Lavoye et al., 2021). To try to resolve this

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conflict, we explore how AR affects the perceived similarity of alternatives and confusion by overchoice, important aspects in the evaluation of large ranges of online options, for example, cosmetics. Qualitative and quantitative methods were used to triangulate and corroborate the findings.

Some AR-based research into consumer behavior has been conducted through quantitative studies in which participants were shown screenshots of examples of AR functioning in online retail, but they did not actually use the AR apps. Some research has examined mobile applications rather than computer-based web environments (see Table 1). Recent literature has highlighted how the device type used can affect psychological states related to consumer experience evaluation and behaviors (Barta, Flavián, & Gurrea, 2021). Moreover, many previous AR-focused studies let participants try only one (or a few) products; the present study presents participants with a wide assortment. Thus, this research aims to provide greater generalization of the results obtained to date by exploring the role AR plays in less considered online environments and shopping situations.

Drawing on the *stimulus-organism-response* (SOR) model and the cognitive load framework, this study aims to contribute to the extant literature by developing a mechanism that explains how AR (stimulus) can influence consumer states (perceived similarity, confusion caused by overchoice and prepurchase cognitive dissonance; organism variables). These states may arise during product choice and affect behavioral intentions (purchase intention and willingness to pay more; response variables). The research theoretically addresses the lack of knowledge about AR's effects on consumers' perceptions of wide online choices, where consumers typically suffer from perceptions of high product similarity and confusion by overchoice. Thus, an explanation is offered of the effects of AR technologies during the purchase process on these variables, and of the underlying mechanisms through which AR reduces the prepurchase cognitive dissonance that arises in these situations by lessening cognitive load.

The research also provides contributions for businesses. The results highlight the importance of AR for increasing sales and profit margins. From the consumer's perspective, due to the large assortment of

Table 1
Summary of AR studies in retailing examining purchase intentions and willingness to pay more.

Source	AR technology/context	Independent variables	Mediators/moderators/control variables	Dependent variables
Javornik (2016)	Mobile AR, furniture and decoration	Presence/absence of AR	Perceived responsiveness, perceived control, augmentation, flow	Purchase intention, return intention, intention to recommend
Javornik et al. (2016)	Mobile AR in-store, Make-up	Augmentation	Playfulness, convenience	Purchase intention, return intention, intention to recommend
Poushneh and Vasquez-Parraga (2017)	Web AR, clothes and accessories	Use of AR	User experience, the trade-off between price and value, user's information privacy control	Purchase intention, user satisfaction
Yim et al. (2017)	Web AR, clothes and accessories	Interactivity, vividness, previous media experience	Immersion, media novelty, attitude toward the medium	Purchase intention
Beck and Crié (2018)	AR virtual room in-store, clothes and accessories	Presence of virtual fitting room	Perceptual specific curiosity about the product, patronage intention	Purchase intention
Brengman et al. (2019)	Mobile AR, furniture and decoration	Media (laptop, mobile phone and AR apps), geometric or material product	Perceived ownership	Product attitude, purchase intention
Watson et al. (2018)	Mobile AR, make-up	Augmentation	Positive affective response, hedonic motivation	Purchase intention
Zhang et al. (2019)	Web AR, clothes and accessories	Ease of use, socialization, product risk, privacy risk	Usefulness, enjoyment, attitude toward VTO, gender, age.	Purchase intention
Heller et al. (2019)	AR-glasses technology - Hololens, furniture and decoration	Sensory control modalities	Assessment, sensory feedback, mental intangibility, decision comfort	Willingness to pay more
Smink et al. (2019)	Mobile AR, make-up	Online product presentation (AR, non-AR self, non-AR model)	Informativeness, enjoyment, intrusiveness	Brand attitude, purchase intention, willingness to share personal data
Bonnin (2020)	Web AR (screenshots), clothes and accessories	Presence/absence of AR	Utilitarian evaluation, hedonic evaluation, perceived product risk, attractiveness of the online store, familiarity with AR	Purchase intention
Park and Yoo (2020)	Mobile AR, make-up	Controllability, responsiveness, playfulness	Elaboration, quality, attitudes	Purchase intention, return intention, intention to recommend
Kowalczuk et al. (2021)	Mobile AR, furniture and decoration	Interactivity, system quality, product informativeness, reality congruence	Immersion, enjoyment, product liking, media usefulness, choice confidence	Reuse intention, purchase intention
Nikhashemi et al. (2021)	Mobile AR, furniture and decoration	Novelty, quality, interactivity, vividness.	Utilitarian benefits, hedonic benefits, brand engagement, psychological inspiration, customization	Continuance intention to use, willingness to pay a price premium
Moriuchi et al. (2021)	Mobile AR, clothes and accessories	Attitude toward technology	Technology engagement, attitude toward firm, satisfaction	Purchase intention, revisit intention
Qin et al. (2021a)	Mobile AR, furniture and decoration	Virtual presence, experiential value, shopping benefits, perceived value	Attitude, satisfaction	Continuous use intention, purchase intention
Wang et al. (2021)	Mobile AR, make-up	Interactivity, vividness, augmentation, aesthetics	Spatial presence, flow experience, decision comfort, individualism, fashion innovativeness	Purchase intention
Whang et al. (2021)	Mobile AR, make-up	Vividness, interactivity	Behavioral control, cognitive control, brand awareness, product involvement	Purchase intention
Tan et al. (2022)	Mobile AR, make-up	AR usage	Brand popularity, product appeal, product rating, product price, new to channel, new to category	Sales
This research	Web AR, make-up	Presence/absence of AR	Perceived similarity, confusion by overchoice, prepurchase cognitive dissonance	Purchase intention, willingness to pay more for the product

products available in online stores, understanding the mechanisms that reduce prepurchase cognitive dissonance in these purchase situations will provide them with a better shopping experience, improve their moods, make their purchase decisions easier and make them more willing to buy the chosen product. From the managerial perspective, it is estimated that 60% of sales opportunities are lost because of consumer indecision prompted by the many products and information available on the web (Edelen, 2018). Understanding the most important factors that can reduce this indecision, and how to generate positive purchase intentions, may help convert these lost sales into actual sales and improve the business performance of online stores.

The research focuses on cosmetics. It should be noted that several cosmetics' vendors have already implemented AR technologies. For example, L'Oreal allows virtual product testing through its website (via its online browsers) on desktop and laptop computers. Other beauty brands have also adapted to the web environment. For example, Garnier, Wella and Madison Reed allow consumers to try different hair colors virtually to help them make comparisons. Virtual product visualization makes consumers more confident in their decisions and generates purchase-related behavioral intentions, such as purchase intentions and willingness to pay more (Qin et al., 2021a).

2. Literature review

2.1. S–O-R model

The stimulus-organism-response (S–O-R) paradigm originates in the classic stimulus-response theory (Pavlov, 1902) which postulates that, after being shown a specific stimulus, subjects perform a paired response. The classic stimulus-response theory was extended by Mehrabian and Russell (1974) and Donovan and Rossiter (1982) to arrive at the S–O-R paradigm. Stimuli are the specific factors that arouse organismic processes in the individual (Eroglu et al., 2001). By processing these stimuli, internal (organism) processes are generated. Ultimately, this leads to responses, such as approach or avoidance behaviors (Donovan & Rossiter, 1982). Thus, the S–O-R model proposes that stimuli provoke organismic reactions that lead to specific actions. The organism mediates the influence of a given stimulus on the response. The S–O-R model has been previously applied to online shopping environments (e.g., Eroglu et al., 2001; Ettis, 2017), and is the most widely used theoretical foundation for immersion-based research (Loureiro et al., 2019).

Recent technological developments have altered the buying process. Some beauty industry e-commerce sites integrate technologies that allow product testing by using facial filters through VTO. Other e-commerce sites do not yet provide this option, and products can be evaluated only through descriptions, images and videos. The technology used during the purchase process is the stimulus proposed to affect the organism components (perceived similarity, confusion by overchoice and prepurchase cognitive dissonance) and responses (purchase intention and willingness to pay more).

2.2. Cognitive load

Online customers find it difficult to imagine how products will fit into their environments, which increases their cognitive load. Cognitive load theory holds that people's cognitive resources are limited. When cognitive load placed on consumers is very high, information processing takes up significant cognitive resources, which affects the acquisition of product information and creates negative attitudes toward products (Semin & Smith, 2013). People are often reluctant to make additional cognitive efforts beyond what is necessary. Therefore, if cognitive load is too high, negative emotions are evoked due to the conflict between the consumer's own will and the needs of the outside world, which negatively affects decision-making, that is, the consumer may purchase nothing (Ayres, 2020).

AR can help consumers process product information by providing virtual representations of how they might look in reality; consequently, the information that users have to process is more closely related to their own faces/bodies, and less to their imaginations (Fan et al., 2020). AR can help consumers view products in their environments, and they need no longer decide whether products are suitable based on factors such as previous experience. AR's ability to overlay 3D virtual product representations onto real-world situations can reduce consumers' cognitive load during the online product search process. This type of visualization allows consumers to make decisions based on the appearance of the product integrated into the real world, thus reducing the importance of other factors in online shopping, such as the product description (Kim & Choo, 2021). VTO allows consumers to verify if products suit them, by enhancing their mental imaging capacity (Hilken et al., 2018). Therefore, the visualization provided by AR reduces consumers' cognitive load and, consequently, choice overload, by increasing their mental imaging capacity.

Virtuality is important for triggering consumers' cognitive and affective states. Cognitive reactions are intellectual coping responses that emerge from mental process feedback (Qin et al., 2021a). Consumers tend to imagine how an evaluated alternative will fit into their environment when choosing a product. This is especially important for products that should align with other environmental elements, such as a piece of living room furniture or cosmetic products that enhance facial features. Thus, the increased mental imaging capacity provided by AR may affect mental processes associated with cognitive states. These cognitive states, such as anxiety, confusion and dissonance, may stop the consumer making the purchase (Mitchell et al., 2005), thus they play a significant role in consumer behavior. Furthermore, online retailers are characterized by offering a wider assortment than do physical stores. In these cases, the wide range available may evoke cognitive states such as confusion by overchoice and/or prepurchase cognitive dissonance. Consequently, it is important to understand how the increased virtuality provided by AR in online stores affects the consumer's mental processes and, more specifically, the cognitive states that may develop during the choice process.

2.3. The effect of AR on consumer uncertainty

The cognitive theory of multimedia learning proposes that people have different ways of processing the information presented in visual and aural materials (Mayer, 1997). Each channel has limited resources, so a large amount of information increases cognitive load. Based on its origin, cognitive load can be internal or external (Sepp et al., 2019). Internal cognitive load relates to the difficulty of evaluating information about how a material or product works (e.g., whether a component would help repair an electronic appliance). External cognitive load relates to how information is displayed. For example, virtual elements integrated into the real world through AR make it possible to verify if a chosen color fits the consumer's skin tone.

Two types of product uncertainty have been identified in the online commerce literature. Product performance uncertainty arises when customers cannot evaluate product performance because of imperfect knowledge. Product fit uncertainty arises when customers cannot establish if a product meets their needs (Tan et al., 2022). The present study focuses on reducing the latter uncertainty based on AR's capacity to show the product integrated with the real environment (in our case, the consumer's face). In this way, it is easier to verify if the chosen color suits the consumer's tastes based on his/her skin tone. Uncertainty reduction theory proposes there are three ways to reduce uncertainty: active, passive and interactive (bib_citation_to_be_resolvedBerger & Calabrese, 1974). Consumers can actively seek new product information to reduce uncertainty. They can also passively receive information about a product. For example, when searching for a product on a website, they can read the reviews of previous purchasers. Technological advances have enabled consumers to enjoy interactive experiences that provide a

wealth of information during the shopping process. For example, through AR, consumers can view a product integrated into the real-world environment and verify it suits them.

Thus, AR can overlay significant amounts of information onto real-world representations, which can help consumers make purchase decisions independently, and even provides prepurchase tests of products through tools such as VTO. This information helps consumers evaluate their options, thus simplifying their decision-making (Chylinski et al., 2020). Furthermore, it should be noted that information displayed on the web can provide details about product characteristics, such as their components. Likewise, information proffered by other users provides more in-depth knowledge about subjective aspects, such as product quality and details based on personal experiences. Moreover, AR also reduces product fit uncertainty (Sun et al., 2022), which cannot be reduced through active or passive uncertainty reduction methods. Specifically, in the cosmetics industry, testing the product on the face provides a clearer idea of the most suitable color shades; that is, AR makes it possible to analyze the representations in more detail when comparing available shades and, therefore, any differences between them can be more easily perceived (Do et al., 2020). Similar shades on a white background on a 2D image require much more effort to detect important differences (Creusen & Schoormans, 2005). Thus:

H1. Compared to no web AR, web AR reduces (a) the perceived similarity of products, (b) prepurchase cognitive dissonance and (c) confusion by overchoice.

2.4. Effects of reducing perceived similarity and confusion by overchoice

Confusion by overchoice is a cognitive impairment in which people have difficulty deciding when faced with many options (Pappas, 2017). Inconsistency among thoughts, beliefs and behaviors causes uncomfortable psychological tension (e.g., cognitive dissonance), which leads people to change one of the inconsistent elements to reduce the dissonance, or to add consonant elements to restore consonance (Festinger, 1957). To reduce confusion by overchoice, reducing the number of options offered is often the strategy employed. To this end, individuals tend to eliminate those options that do not fit their wishes (Mitchell et al., 2005). The perception that options are not similar helps reduce the possibility that the consumer will abandon the purchase.

During the purchase decision-making stage, the consumer may enjoy the information search process, but may also experience negative feelings due to the difficulties presented by choosing a product (Bloch et al., 1986). Reducing the perceived similarity of the options available will facilitate the purchase decision, as consumers will consequently have a clearer idea of the product they want to buy. When consumers can view products, they can see the differences between them more clearly (Gourville & Soman, 2005). This makes their decisions much more obvious and avoids the emergence of negative psychological states. On the one hand, confusion by overchoice is reduced, as the evident differences between the products allows the consumer to eliminate some options. On the other hand, the perceived lower similarity of the options available helps reduce the consumer's anxiety. When consumers are faced with many similar options, they may experience uncertainty and doubt (Koller & Salzberger, 2007). When faced with similar options during the decision-making stage, consumers tend to think that they will not choose the best option, which gives rise to a feeling of dissonance. Based on these points, we propose that:

H2. Perceived similarity has a direct, positive effect on (a) confusion by overchoice and (b) prepurchase cognitive dissonance.

Decreasing the confusion caused to the individual by the available options will also affect states that involve anxiety and nervousness, such as dissonance (Chou, 2012). When confusion is reduced the consumer is clearer about which product to buy. Therefore, when confusion is reduced dissonance is reduced. This reduction in confusion will result in consumers having fewer negative thoughts about whether they have made the right choice (Mitchell & Papavassiliou, 1999). As prepurchase cognitive dissonance is a psychological state that evokes emotions such as anxiety, less confusion will reduce these emotions. On the other hand, increased overchoice confusion will favor the evocation of dissonance. When the consumer suffers increased confusion, greater doubts arise, which encourages the emergence of dissonance.

H3. Confusion by overchoice has a direct, positive effect on prepurchase cognitive dissonance.

2.5. The effects of dissonance on behavioral intentions

Prepurchase cognitive dissonance can influence consumers' intentions to purchase products. This state of anxiety may cause consumers to suffer an information overload that generates intention not to buy the product at that moment, and to decide to look later at the available options (Menasco & Hawkins, 1978). For this reason, dissonance experienced during a product choice process can result in the consumer abandoning the purchase (Hasan, 2012). On the other hand, an absence of dissonance will ensure that consumers will feel calm and relaxed, which can reinforce their purchase decisions. Consumers who feel in cognitive control understand the situations they are in and are more willing to complete tasks (Kim et al., 2020).

Furthermore, consumers who feel uncertainty and doubt will be unwilling to pay a higher price for products. In fact, the shopping experience has a key role to play in willingness to pay more for products (Li et al., 2012). The state of dissonance that consumers experience is a bad experience. Consumers who do not enjoy a positive shopping experience are less willing to pay more for products (Huang, 2021). Therefore, it is proposed that dissonance lowers purchase intentions.

H4. Prepurchase cognitive dissonance has a direct, negative effect on (a) purchase intentions and (b) willingness to pay more.

Purchase intention involves the desire to purchase a product. This intention usually originates from the consumer's perceptions and evaluation of available options (Wu et al., 2012). This process generates a purchase decision for a product that the consumer wants to buy. Because the consumer desires the product, (s)he will be willing to purchase it. A consumer who strongly desires a product will be willing to pay a higher price. The strong desire to acquire and enjoy a product generates greater purchase intention, ultimately affecting the price the consumer is willing to pay for the product. Similarly, sometimes the consumer's desire to acquire a product generates a time cost, in comparison to obtaining a similar product situated closer to him/her (Rucker & Galinsky, 2008); the same applies to economic costs. Therefore, the greater is the consumer's intention to buy a product, the higher will be the price (s)he will be willing to pay. Thus:

H5. Purchase intention has a direct, positive effect on willingness to pay more.

2.6. Perceived similarity and confusion by overchoice as mediators

In this research it is proposed that perceived similarity and confusion by overchoice form the underlying mechanism through which using AR during the decision-making process affects prepurchase cognitive dissonance. The content provided through the filters of the VTO function allows consumers to decide if products suit them. That is, with AR it is easier for consumers to create mental images of themselves wearing products (Hilken et al., 2022). This mental image can reduce the cognitive load involved in the choice process (Heller et al., 2019), which can reduce the effect of cognitive variables such as perceived similarity and confusion by overchoice.

Perceived similarity and confusion by overchoice are expected to mediate the effects of AR technologies on prepurchase cognitive dissonance. On the one hand, when customers perceive less similarity, they have a clearer choice. Specifically, in the study context, consumers tend

to have a set range of preferred colors. Therefore, when consumers look at the various colors provided by online stores (photos), or filters in the case of AR, they will have an easier purchase decision to make, thus reducing the conflict of choosing one option over others (Hilken et al., 2018). On the other hand, when consumers use AR, they may be less confused due to the number of options available. This is because the ease of understanding what the product will look like, using AR, reduces the available options. This reduced confusion will make dissonance less likely to arise. Consequently, the following hypotheses are proposed.

H6. The effect of the use of web AR (versus no web AR) on prepurchase cognitive dissonance is mediated by (a) perceived similarity and (b) confusion by overchoice.

The research model proposed is shown in Fig. 1:

3. Methodology

This study uses mixed methods. First, two focus groups were conducted. Focus groups are suitable for defining important variables and understanding the relationships between variables in the early stages of research (Van Esch & Van Esch, 2013). In addition, we collected quantitative data through an online questionnaire, which was analyzed through structural equation modeling (SEM) using PLS software. This software is particularly appropriate for exploratory research and predicts relationships between variables for theory development (Hair et al., 2019). In addition, traditional PLS is appropriate when there are variables with five or more categories (Jakobowicz & Derquenne, 2007).

The use of mixed methods is appropriate in this research for several reasons (Bryman, 2006; Harrison & Reilly, 2011). First, additional validity is obtained by using qualitative and quantitative research to triangulate findings that can then be mutually corroborated. Second, in terms of completeness, mixed methods allow researchers to achieve a comprehensive overview of a research topic to develop an initial framework. Third, following the confirm and discover rationale, qualitative data can be used to generate hypotheses, and then quantitative research can be conducted to test them. Fourth, on the basis of the completeness and utility rationales; mixing two approaches allows for a more applied focus with greater practical implications.

3.1. Qualitative research: focus groups

Qualitative studies help marketers analyze individuals' deep motivations and better understand their behaviors. An interpretative paradigm was used because of its capability of eliciting new knowledge of emerging concepts in the social science area (Van Esch & Van Esch, 2013). The subjective experiences described by participants can help explain their reality and behaviors. By definition, these data are subjective but, once interpreted, can have real research value (Creswell, 1998).

We conducted two focus groups of 5 participants to create a comfortable environment that favors the examination of specific issues (Krueger, 2014). Each focus session lasted 60–90 min. The participants were recruited following a non-probabilistic, purposive approach. The group's composition should have a certain degree of homogeneity to avoid great contrasts but, at the same time, it should be sufficiently heterogeneous to encourage debate and provide rich information. Thus, we selected people with similar characteristics in terms of gender, age and buying habits, that is, females of a similar age interested in purchasing cosmetic products; however, they had to have different backgrounds and to share no close personal relationships (Barta, Gurrea, & Flavián, 2021). Two focus groups were conducted to meet the saturation criterion (Hancock et al., 2016). One group was composed of females between 18 and 23 years, and the other, females between 36 and 57 years (see Table 2).

To obtain the most valid and valuable information the recommendations of Kidd and Parshall (2000) were followed to design and develop the focus groups. Before the focus group sessions, the participants were told the purpose of the research. This initial briefing covered the roles of the participants and the moderator; guarantees were given as to the participants' anonymity and privacy. The moderator kept the discussion flowing to ensure focus was only on the relevant topic, thus enabling all

Table 2
Sample profile of focus groups.

FOCUS GROUP 1			FOCUS GROUP 2		
Participant	Age	Profession	Participant	Age	Profession
1	21	Business student	**6**	57	Doctor
2	23	Journalist	**7**	52	Tourism Teacher
3	18	Chemistry student	**8**	56	Technology Teacher
4	20	Architecture student	**9**	36	UX designer
5	21	Business student	**10**	49	Doctor

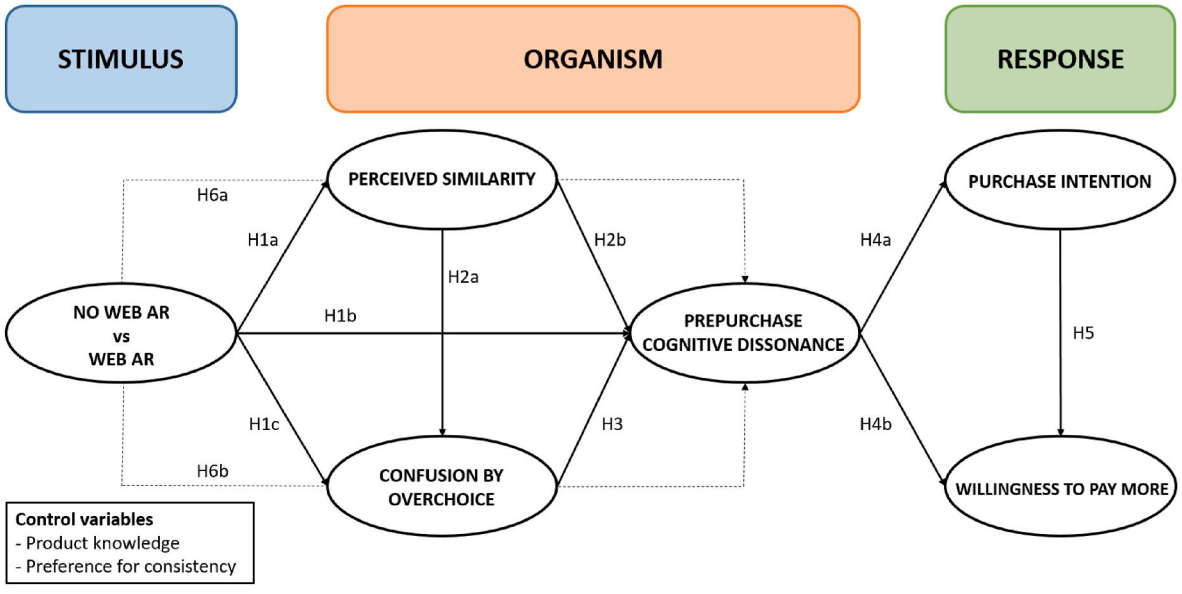


Fig. 1. Research model.

the group members to participate fully. At the beginning of the focus groups, videos were shown to the participants demonstrating how VTO works in the beauty sector. Thereafter, a short introduction to the topic, and an explanation of the key concepts, were provided. Questions were then posed to elicit the groups' opinions and perceptions of the topic under study. The script used with the focus groups is at Table 3. The sessions were recorded, with the participants' agreement, for later transcription.

Two independent researchers specialized in immersive technologies, and one university student, coded the transcriptions to identify core themes and illustrative quotes. The goal was to find the commonalities that would identify the main themes and then to group the main characteristics of each theme. After coding the transcription of the focus groups into the established categories, if there were any disagreements among the coding team members, the three coders discussed the relevant issues until a consensus was reached.

3.2. Quantitative study: experiment

3.2.1. Data collection and sample

The data were collected using four-part, online questionnaires. The survey was then reviewed by two researchers experienced in immersive technologies. Subsequently, a pre-test was conducted with 14 volunteers to check for possible confusion or ambiguities. This reinforced the survey's comprehension and content validity (Elmashhara & Soares, 2022).

An online between-subjects experimental design was used in the research. First, after checking that the participants had the necessary equipment to carry out the study (access to a desktop/laptop computer, access to a webcam), we explained to the participants the shopping situation they had to envisage. They were asked to imagine that they were interested in buying nude lipstick for a special occasion (anniversary, family celebration …). The study was aimed only at females due to the product's characteristics. They were then directed to the e-commerce site (https://www.lorealparisusa.com/) where they could view the available nude shade options (14 shades, see Appendix A). This website was chosen because a conclusion of the pre-test study was that the color options might create confusion among the participants. In addition, as the study was targeted at people living in the United States, a familiar and easily accessible website was used.

The participants were recruited through a market research agency and were economically rewarded. They were randomly assigned to one of the scenarios, no web AR or web AR. In the no web AR, the participants accessed the web and viewed the shades of make-up shown in Appendix A. They could view the photos and information displayed on the page but could not use the VTO function. This was controlled by the market research agency by ensuring that these participants did not have a webcam on their computers. In the web AR scenario, the participants accessed the same website, but had to use the VTO function (these participants had previously confirmed they had webcams installed on their computers). In this scenario, the participants were quizzed about the steps (clicking on the VTO function, giving permission to the camera in their web browser, choosing live try-on) they took to operate the VTO function; this ensured they had actually used it. Questions were also posed to check that the participants were paying attention. For example, "if you are reading this, check option four". Participants who answered these questions wrongly were excluded.

After incomplete surveys, and participants who had failed even one attention control question, were excluded, 128 participants remained. After conducting the same procedure with the AR group, 128 participants remained. Thus, 256 predominantly young North American women participated in the study (Mage = 33.06; SD = 8.99). The sample is representative of the US online shopping population who buy beauty products (Statista, 2021). Some 21.88% were between 18 and 25 years of age, 39.84% between 26 and 35, 25.78% between 36 and 45 and 12.50% were over 45. Therefore, the sample size is appropriate for the experimental design (Viglia & Dolnicar, 2020).

Table 3
Focus group script.

Welcome and focus group explanation	
Introduction questions	Name, age, online shopping habits, AR use experience
Showing of videos, explanation of the topic and key concepts	
Cognitive dissonance situations	In which situations do you experience more dissonance when you buy make-up online? - If there are few, or many, alternatives? - If the products are very similar, or not?
Impact of AR on the decision-making process	Does AR help the decision-making process? Why? In which purchase situations is it most helpful?
Impact of AR on dissonance	Using AR, consumers are more likely to try more products due to the convenience of trying them on: - would this make the purchase decision more difficult? - will consumers experience greater dissonance if they try more products?
Acknowledgments and closing remarks	

3.2.2. Measurement

To ensure content validity, the variables were measured using scales validated in previous literature, adapted to the study context. Perceived similarity was adapted from Kwon et al. (2016), confusion by overchoice from Tarnanidis et al. (2015), prepurchase cognitive dissonance from Koller and Salzberger (2007) and purchase intention from McClure and Seock (2020). Aspects relating to the product and the individuals were controlled. Product knowledge and preference for consistency of the participant's thoughts were measured because of their possible impact on the cognitive variables and behavioral intentions. Product knowledge was adapted from Smith and Park (1992) and preference for consistency from Gopinath and Nyer (2009). These variables were measured using 7-point Likert scales, where degree of agreement was measured by statements from 1 = "Strongly disagree" to 7 = "Strongly agree". Willingness to pay more was measured by asking the participants how much they would be willing to overpay for the product as a percentage (from 0 to 10%), an approach similar to that of Boccaletti and Nardella (2000). The scale items are presented in Appendix B.

3.2.3. Common method bias

As the data were collected using a single web-based survey and the self-reported answers were conceptual, common method bias (CMB) might arise. To minimize the potential for CMB, before taking part in the survey the respondents were assured of anonymity (Podsakoff et al., 2012). To assess possible common method variance statistically, confirmatory factor analyses were applied. Four models (including all the model's variables) were developed to estimate the amount of trait, method and error variance present (Podsakoff et al., 2003). Table 4 shows the values obtained for each model. The analyses revealed that models 2 and 4 had a significantly better fit than models 1 and 3, respectively, which implies that trait variance is present. However, we should acknowledge that some variation is due to the method employed, as models 3 and 4 fit significantly better than models 1 and 2. The variance estimation shows that the method accounts for 23.94% of the estimation, trait factors being the main source of the variance. This method variance is notably lower than the variance estimations obtained in previous research (28.9% in the psychology field; Cote & Buckley, 1987).

4. Results

4.1. Qualitative study

Table 5 briefly summarizes the main concepts discussed in the focus groups. In general, it was agreed that the similarity of alternatives leads to greater dissonance, and AR is helpful in reducing perceived similarity. AR facilitates product testing, so consumers tend to use it to evaluate

Table 4
Nested confirmatory factor analyses tests for trait and method effects.

MODEL	$\chi 2$	d.f.	*p*	Model comparison	$\chi 2$ difference	d.f.	*p*
NULL	5109.655	253	<0.001	1 vs 2	4455.408	36	<0.001
TRAIT-ONLY	654.247	217	<0.001	3 vs 4	2519.063	36	<0.001
METHOD-ONLY	2990.475	229	<0.001	1 vs 3	2119.18	24	<0.001
TRAIT-METHOD	471.412	193	<0.001	2 vs 4	182.835	24	<0.001

Table 5
Focus groups results.

Concept	Description	Example of participants' statements
Similarity of alternatives	In general, all the participants agreed that AR can help them decide which products to buy, especially when a range of colors look similar in the photos. Participants stated that tones that looked the same in the webpage photos looked completely different once they had tried them out with the AR tool. One participant explained that the dissonance was greatest for her when the alternatives were quite different. In this case, some people felt that the error would be greater if they had not chosen correctly.	*"I have a first decision on the color range already. I like nude, but if there are a lot of similar tones, this is when I have a hard time deciding"* (P2, 23). *"It is especially helpful when two colors seem very much alike, then you try them out and you see a clearer distinction"* (P1, 21). *"If they are very different, I don't know which one will look better, but if they are similar, I know I'm going to get it right because it's inside the range of things that I like"* (P10, 49).
Confusion by overchoice	The more alternatives available, the more dissonance consumers experience. However, it was found that the impact of the number of alternatives on dissonance was conditional on their similarity.	*"The number of alternatives influences because the more possibilities you have, the more doubts you will have about whether you have made the right choice or not. But, in this case, what matters to me is if they are similar or not. If there are many alternatives, but they are very different, I already have a range of colors from which I would choose. So, if there are many alternatives of other shades, it doesn't worry me, nor does it affect me"* (P6, 57).
Prepurchase cognitive dissonance	More products would be tested with the AR function because of its interactivity and convenience. Although the increased evaluation of alternatives could result in greater dissonance, as postulated by Romano et al. (2021), the help provided for decision-making by AR seems to overcome that fact in its impact on dissonance.	*"I think you try many more products online, for convenience and hygiene reasons" (P2, 23).* *"You are more entertained, you try things out, you see how it looks on your face. It's something innovative, it's a new experience. It motivates you to try products. If you buy by just looking at photos, it's boring" (P5, 21).*

more alternatives. However, the various options were not chosen by the participants unless they were similar to the shades they had planned to choose.

4.2. Measurement model

Drawing on the proposals made by Sarstedt et al. (2022), the following sections describe the indicators used to assess the validity of our reflective measurement model, the structural model's explanatory and predictive power and the path coefficients' significance and relevance (Hair et al., 2020).

4.2.1. Scale validity

Table 6 summarizes the reliability and convergent validity of the measurement instrument. An analysis of the factorial loads showed that all items exceeded the 0.70 criterion, except the first and fourth items of preference for consistency, which were removed from the analysis (Hair et al., 2011). Furthermore, the Cronbach's alphas of the variables were higher than the minimum level criterion of 0.70 (Dijkstra & Henseler, 2015). Internal consistency reliability was evaluated through two indicators. The composite reliability ρa and composite reliability ρc of the constructs were greater than 0.88, exceeding the minimum 0.70 level (Dijkstra & Henseler, 2015). Convergent validity was evaluated through the average variance extracted (AVE) indicator. This exceeded the recommended threshold of 0.50 (Fornell & Larcker, 1981).

Finally, we assessed the model's discriminant validity by verifying that the inter-construct correlations were lower than the square roots of the AVEs of each variable (Fornell & Larcker, 1981) and by an analysis of the heterotrait-monotrait ratio (HTMT), which returned values below 0.85 for all variables (Kline, 2011). As all pairs of constructs met this criterion, it can be concluded that the model has an acceptable level of discriminant validity. Table 7 shows the values.

4.3. Structural model

A dummy variable was introduced as an independent variable into the proposed model (0 = No web AR; 1 = Web AR). For the structural model evaluation, collinearity was assessed, and the results confirmed that all the variance inflation factors (VIFs) were below the threshold of 3.0 proposed in the literature (Hair et al., 2019).

The R^2 values are influenced by the model's complexity and the phenomena under research. Perceived similarity (R^2 = 0.078) and willingness to pay more (R^2 = 0.135) were shown to have weak explanatory power, whereas confusion by overchoice (R^2 = 0.418), prepurchase cognitive dissonance (R^2 = 0.444) and purchase intention (R^2 = 0.266) were shown to have moderate explanatory power (Hair et al., 2019).

$PLS_{predict}$ was used to compare the predictions generated by the PLS path model with those of a naive linear benchmark model. $PLS_{predict}$ is a relatively new procedure and research has only recently provided guidelines on how best to use it (Shmueli et al., 2019). This method explains the predictive power of the study. $PLS_{predict}$ with 10 folds and one repetition was used, in line with Shmueli et al. (2019). All the indicators yielded Q2 predict values above 0 (see Table 8). Next, we analyzed the prediction errors in greater detail to identify the relevant statistic. The visual inspection of the prediction errors suggested that the distribution is not highly non-symmetric. Hence, we base our predictive power assessment on the RMSE (Shmueli et al., 2019). In this sense, it should be noted that the MAE analysis did not produce substantially different findings. As seen in Table 8, for most indicators, the RMSE of LM is higher than for PLS-SEM. So, it can be concluded that the model has medium predictive power (Shmueli et al., 2019).

4.3.1. Test of the direct effects

To test the model's hypotheses, a bootstrapping method using SmartPLS with 5.000 subsamples was used (Hair et al., 2011). Table 9 shows the results.

Using AR results in lower perceived similarity of alternatives ($\beta = -0.250$, $p < 0.01$; H1a supported), and lower confusion by overchoice

Table 6
Construct reliability and convergent validity.

CONSTRUCT	ITEM	INDICATOR LOADINGS	CRONBACH'S ALPHA	COMPOSITE RELIABILITY ρ_a	COMPOSITE RELIABILITY ρ_c	AVE
Perceived similarity	SIM1	0.820	0.896	0.906	0.927	0.762
	SIM2	0.914				
	SIM3	0.916				
	SIM4	0.837				
Confusion by overchoice	OVER1	0.916	0.933	0.940	0.952	0.832
	OVER2	0.921				
	OVER3	0.915				
	OVER4	0.896				
Prepurchase cognitive dissonance	DIS1	0.915	0.924	0.931	0.943	0.769
	DIS2	0.839				
	DIS3	0.930				
	DIS4	0.759				
	DIS5	0.930				
Purchase intention	PUR1	0.954	0.958	0.961	0.973	0.922
	PUR2	0.968				
	PUR3	0.959				
Product knowledge	KNOW1	0.865	0.830	0.920	0.897	0.745
	KNOW2	0.771				
	KNOW3	0.945				
Preference for consistency	*CONSIS1*	*0.538*	0.807	0.880	0.885	0.723
	CONSIS2	0.920				
	CONSIS3	0.912				
	CONSIS4	*0.638*				
	CONSIS5	0.704				

Note: items in italics were deleted during the validation process.

Table 7
Discriminant validity of the scales.

Variables	1	2	3	4	5	6	7	8
(1) (1) No web AR/web AR	**N.A**	0.267	0.332	0.245	0.140	0.054	0.000	0.000
(2) (2) Perceived similarity	−0.250	**0.873**	0.643	0.641	0.373	0.259	0.172	0.058
(3) Confusion by overchoice	−0.321	0.603	**0.912**	0.614	0.246	0.216	0.261	0.136
(3) (4) Prepurchase cognitive dissonance	−0.238	0.598	0.572	**0.877**	0.492	0.264	0.277	0.191
(4) (5) Purchase intention	0.137	−0.353	−0.233	−0.467	**0.960**	0.377	0.305	0.274
(5) (6) Willingness to pay more	0.054	−0.246	−0.209	−0.253	0.370	**N.A**	0.192	0.132
(6) (7) Product knowledge	0.000	−0.157	−0.236	−0.253	0.296	0.175	**0.863**	0.224
(7) (8) Preference for consistency	0.000	0.009	−0.123	−0.165	0.254	0.110	0.206	**0.850**

Notes: N.A = not available. The diagonal elements (in bold) are the square roots of the AVEs. Above the diagonal elements are the HTMT values. Values below the diagonal elements are the inter-construct correlations.

Table 8
Predictive performance of the PLS Model Versus Benchmark LM.

Item	PLS-SEM		LM RMSE	PLS-SEM – LM RMSE
	RMSE	Q predict		
SIM1	1.573	0.052	1.566	0.007
SIM2	1.712	0.049	1.727	−0.015
SIM3	1.799	0.023	1.841	−0.042
SIM4	1.805	0.054	1.821	−0.016
OVER1	1.682	0.117	1.695	−0.013
OVER2	1.655	0.098	1.672	−0.017
OVER3	1.646	0.103	1.660	−0.014
OVER4	1.809	0.123	1.839	−0.03
DIS1	1.818	0.096	1.809	0.009
DIS2	1.453	0.067	1.461	−0.008
DIS3	1.779	0.082	1.792	−0.013
DIS4	1.533	0.054	1.532	0.001
DIS5	1.749	0.085	1.759	−0.01
PUR1	1.590	0.113	1.552	0.038
PUR2	1.587	0.123	1.546	0.041
PUR3	1.647	0.114	1.607	0.04
WILLPAY	1.355	0.023	1.373	−0.018

Finally, the structural model's goodness-of-fit assessment returned a standardized residual mean square root (SRMR) of 0.064, which is lower than the maximum recommended level of 0.080 (Hair et al., 2022). As a result, the research model's goodness-of-fit is satisfactory.

($\beta = -0.187$, $p < 0.01$; H1c supported), but had no effect on prepurchase cognitive dissonance ($\beta = -0.48$, $p = 0.370$; H1b not supported). Perceived similarity had a positive effect on confusion by overchoice ($\beta = 0.274$, $p < 0.01$; H2a supported) and on prepurchase cognitive dissonance ($\beta = 0.450$, $p < 0.01$; H2b supported). On the other hand, confusion by overchoice had a positive effect on prepurchase cognitive dissonance ($\beta = 0.274$, $p < 0.01$; H3 supported). Furthermore, prepurchase cognitive dissonance had a negative effect on purchase intentions ($\beta = -0.400$, $p < 0.01$; H4a supported), but it did not affect willingness to pay more ($\beta = -0.094$, $p = 0.185$; H4b not supported). Finally, purchase intention positively affected willingness to pay more ($\beta = 0.308$, $p < 0.01$; H5 supported).

As to the control variables, product knowledge significantly reduced perceived similarity, confusion by overchoice and prepurchase cognitive dissonance, and increased purchase intention (all ps < 0.05). However, it did not affect willingness to pay more. Preference for consistency reduced confusion by overchoice and prepurchase cognitive dissonance, and positively affected purchase intention (all ps < 0.05). The control variables had no significant effects on perceived similarity and willingness to pay more.

4.3.2. Test of the mediating variables

As to the proposed mediating effects, it was observed that AR (versus an online webpage) reduced prepurchase cognitive dissonance through perceived similarity ($\beta = -0.101$; $p < 0.01$; H6a supported). Furthermore, AR (versus an online webpage) also reduced prepurchase

Table 9
Estimated parameters and significance levels.

DEPENDENT VARIABLES					
	Perceived similarity	Confusion by overchoice	Prepurchase cognitive dissonance	Purchase intention	Willingness to pay more
No web AR/web AR	−0.250**	−0.187**	−0.048 n.s	-	-
Perceived similarity	-	0.537**	0.405**	-	-
Confusion by overchoice	-	-	0.274**	-	-
Prepurchase cognitive dissonance	-	-	-	−0.400**	−0.094 n.s
Purchase intention	-	-	-	-	0.308**
Product knowledge	−0.166*	−0.130**	−0.100*	0.163*	0.059 n.s
Preference for consistency	0.044 n.s	−0.101*	−0.115*	0.155**	0.004 n.s

Notes: ** = p < 0.01; * = p < 0.05; n.s = not significant.

cognitive dissonance through confusion by overchoice (β = −0.051; p < 0.01; H6b supported). Because AR did not directly affect prepurchase cognitive dissonance, it can be concluded that perceived similarity and confusion by overchoice exert total mediation in this relationship. The results are shown in Fig. 2.

5. Discussion

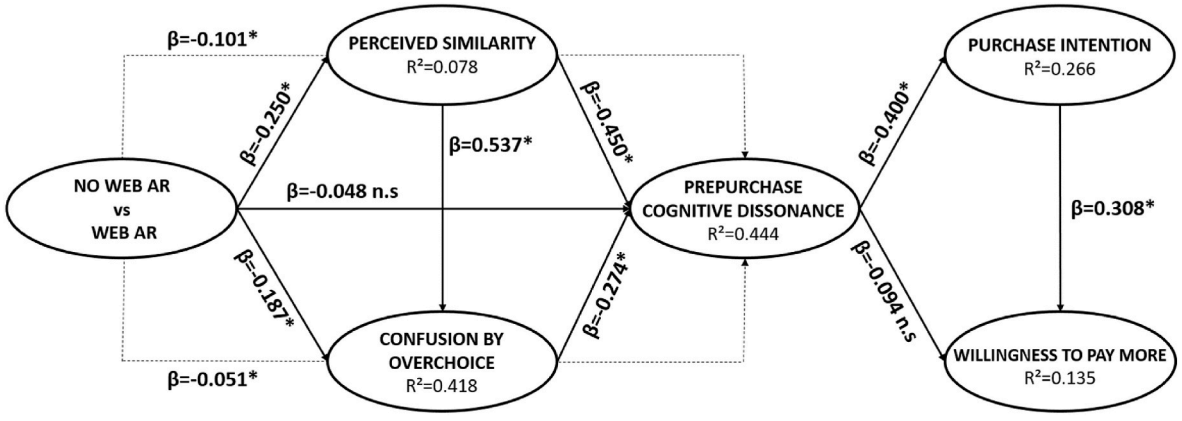
In addition to the benefits that AR provides in co-creation (Alimamy & Gnoth, 2022), and the utilitarian and hedonic value and loyalty it offers (Ameen et al., 2022; Flavián et al., 2021a; Hilken et al., 2017), it has been shown to offer significant advantages during the consumer choice process (Chylinski et al., 2020; Heller et al., 2019; Rauschnabel, 2021). The present study shows the importance and value of AR in the consumer's decision-making process when faced with a wide assortment of similar options. The organism variables considered contribute to the knowledge of the cognitive factors identified in the AR literature that influence purchase intention and willingness to pay more for a product.

It was observed that AR directly affected some of the cognitive variables of the proposed model. Its greatest effect was on perceived similarity. Therefore, using AR on the web can be especially useful with very similar products. This highlights the importance of using AR when faced with very similar products. For example, products where the difference may simply be between shades of similar colors, slight modifications in shape or in small details. Similarly, AR reduces the confusion by overchoice consumers feel when faced with a wide product assortment. Virtual testing directly reduces this confusion, allowing consumers to limit their choice options. Confusion by overchoice is lessened by using AR to reduce the perceived similarity between options.

However, no direct effect of AR on prepurchase cognitive dissonance was found. Thus, AR can significantly improve the consumer's shopping experience and reduce cognitive dissonance by lessening perceived similarity and confusion by overchoice. Reducing dissonance through these variables enhances the consumer's feeling of well-being during the choice process. These results align with previous research that showed that the quantity and quality of information offered improved online purchase decision-making (Gao et al., 2012), and studies in other fields that showed that AR enhances learning by reducing cognitive load (Thees et al., 2020). They are also in line with the results obtained from our qualitative study. On the one hand, AR may increase dissonance because it encourages consumers to try more products, due to its convenience and ease of use. On the other, it can reduce dissonance because the consumer can try on the product virtually and thus identify much more easily if it suits him/her. This may be why AR does not have a direct effect on dissonance. It was also observed that the impact of AR on the perceived similarity of options is key, given that it affects confusion by overchoice and dissonance, as postulated by the focus group participants.

Consumers may experience negative states such as prepurchase cognitive dissonance during the choice process. In addition to the fact that it has been shown that anxiety reduction can lead to greater intention to use AR apps, this reduction also affects consumers' decisions (Oyman et al., 2022). The present study has shown that during the consumer decision-making process, AR also negatively affects variables representing negative cognitive states. These states may arise due to the perceptions formed by consumers during the decision-making process. For example, perceived similarity and confusion by overchoice is reduced by AR.

Qualitative studies have shown that AR-based purchase processes can generate more cognitive dissonance than non-AR-based purchase processes because the former make more options available (Romano et al., 2021). The present study explores this topic in depth, taking a mixed-method approach. The research shows that AR can help identify the differences between available options more easily, thus helping the consumer to avoid feeling confusion, doubt and/or anxiety. Prepurchase cognitive dissonance is built up throughout the decision-buying process,



Notes: *=p<0.01; n. s=not significant; solid lines=direct effects; dotted lines=indirect effects

Fig. 2. Structural model results. Notes: * = p < 0.01; n. s = not significant; solid lines = direct effects; dotted lines = indirect effects.

and includes feelings such as anxiety, that need a high state of doubt or confusion to emerge (Festinger, 1957). Finally, AR helps reduce the perceived similarity of options and confusion by overchoice, which results in lower dissonance, and enhances purchase intentions.

An improved experience during the consumer decision-making process generates several consumer responses. First, it was observed that a reduction in dissonance experienced during the decision-making process promotes purchase intentions. Although it does not generate a greater intention to pay more for a desired product, it is, thus, important. Second, the greater desire evoked by AR to buy products because of the greater ease and improved experience of the consumer during the choice process generates a greater willingness to pay a higher price. Thus, despite the extensive research that has been conducted into mobile AR, it was observed that web AR can also greatly improve the consumer's experience, which is in line with previous studies (Hilken et al., 2017). Using technological tools that facilitate the consumer's decision-making process in the web environment, as in this case, has advantages for both consumers and companies. Increased purchase intentions can help e-commerce companies obtain higher profits in two ways. On the one hand, profits can increase based on the higher sales' volumes associated with greater purchase intentions. On the other, profits can also increase due to the higher margins that can be achieved from each sale, due to the higher willingness to pay more that consumers develop because of their increased desire to purchase the product. Of the respondents who were willing to pay more for the product, 39.74% were willing to pay between 1% and 2% more than the normal price, and 23.08% were willing to pay between 3% and 5% more. These results align with studies based on data collected through AR apps in e-commerce (Tan et al., 2022).

6. Theoretical contributions

This study contributes to a better understanding of how AR can improve and facilitate the consumer's decision-making by reducing his/her cognitive dissonance. Previous studies have shown the positive effect that AR has on psychological states involving positive experiences, such as flow (Barhorst et al., 2021; Javornik, 2016), and on the evaluation of the experience itself, such as satisfaction (Poushneh, 2018; Poushneh & Vasquez-Parraga, 2017). In contrast to these studies, this paper contributes to understanding the impact of AR on states involving negative emotions. Specifically, the impacts of AR on confusion by overchoice and prepurchase cognitive dissonance were examined. Although some studies have postulated that using AR may cause more dissonance because a greater range of options are evaluated due to the enjoyment and ease of trying them virtually (Romano et al., 2021), the present study shows that this need not always be the case. In situations where many options exist and the consumer feels uncertainty because (s)he is faced with a wide choice of similar products, the use of the AR reduces consumer dissonance. In this regard, the present study showed that using AR plays a very important role in alleviating cognitive load by reducing perceived similarity and confusion by overchoice. Thus, AR is a useful tool that indirectly affects prepurchase cognitive dissonance. To a greater degree, dissonance is reduced through the effect of AR on perceived similarity and, to a lesser extent, through its effect on confusion by overchoice.

The study also extends knowledge about factors, examined in AR-based studies, that increase sales and profits. Increased willingness to pay more has recently been shown to be related to increased satisfaction and engagement (McLean & Wilson, 2019; Tom Dieck et al., 2018). This study shows that AR may improve decision-making from another perspective. Traditionally, it has been observed that AR improves variables that are already positive for the consumer. It has been observed that AR generates in the consumer greater comfort and confidence with his/her decisions (Heller et al., 2019; Hilken et al., 2017; Song et al., 2019). The present study highlights the role that AR can play in purchase situations in which the consumer may experience negative feelings and emotions due to the great difficulty (s)he has in making his/her choice. In other words, it has been shown that AR helps reduce the negative feelings that consumers might experience during the choice process.

Finally, this study provides further generalization of the AR-related benefits examined in previous research. The present study showed that using AR on websites can affect cognitive variables and increase business profits through increased purchase intention and willingness to pay more. AR's advantages in the consumer decision-making process in mobile commerce have been widely demonstrated (Qin et al., 2021b; Rauschnabel et al., 2019; Scholz & Duffy, 2018). However, the devices on which AR can be integrated may play a role in varying these results. Different degrees of embodiment, sense of presence and interactivity can affect consumers' perceptions and behaviors (Flavián et al., 2019, 2021b). In line with previous studies comparing the use of AR on different devices (Hilken et al., 2017), we have shown that AR can reduce cognitive load not only in the mobile environment, but also in the web environment.

7. Managerial implications

The results of this study highlight that retailers should provide computer-accessible AR web facilities on their e-commerce sites. This will allow them to derive direct economic benefits and indirect economic benefits by improving the customer experience. In addition to the economic benefits obtained through increased purchase intentions and increased sales margins through willingness to pay more, the customer experience can be improved by reducing negative aspects that may arise during the purchase process, such as confusion and dissonance.

Using AR on the web is particularly effective when there is a wide variety of products available and, more specifically, when they are very similar. In these situations, it has been shown that AR can improve the consumer's decision-making process, and create a more satisfying customer journey, by reducing negative emotions (Telci et al., 2011). Therefore, online retailers who sell very similar products should include AR in their web environments.

In addition, because of the identified importance of reducing perceived similarity and confusion by overchoice in alleviating dissonance, online sellers should carefully consider these factors. More variety is not always better. Online retailers need to find the balance between making many products available and confusion caused by overchoice to avoid the prepurchase cognitive dissonance that may negatively affect purchasing behaviors.

8. Limitations and future research lines

This research has some limitations. The study examined a single e-commerce store selling cosmetics. Although the VTOs offered by these companies are similar in function, their individual features can affect the ease or difficulty of the decisions consumers take. The amount of information displayed, and the way it is displayed, and how virtual the try-on function operates, can have an impact. For example, VTOs have different interfaces. Sometimes, consumers can compare half of their face without the product and half with the product, while at others they can see only the result of the product. Therefore, future research should assess which interfaces make consumers' choices easier.

Future research could be carried out with other higher-cost products to explore the effect of AR on the purchase experience to examine consumers' willingness to pay more for products. In this research it was seen that consumers would be willing to pay between 1 and 5% of the price for a low-cost product ($8.95). Future works might examine what percentage benefit would be achieved by introducing technological tools to improve the consumer's decision-making. This would help explain to what extent the implementation of these technological tools is beneficial to the retailer. Previous research has shown that the increase in sales and economic margins derived from AR can be higher for high-cost products (Tan et al., 2022).

In addition to mobile and web AR, other environments seem to be

gaining importance. For example, live-stream shopping strategies developed in social networks, such as Instagram and TikTok, and other environments, such as the metaverse, could be analyzed to facilitate consumer decision-making. Furthermore, other immersive technologies, such as virtual reality, which has been shown to provide a more satisfying shopping experience than the offline channel, might also be examined (Pizzi et al., 2019). In this way, it would be possible to discover which immersive technologies can generate the most profit for e-commerce companies.

Credit authors statement

Sergio Barta: Conceptualization, Methodology, Formal analysis, Writing - Original Draft, Validation.; **Raquel Gurrea**: Formal analysis, Data Curation, Writing - Review & Editing; **Carlos Flavián**: Conceptualization, Project administration, Writing - Review & Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Nude shades

Appendix B. Scale items

Perceived similarity (Adapted from Kwon et al. 2016)
SIM1. The available alternatives were very similar to each other
SIM2. Due to the great similarity of alternatives, it was often difficult to identify different lipstick shades
SIM3. Some lipstick shades looked so similar that it was not possible to know if they were the same, or not
SIM4. I could not clearly identify the lipstick shade I wanted among the available alternatives
Confusion by overchoice (Adapted from Tarnanidis et al., 2015)
OVER1. There were so many products to choose from that I felt confused
OVER2. It was hard to choose which products to buy because of the wide offer
OVER3. All the information I obtained on different products confused me
OVER4. The more I look at the products, the harder it seems to choose the best
Prepurchase cognitive dissonance (Adapted from Koller & Salzberger, 2007)
DIS1. I am not quite sure about my decision
DIS2. When thinking of the decision, I feel uncomfortable
DIS3. I do not know whether the decision is right
DIS4. Before the choice, I felt uneasy
DIS5. I do not know whether this is the right choice
Purchase intention (Adapted from McClure & Seock, 2020)
PUR1. I am very likely to purchase the lipstick
PUR2. I intend to purchase the lipstick
PUR3. I will purchase the lipstick
Willingness to pay more (Adapted from Boccaletti & Nardella, 2000)
The lipstick costs $8.95. How much more would you be willing to pay for the lipstick?
PAY1. 0% ($8.95)
PAY2. 1–2% ($8.96-$9.13)
PAY3. 3–5% ($9.14-$9.40)
PAY4. 5–10% ($9.41-$9.85)
PAY5. More than 10% ($9.86 and above)

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(*continued*)

Perceived similarity (Adapted from Kwon et al. 2016)
Product knowledge (Adapted from Smith & Park, 1992)
KNOW1. I feel very knowledgeable about the product I just examined
KNOW2. If I had to purchase the product, I would need to gather very little information to make a wise decision
KNOW3. I feel very confident about my ability to judge these products
Preference for consistency (Adapted from Gopinath & Nyer, 2009)
CONSIS1. It is important to me that my actions are consistent with my beliefs
CONSIS2. The appearance of consistency is an important part of the image I present to the world
CONSIS3. I make an effort to appear consistent to others
CONSIS4. I typically prefer to do things the same way
CONSIS5. It bothers me if my actions are inconsistent with my past behaviors.

Note: items in italics were removed during the validation process.

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