

Repositório ISCTE-IUL

Deposited in *Repositório ISCTE-IUL*:

2023-03-29

Deposited version:

Accepted Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Amorim, I. P. de, Guerreiro, J., Eloy, S. & Loureiro, S. M. C. (2022). How augmented reality media richness influences consumer behaviour: A study in a realworld retail environment. *International Journal of Consumer Studies*. 46 (6), 2351-2366

Further information on publisher's website:

[10.1111/ijcs.12790](https://doi.org/10.1111/ijcs.12790)

Publisher's copyright statement:

This is the peer reviewed version of the following article: Amorim, I. P. de, Guerreiro, J., Eloy, S. & Loureiro, S. M. C. (2022). How augmented reality media richness influences consumer behaviour: A study in a realworld retail environment. *International Journal of Consumer Studies*. 46 (6), 2351-2366, which has been published in final form at <https://dx.doi.org/10.1111/ijcs.12790>. This article may be used for non-commercial purposes in accordance with the Publisher's Terms and Conditions for self-archiving.

Use policy

Creative Commons CC BY 4.0

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a link is made to the metadata record in the Repository
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

HOW AUGMENTED REALITY MEDIA RICHNESS INFLUENCES CONSUMER BEHAVIOUR

A study in a real-world retail environment

Inês Pessoa de Amorim, João Guerreiro, Sara Eloy, Sandra Maria Correia Loureiro

Inês Pessoa de Amorim, Instituto Universitário de Lisboa (ISCTE-IUL), Lisboa, Portugal

João Guerreiro, Instituto Universitário de Lisboa (ISCTE-IUL), Business Research Unit (BRU-IUL), Lisboa, Portugal

Sara Eloy, Instituto Universitário de Lisboa (ISCTE-IUL), ISTAR-IUL, Lisboa, Portugal

Sandra Maria Correia Loureiro, Instituto Universitário de Lisboa (ISCTE-IUL), Business Research Unit (BRU-IUL), Lisboa, Portugal

Conflict of Interest:

There are no conflict of Interest

Funding Information:

This work was supported by Fundação para a Ciência e a Tecnologia, grant UIDB/00315/2020.

Data Availability:

The data are not publicly available due to privacy or ethical restrictions.

Author Bios:

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/IJCS.12790](https://doi.org/10.1111/IJCS.12790)

This article is protected by copyright. All rights reserved

Inês Pessoa de Amorim research has focused on the influences of technology on consumer behaviour, much due to her passion for tech solutions for both consumers and companies. Inês has a MSc in Marketing from ISCTE Business School and a UX&UI Design course from EDIT. She has been working as a UX Designer at Deloitte Digital, specialising in Financial Services and improving the experience of digital products users.

João Guerreiro (Ph.D.) is an Assistant Professor in Marketing at Instituto Universitário de Lisboa - Iscte, Portugal and currently the Vice-Director of the Business Research Unit (BRU) at Iscte. His research interests and publications have been focused on the technological transformations and implications for Marketing, namely with publications on Augmented Reality, Virtual Reality and Artificial Intelligence implications for businesses. He has also published on high ranked journals on topics around sustainability and cause-related marketing. His publications include articles in journals such as the Journal of Sustainable Tourism, Journal of Travel Research, Journal of Business Research, Tourism Management, Journal of Business Ethics, European Journal of Marketing, among others. João Guerreiro has also received the best paper award in the Global Fashion Management Conference – 2019 at Paris (GAMMA) with a paper on Virtual Reality.

Sandra Maria Correia Loureiro research interests include relationship marketing, tourism marketing issues and the implications with VR, AR and AI. Her papers have been published in a variety of peer reviewed journals that include Journal of Marketing, Journal of Retailing, Tourism Management, Journal of Travel Research, Journal of Service Management, Journal of Business Research, Journal of Cleaner Production, Journal of Promotion Management, the Service Industries Journal or International Journal of Consumer Studies, at conferences (EMAC, AMZMC, Global Marketing Conference) and books. She recently won several awards, such as: the 2012 Best Paper Premier Award presented by the Global Marketing Conference (comprised of EMAC, ANZMAC, KSMS, and the Japanese Association of Marketing), Highly Commended paper Award 2014 - 7th EuroMed Conference and EuroMed Research Business Institute (EMRBI), Highly Commended paper Award 2016 - 9th EuroMed Conference and EuroMed Research Business Institute (EMRBI), Best Paper Award 2016- ICCMI 2016. In 2017 and 2018 she also

won high commended papers award from editor Emerald. Best paper award at the Fashion Management Conference 2019. Best reviewer award in 2021 for the journal Psychology and marketing

Sara Eloy [Instituto Universitário de Lisboa (ISCTE-IUL), ISTAR, Portugal]

Eloy is an architect and PhD in Architecture. Eloy's main areas of research include Digital Technologies applied to Architecture, Virtual and Augmented Reality, Space Perception and Shape Grammar. She is the director of the Information Sciences, Technologies, and Architecture Research Centre (ISTAR) at Iscte – Instituto Universitário de Lisboa, where she is also a fellow researcher. She has participated in national and international research projects and published her work in several journals.

Corresponding author mail id: joao.guerreiro@iscte-iul.pt

HOW AUGMENTED REALITY MEDIA RICHNESS INFLUENCES CONSUMER BEHAVIOUR

A study in a real-world retail environment

Inês Pessoa de Amorim, João Guerreiro, Sara Eloy, Sandra Maria Correia Loureiro

Abstract

The current paper explores the impact that an augmented reality shopping assistant may have on consumers' emotional and cognitive responses, and how it would affect their buying behaviours. A prototype of an application to assist consumers inside a supermarket was developed using HoloLens glasses. A total of 85 participants were invited to walk-through the store using augmented reality glasses. A PLS-SEM approach was used to test the conceptual model. Results using different scenarios show that media richness (the level of information cues, variety and immediate feedback) impacts consumer decisions and heightens their cognitive and emotional responses. The current study finds that a media-rich augmented reality experience influences brand engagement and willingness to buy through perceived information quality and brand attitudes. At a time when managers in every industry work to capture consumers' attention, the present study shows how content remains important in every communication activity, even in an innovative augmented reality retail shopping experience.

Keywords: augmented reality; Social Presence; Avatar; Emotions; Retail.

HOW AUGMENTED REALITY MEDIA RICHNESS INFLUENCES CONSUMER BEHAVIOUR

A study in a real-world retail environment

1. Introduction

In an era where businesses are competing for customers' attention, augmented reality (AR) technologies allow them to reach audiences in novel and exciting ways. Digital communication channels such as social media are being complemented by other virtual channels such as AR and virtual reality (VR) as a way for companies to reach their audiences (e.g., Hilken, Heller, Chylinski, Keeling, Mahr, & de Ruyter, K., 2018; Scholz & Schmith, 2016). In the coming years, AR will transform how we learn, make decisions, and interact with the physical world. It will also change how enterprises serve customers, train employees and design their products (Porter & Heppelmann, 2017). Indeed, the worldwide market for AR is predicted to grow from \$3.5 billion in 2017 to \$198 billion in 2025, which suggests considerable investment by consumers and companies in such technology (Statista, 2020).

Several of these investments have been directed toward improving the outside and inside-store experience. IKEA, one of the world's leading furniture manufacturers, presented an AR app - IKEA Place - that allows customers to simulate IKEA furniture, full scale, in their homes by placing 3D virtual representations of IKEA products into their rooms (IKEA, 2021). In the clothes industry, GAP also launched an AR app - DressingRoom - that enables customers to try on clothes in a virtual mirror without taking the time to go into a fitting room or even go to a physical store (APKMirror, 2021). Similarly, the Converse Nike shoe brand's augmented reality software – Converse Sampler App – allows users to simulate wearing a futuristic shoe on their own foot. Inside the confines of the shop, Lowe's stores piloted an augmented reality app in 2017 that aids customers in locating items in their stores using indoor mapping via a smartphone equipped with a camera (CNET, 2021). Timberland is now experimenting with augmented reality technologies, using Kinect to recognize buyers and superimpose Timberland clothing and accessories on them, allowing them to browse the catalogue and choose their size (Lemon & Orange, 2021).

Despite the studies and real applications that have been developed in the past, research has been mainly focused on mobile AR using the consumers' own smartphone as a way to augment the physical world (Nikhashemi et al., 2021; Daassi & Debbabi, 2021; Whang et al.,

2021). However, there is a lack of studies in the retail environment using wearable AR – such as glasses - that allow the consumer to be much more immersed in the retail environment than smartphone-enabled AR. Indeed, AR glasses are expected to grow from 250 thousand units sold in 2020 to 3.9 million in 2024 (Statista, 2021). This growth will accompany technological development of AR glasses by brands such as Microsoft (Microsoft HoloLens, 2021), Magic Leap (Magicleap, 2021) and Vuzix (Vuzix, 2021). Therefore, given the importance of wearable AR for the future of businesses, the current paper addresses two specific research questions that have not been studied previously, namely: (1) how wearable AR media richness (the level of information cues, variety and feedback) affects brand engagement and willingness to buy, and (2) how consumers' level of satisfaction (arousal and pleasure), attitude and perceived information quality mediate this relationship. These relations are explored in different media-rich environments (using an avatar to guide information cues or without an avatar present). The contributions of the current study are twofold. First, it adds a new conceptual model to the existing literature based on S-O-R theory by exploring how media richness affects AR consumer behaviour, including engagement and willingness to buy. Second, it presents important contributions for managers due to its real-world implementation. The results of this research have been embodied in a practical application that guides managers on how to create media-rich AR environments that increase brand engagement and consumers' willingness to buy. The paper is structured as follows. First, we review the theoretical literature and present the hypotheses and conceptual framework of the study. Second, we explain the methodology used to collect and analyse the data. Third, we present and discuss the results. Finally, we conclude by highlighting the theoretical contributions and practical implications for managers and consumers, followed by limitations and future research directions.

2. Theoretical Framework

Recent developments in virtual environment technologies have opened new and exciting opportunities for brands to extend their offering beyond the traditional physical environment. The embodiment-presence-interactivity (EPI) cube proposed by Flávia et al. (2019) suggests that real environments can be extended in three vectors. First, *embodiment*, which ranges between external devices (e.g. mobile smartphones) and internal devices (wearable augmented reality – e.g. AR glasses - and implanted devices – e.g. AR contact lenses). A second dimension of *presence* that ranges from technology reinforcing the sense of being

“here” to technology that heightens the sense of being “elsewhere”. Finally, the vector of *interactivity*, ranging from low interactivity with the environment to high interactivity with the virtual setting. All three vectors of the EPI cube contain a diversity of possible technologies that allow for more or less *embodiment*, *presence* and *interactivity*. For example, while VR is located close to the vertex with the highest interactivity, presence (sense of being “elsewhere”) and embodiment, mixed reality-AR glasses are located in the vertex with the highest embodiment and interactivity, while low on perceptual presence (sense of being “here”) (Flávian et al., 2019).

According to Scholz and Smith (2016), AR is the practice of augmenting a real-time direct or indirect view of the physical world with virtual information. AR is also defined as “the superposition of virtual objects (computer generated images, texts, sounds, etc.) on the real environment of the user” (Faust et al., 2012, p. 1164). Although AR may be similar to VR in the sense that it aims to enhance or enrich a viewer's experience, AR creates a superimposed overlay of the viewer in the electronically generated setting and does not immerse users in a different reality (Milgram et al. 1994; Billinghurst, Clark & Lee, 2015). AR supplements reality, rather than completely replacing it like VR. Using AR, the user is presented with a mixture of virtual and real objects that coexist in the same space (Billinghurst, Clark & Lee, 2015). AR can then be thought of as the "middle ground" between a virtual environment (completely synthetic) and a real environment (Milgram & Kishino, 1994; Milgram et al., 1994).

Unlike VR, AR, does not require the user to be absent from reality, which makes it easier to adopt. Indeed, AR technology overlays digital content onto the real world, and therefore creates added value for both consumers and retailers (Caboni & Hagberg, 2019). Consumers benefit from an augmented reality because they can interact with products or experiences without even being in the store (Breneman et al., 2019; Verhagen et al., 2014). AR is also beneficial in decreasing information costs and the perception of risk in the purchasing choice by giving consumers the possibility to overlay ratings, characteristics and other details on top of products (Yaoyuneyong et al., 2014). Such interaction creates opportunities for retailers to develop virtual try-ons or improve services at the point of sale (Flávian et al., 2019), send customized and targeted marketing messages that promote awareness, loyalty and engagement, and the opportunity to foster co-creation activities with customers (Caboni & Hagberg, 2019).

Research on AR has increased over the last decade on a par with technological developments (Loureiro, Guerreiro & Ali, 2020; Caboni & Hagberg, 2019; Flávian et al., 2019). While most

research is focused on using TAM (technology acceptance model) to study the effects of ease of use and usefulness on acceptance (Holdack et al., 2020; Jetter et al., 2020; Lin & Chen, 2017), recent studies have used other models to understand how interactivity, vividness, presence perceptions, emotions and cognitive appraisals affect behaviour (McLean & Wilson, 2019; Yim et al., 2017). One such model has been the S-O-R (stimuli-organism-response) (Daassi & Debbabi, 2021; Suh & Prophet, 2018). In the S-O-R model (Mehrabian & Russel, 1974), the stimuli are driven from experiences which are the starting point of both emotional and cognitive reactions (organismic responses) that can lead consumers to develop the experience further (approach) or to avoid the experience (avoidance).

Consumer experiences with AR can be framed into the Stimuli-Organism-Response (S-O-R) model. Here, the stimuli represent the use of augmented content overlaid on consumers' reality. In an AR environment, the degree of information added to the consumers' visual senses can affect the overall experience and help decision-making, particularly if it complements the existing information in the physical setting (Caboni & Hagberg, 2019). Therefore, the degree of media richness of the AR environment can have an important implication for how consumers behave.

2.1 Stimuli: Media Richness

The Media Richness Theory developed by Daft and Lengel (1984) suggests that communication media varies in its ability to convey information and enable users to communicate, either by using different types of message or ways to convey the message. In other words, it means that media is "rich" when it is able to provide multiple information cues, immediate feedback and uses very varied language (Daft & Lengel, 1984). Print newspapers, which deliver information through text, are considered less media-rich than iPods, which have a multitude of cues (Lu et al., 2014). The media richness theory suggests that richer information inspires greater trust since online consumers cannot touch actual goods and online sellers seek to provide more complete, clear and transparent product information. Websites can achieve these levels of trust through enhanced media richness using, for example, interactive virtual experiences that reduce information asymmetry and transaction costs while increasing buyer satisfaction and confidence (Chen & Chang, 2018). Li, Daugherty, and Biocca (2002), for example, found that 3D advertising is richer than 2D media and can enhance the sense of presence, leading to an increase in consumers' product knowledge, brand attitude and purchase intention. The same effect occurs using avatars. Holzwarth, Janiszewski and Neumann (2006) used avatars in web-based shopping – a much

richer type of communication than textual information – and found that their use increased satisfaction with the retailer, a more positive attitude towards the product being advertised and a greater purchase intention. Likewise, a study conducted by Moon et al. (2013) found that when consumers interacted with other avatars in a virtual shopping scenario (using VR), they experienced a higher sense of social presence, which increased shopping enjoyment, attitudes towards the brands and purchase intentions. Indeed, Sundar (2007) also suggested that the level of a user's sense of social presence influenced the way users process the received information, and ultimately, how they behave in such an environment. More recently, Lee et al., (2021) found that media richness is affected by the vividness and interactivity of a VR environment and that richness may affect both information sharing and seeking behaviour. Furthermore, Van Kerrebroeck, Brengman and Willems (2017) showed that vividness (an antecedent of media richness) increases brand attitudes. Therefore, previous findings suggest that the level of media richness can play an important role in an AR environment, namely in how consumers react in terms of cognitive and affective states.

2.2 Organism: Cognitive and Affective States

Cognitive states refer to “everything that goes on in the consumers' minds concerning the acquisition, processing, retention, and retrieval of information” (Eroglu et al., 2001, p. 181), which translates into how they form their attitude towards products and their attributes. Previous research shows that media richness may positively affect users' attitude towards online advertising (Li, Daugherty, & Biocca, 2002; Suh & Lee, 2005) turning the online shopping experience into something more enjoyable (Davis, 1989). In fact, in an online context, the user's cognitive and affective processes positively influence their reaction towards the ads, as well as their attitude towards their content (Ducoffe, 1996). Recently, Lee et al. (2021) found evidence in the case of VR that media richness increases the need to search for more information and the work of Van Kerrebroeck, Brengman and Willems (2017) suggests increased consumer attitude through enhanced vividness. Therefore, we suggest here that in an AR environment, as the level of media richness increases (for example using an avatar instead of a 2D textual cue), consumers' attitudes toward the brand also increase.

However, cognitive responses are also characterized by other appraisals of the experience, such as perceived quality. Perceived information quality refers to how well AR can generate useful, trustworthy, personalized, and reliable virtual content for the user (Poushneh, 2018). The amount of virtual content shown on the screen should be in accordance with the user's

expectation and needs. To the best of the authors' knowledge, no study links information quality to media richness in the AR environment, although the role of information quality and media richness has been studied in other online settings. For example, Chen and Chang (2018) show that both media richness and information quality affect satisfaction of AirBnB experiences and Han and Stoel (2017) showed that media richness affects information quality in fair-trade purchases. In an AR environment, 3D type information, such as that communicated by an avatar may add more information than a 2D textual type of display. In fact, research shows that the degree of information can affect overall experiences in an AR environment (Caboni & Hagberg, 2019). Therefore, we posit that:

H1: The level of media richness will positively influence the consumer's cognitive responses (a. attitude, b. perceived information quality) in an AR environment.

As pointed out by Guerreiro, Rita and Trigueiros (2015: 1729), "the complexity and abundance of stimuli during purchase decisions may influence consumers' cognitive and emotional state which, in turn, may trigger approach or avoidance responses". Focusing on the variables in the emotional responses to the experiment, Mehrabian and Russell (1974) categorize emotional states along the pleasure, arousal, and dominance (PAD) dimensions. Pleasure refers to the degree to which a consumer feels good, happy or satisfied with the information and interaction available during the AR experience, while arousal is the degree to which a consumer feels stimulated, active or excited. Moes and Vliet (2017) have shown that the consumer's enjoyment influences the effect the medium's richness has on purchase intention. Indeed, Pantano, Rese and Baier (2017) also analysed the influence that a higher level of aesthetic quality can have on the consumer's level of enjoyment. In their research, they conclude that one influences the other, in the eyes of the consumer. Lee, Ha and Widdows (2011) conducted a study that explored the relationship between technology product attributes and emotional responses (pleasure and arousal). The study showed that how much a product appeals visually (appearance) has a significant effect on the consumer's level of pleasure. The same effects were found by Han and Stoel (2017). In their study focused on social media communication in fair-trade purchases, participants exposed to a richer type of media scored higher in emotional levels than those exposed to lower media richness. Therefore, because an AR environment can also highlight such differences in richness levels, we suggest that perceived level of media richness can influence a consumer's level of pleasure and arousal while wearing AR technology during a shopping experience. Thus:

H2: The level of media richness will positively influence the consumer's emotional responses (a. pleasure, b. arousal) in an AR environment.

2.3 Response: Brand Engagement

The brand engagement concept has been continuously developed by several researchers (Van Doorn et al., 2010; Vivek et al., 2012; Goldsmith, 2012; Hollebeek et al., 2016), and built from different perspectives, creating a valuable amount of knowledge on this topic. For Goldsmith (2012), brand engagement is described as the emotional tie that connects customer to brands. Keller (2001) states that brand engagement is a key component in building relationships between brands and customers. It brings a wide range of benefits on both sides as it allows for engaged customers to involve themselves willingly with a brand, and share their information and opinions about the brand, spread the word and share its products with an even broader audience (Keller, 2001). Adapting the conclusions drawn by Kim and Johnson (2016) to the present case, brand engagement is a consequence of emotional and cognitive states evoked by the brand (Allen, Fournier & Miller, 2008; Goldsmith, 2012) and which could be induced by the media richness or interactivity of an AR experience.

Hollebeek et al. (2014) present three different dimensions of brand engagement: a person's cognitive processing, and their emotional and behavioural responses to a certain level of 'engagement'. In this context, the terms used are cognitive processing (consumer's level of relationship with a brand through processing and elaboration in a particular consumer/brand interaction), affection (degree of positive affective relation with a brand) and activation (level of energy, effort and time spent on a brand). However, studies show that engagement depends on the utilitarian vs. hedonic motivation to consume the brand's products or services. Attitudes and satisfaction are known to lead to higher usage in hedonic rather than in utilitarian situations (Hepola, Leppäniemi & Karjaluoto, 2020). Indeed, online experiences can be engaging because users have a utilitarian experience (much more focused on the benefits of products such as characteristics or features) or an emotional experience (more focused on the affective and experiential side of the product) (Calder, Malthouse & Schaedel, 2009). Lee, Ha and Widdows (2011) show that pleasure can influence consumers' behavioural responses, in terms of their approach-avoidance behaviour. Through these findings the authors show that the product's visual appeal is important to create pleasure, thus leading to an approach behaviour. Similarly, the work by Eroglu, Machleit and Davis (2003) shows that both pleasure and arousal influence the consumer's approach-avoidance behaviour, in an online store. Kim and Johnson also show that the level of the user's

perceived information quality presents a significant connection with brand engagement, being a reliable predictor of this construct. Interesting conclusions were also drawn by Lu et al. (2014). In their study on web design, media richness positively influences attitude, which also plays its part as a mediator between the first construct and the probability of website users recommending the store to others (which can be interpreted as a descriptive behaviour of brand activation). Hence, we hypothesize that:

H3: Emotional responses (a. pleasure, b. arousal) positively influence brand engagement in an AR environment.

H4: Cognitive responses (a. attitude, b. perceived information quality) positively influence brand engagement in an AR environment.

2.4 Response: Willingness to Buy

In general, a consumer's willingness to buy refers to a future purchase intention of a particular product or service (Adelaar et al., 2003). Ultimately, it is within the interests of any marketer to know and raise every consumer's level of willingness to buy. According to Kim and Johnson (2016), within the S-O-R framework, purchase intention represents an intention to act favourably in response to informational stimuli related to brands or products. Given the fact that virtual brand experiences may affect a consumer's decision to try and purchase the brand offline, findings suggest that establishing a virtual world brand presence may be effective in increasing a consumer's interest in purchasing a brand and has the potential to result in real-world sales (Gabisch, 2011; Domina, Lee & MacGillivray, 2012). A consumer's interaction with a brand in the virtual environment may provide important information about their desire to develop a relationship with the brand in other marketing channels and serves as an opportunity for the marketer to assist in the buying process. Baker et al. (1992), in their study in the retail store environment, found that participants' willingness to purchase was enhanced as pleasure and arousal increased. More recently, results from research by Poushneh and Vasquez-Parraga (2017) indicated that an AR-enriched user experience empowers users to perform their tasks better and appreciate the functionality of the product. Therefore, being more entertaining and enabling potential customers to have virtual interactions can lead to increased user satisfaction and willingness to buy. As shown by Kim and Johnson (2016), in the context of online consumer social behaviours, pleasure and arousal can influence a consumer's level of willingness to buy. Hence:

H5a: Pleasure positively influences consumers' willingness to buy in an AR environment.

H5b: Arousal positively influences consumers' willingness to buy in an AR environment.

Moreover, Lang (1994) argued that arousal works as a V-shaped function of valence, i.e., both positive (pleasure) and negative (displeasure) valence have high levels of arousal. Later researchers suggest that arousal positively affects pleasure in cultural environments that elicit a high degree of experience (Miniero et al., 2014). Therefore, with AR being an environment that is used to inform consumers better about their choices, we posit that:

H5c: Arousal positively influences Pleasure in an AR environment.

Kim and Johnson (2016) found a connection between the consumer's perceived level of information quality in social media and the intention to purchase something in the future. Moreover, information quality is also linked to perceived value (Kim & Niehm, 2009), which is usually linked to consumers' attitudes (Hsu & Lin, 2016; Hajiha, Shahriri & Vakilian, 2014) according to the technology acceptance model (TAM) of Davis (1989). Moon et al. (2013) also suggest there is a relevant relationship between the user's brand attitude and their intention to purchase. Therefore, we posit that the same effects are expected in an AR environment, where technology acceptance is paramount for the success of positive behaviour. Hence:

H6a: Attitude positively influences consumers' willingness to buy in an AR environment.

H6b: Perceived Information Quality positively influences consumers' willingness to buy in an AR environment.

H6c: Perceived information quality positively influences Attitude.

Finally, as pointed out by Algharabat (2018), it is important to evaluate the relationship between brand engagement and willingness to buy. Previous research (Blasco-Arcas, Hernandez-Ortega, & Jimenez-Martinez, 2016; Papagiannidis et al., 2013; Mollen & Wilson, 2010) has successfully indicated in different contexts that brand engagement has a positive impact on purchase intention. Hence, the same effect is expected to occur in an AR environment:

H7: Brand engagement positively influences the consumer's willingness to buy in an AR environment.

Despite the evidence supporting each relationship in the current model, consumers vary in their demographics and other specific aspects. For example, studies show that gender influences individual performance to conduct visual space tasks in AR environments (Munoz-Montoya, et al., 2019). Men usually take more time to acquire knowledge in AR tasks than women. Age groups also behave differently in terms of technology usage, particularly in virtual environments (Loureiro & Guerreiro, 2018). For example, Millennial consumers, who are more tech savvy, enjoy using virtual environments more than other older age groups. Therefore, there is a need to control for such demographic characteristics when analysing consumer behaviour.

Figure 1 shows the conceptual model presented in the current paper.

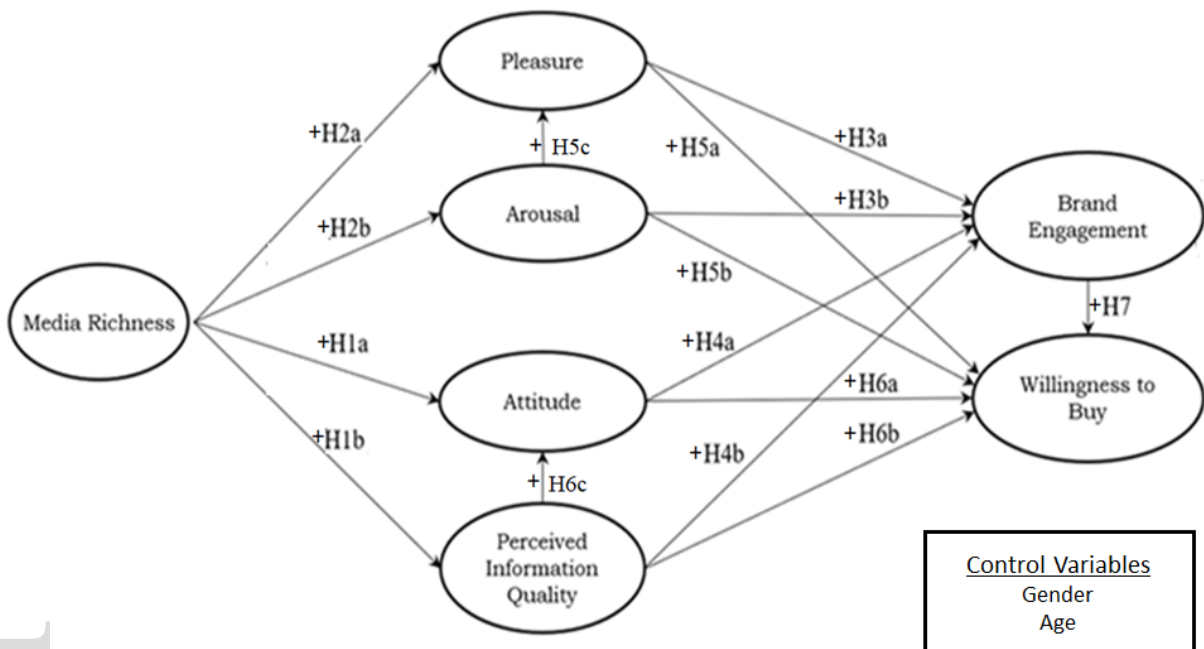


Figure 1 - Conceptual model with proposed hypotheses

3. Method

3.1 Research Design

A total of 85 subjects were invited to participate voluntarily at the entrance to a retail food store. The supermarket located in Lisbon, Portugal was about 300 m², with three distinct areas: groceries, snacks and retail products. The tests were distributed and scheduled between 9am and 8pm on 5 days in July 2018. All the subjects invited agreed to participate in the experiment and in the survey to access the constructs in the study (100% response rate). In order to create variability in the media richness of the shopping experience, 44 participants were randomly assigned to an avatar condition – to create a higher level of media richness

and the other 41 participants were presented with an experience without an avatar condition (2D information). In the condition without the avatar, suggestions on different products were made in different places throughout the store. To present these suggestions, static virtual billboards were developed, with the image and name of the product being displayed. Representing a lower level of media richness, only textual and 2D images were used in this condition. Representing a higher level of media richness, the second condition of the experiment was shown to a different group of participants using a 3D avatar (a shopping assistant). Such manipulations conform with the media richness theory and later studies that used such manipulations in the past (Maity, Dass & Kumar, 2018; Li, Daugherty, & Biocca, 2002; Suh & Lee, 2005). Here the information was not only shown visually, but also heard, as the avatar talked about it, and held the product in his hand. Such differences between an avatar/no avatar were used to create a more diverse environment that could be accessed in terms of media richness using a scale adapted from Maity, Dass and Kumar (2016) and Suh (1999). Figure 2 shows an illustration of the experiment without the avatar (on the left) and with the avatar (on the right). Due to the effects that hedonic products may have on pleasure and arousal (higher levels of arousal for hedonic than utilitarian products) (Kempf, 1999), we used functional products so that the experiment perceptions were focused on the AR environment and not so much on emotional evaluation of the product. Therefore, the brands used in the study all sold utilitarian products such as frozen fish, spaghetti, olive oil and tomato sauce. To control for endogenous variables and to make sure that the position of the brand inside the store was not influencing the results, participants were exposed to two different scenarios. In one scenario the brand was exposed when the consumer was passing by a non-related shelf and in a second scenario the brand was exposed when the participant was at the shelf of the product.



Figure 2 - Product suggestion in an aisle: Left (without avatar – low media richness) and Right (with avatar – high media richness)

3.2 Procedure

Subjects were firstly given a brief explanation of the context and main objectives of the experiment and then handed a consent form. Once the equipment was placed on the participant's head, the participants were then told to enter the store and start shopping. A final questionnaire was handed to them. The survey was translated and later back-translated to the consumers' local language by a bilingual expert and included scales to collect data regarding the subjects' perception of media richness (4 items) on a seven-point Likert scale (1="totally disagree to 7="totally agree") (adapted from Maity, Dass & Kumar, 2016; Suh, 1999), perceived information quality measured using 4 items on a five-point Likert scale ranging from 1="totally disagree" to 5="totally agree" (adapted from Yang et al., 2005), brand attitude (adapted from Mitchell and Olson (1981) measured using 3 items, also using a five-point Likert scale ranging from 1="totally disagree" to 5="totally agree"), emotional responses (pleasure and arousal (adapted from Lang (1980)) and measured using SAM pictorial scale, level of brand engagement (adapted from Hollebeek et al. (2014)) measured by 10 items using a seven-point Likert scale and their willingness to buy (adapted from Kim and Johnson (2016)) measured using 4 items also on a seven-point Likert scale ranging from 1="totally disagree to 7="totally agree". Appendix 1 shows the question for each item.

For procedural design, the survey was pretested using a group of 6 supermarket experts (managers) to ensure the survey questions were clear, concise, and specific for the created retail experience. After reading the survey, the experts advised on how to adapt the original scales to ensure the respondents were interpreting questions correctly, to clarify ambiguous questions and to ensure that the order of questions was not influencing the way the respondents would answer. A counterbalancing of the question order was done by separating the survey sections, making it less obvious which items intended to evaluate which constructs (Podsakoff et al., 2003). At the beginning of the questionnaire, we introduced a section containing personal demographic questions, such as age and gender, followed by questions about usual shopping experience and habits interspersed with additional demographic questions. A post-hoc analysis of Common Method Bias (CMB) was conducted using Harman's (1967) one factor test. The eigenvalue unrotated exploratory factor analysis solution detected seven factors, with the highest portion of the variance, 37.26%, being explained by a single factor. This result indicated that CMB was unlikely to be an issue for this study, as most of the variance was not due to a single factor (Fraj, Matute, & Melero, 2015).

4. Results

A total of 47 female and 38 male subjects participated in the study. Most of the participants were between 21 and 30 years old, 42.3% of the sample held a bachelor's degree, and 37.6% a master's degree. Because participants were required to be able to buy groceries by themselves for their household, the youngest participant was 18 years old. Table 1 shows the demographic information of participants.

Table 1 –Sample Characteristics

| Variables | Categories | Frequency | Percentage (%) |
|-----------------|--------------------|-----------|----------------|
| Age | Less than 20 Years | 9 | 10.6 |
| | 21-30 Years | 42 | 49.4 |
| | 31-40 Years | 5 | 5.9 |
| | 41-50 Years | 11 | 12.9 |
| | 51-60 Years | 12 | 14.1 |
| | More than 60 Year | 6 | 7.1 |
| Gender | Male | 38 | 44.7 |
| | Female | 47 | 55.3 |
| Education level | Below Graduate | 15 | 17.7 |
| | Graduate | 36 | 42.3 |
| | Post-Graduate | 32 | 37.6 |
| | Doctorate | 2 | 2.4 |

Note: The data refers to the 85 participants in the study.

4.1 Validity and Test of the Structural Model

A reflective Partial Least Squares Structural Equation Modeling (PLS-SEM) model was estimated with validity and reliability conforming to the standards and an SRMR=0.064. PLS-SEM is particularly interesting for experimental studies because the number of potential participants is usually restricted by a complex and time-consuming study (Hair, Ringle, &

Sarstedt, 2011). As for the minimum sample size for PLS-SEM, there should be a minimum threshold of ten times the maximum number of arrowheads pointing at a latent variable in the path model (Cohen, 1992; Hair et al., 2014). According to this guideline, the minimum sample for our model is 40 participants for each between-subjects condition. The 85 participants are therefore an acceptable number of subjects to use the PLS-SEM technique.

The internal reliability for media richness, pleasure, arousal, brand attitude, perceived information quality and willingness to buy constructs were established as both Dillon-Goldstein's rho (Composite Reliability) and Cronbach's alpha values were above the lower limit of 0.70 (Bagozzi & Yi, 1988). For the Convergent Validity test, all the construct's loadings concerning the AVE were above 0.50 (Hair et al., 2010; Bagozzi & Yi, 1988). Table 2 shows the results.

Table 2 - Results of the reflective construct measurements

| | Items | Loadings | AVE | CR | ρ_A | Cronbach's α |
|-------------------------------|-------|----------|-------|-------|----------|---------------------|
| Media Richness | MR1 | 0.923 | 0.717 | 0.882 | 0.890 | 0.803 |
| | MR2 | 0.926 | | | | |
| | MR4 | 0.665 | | | | |
| Brand Attitude | BA1 | 0.912 | 0.830 | 0.936 | 0.906 | 0.898 |
| | BA2 | 0.923 | | | | |
| | BA3 | 0.898 | | | | |
| Perceived Information Quality | PIQ1 | 0.799 | 0.605 | 0.860 | 0.807 | 0.787 |
| | PIQ2 | 0.734 | | | | |
| | PIQ3 | 0.815 | | | | |
| | PIQ4 | 0.762 | | | | |
| Willingness to Buy | WTB1 | 0.915 | 0.856 | 0.960 | 0.945 | 0.944 |
| | WTB2 | 0.938 | | | | |
| | WTB3 | 0.908 | | | | |
| | WTB4 | 0.940 | | | | |

Note: MR3 was deleted from the model due to an outer loading lower than 0.4 (Hair et al., 2014)

Finally, all constructs exhibited discriminant validity, as the confidence intervals for the Heterotrait-Monotrait ratio (HTMT) of the correlations between the reflective constructs were lower than 0.85, and the HTMT confidence intervals do not include 1 (Hair et al., 2014). For further analysis of the values obtained, the results are presented in Table 3.

Table 3 - Heterotrait-Monotrait Ratio (HTMT)

| | Arousal | Brand Attitude | Media Richness | Pleasure | Perceived Information Quality | Willingness to Buy |
|-------------------------------|---------|----------------|----------------|----------|-------------------------------|--------------------|
| Arousal | | | | | | |
| Brand Attitude | 0.229 | | | | | |
| Media Richness | 0.343 | 0.316 | | | | |
| Pleasure | 0.488 | 0.044 | 0.374 | | | |
| Perceived Information Quality | 0.230 | 0.333 | 0.764 | 0.198 | | |
| Willingness to Buy | 0.306 | 0.574 | 0.669 | 0.263 | 0.536 | |

Given the second-order brand engagement, a three-step approach was followed (Van Riel et al., 2017). Brand Engagement was represented by its three first-order constructs: Cognitive Processing (CP), Affection (AF) and Activation (AC). Figure 3 shows the results for the path coefficients.

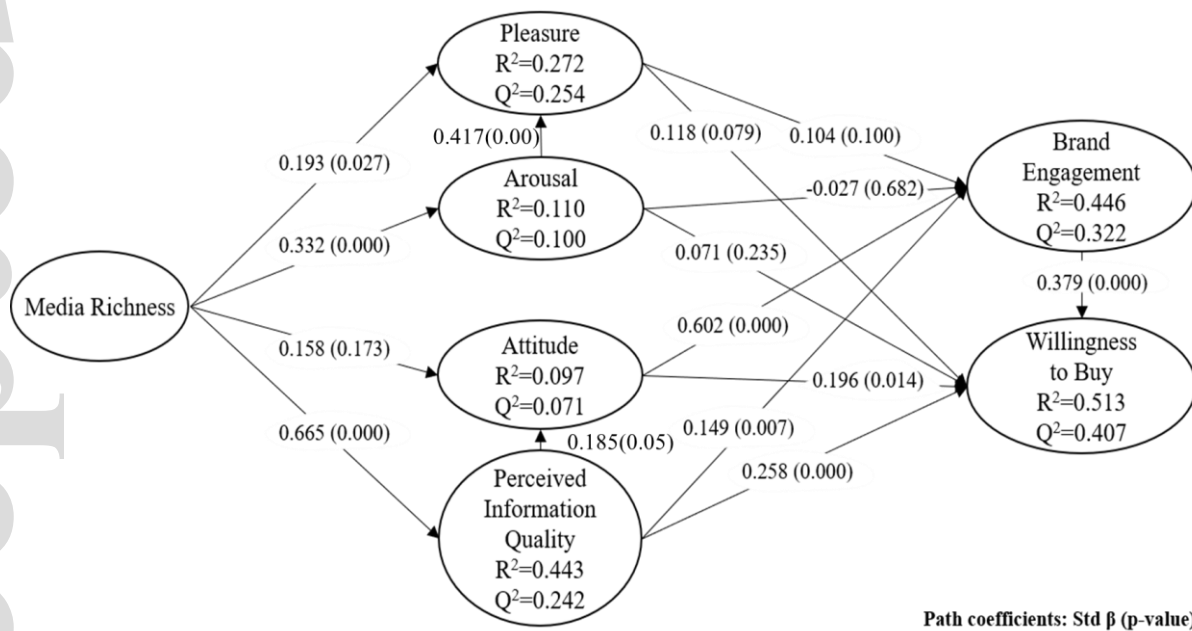


Figure 3- Overall model with pls-algorithm and bootstrapping results'

The overall strongest effect in the structural model can be found for the relationship between media richness and the construct of perceived information quality with a path coefficient value of $\beta = 0.665$. Nevertheless, the strong relationship between brand attitude and brand engagement is worth mentioning (with $\beta = 0.602$), as well as the relationship between brand

engagement and willingness to buy (with $\beta = 0.379$). Table 4 shows the detailed results after a bootstrapping procedure.

Table 4 – PLS-SEM Bootstrapping results

| Hypothesis | Relationship | Std β | Std Error | p-value | Decision | f ² | q ² | 95%CI LL | 95%CI UL |
|------------|--------------|-------------|-----------|----------|---------------|----------------|----------------|----------|----------|
| H1a | MR -> ATT | 0.158 | 0.116 | 0.173 | Not Supported | 0.015 | 0.010 | -0.034 | 0.348 |
| H1b | MR -> PIQ | 0.665 | 0.054 | 0.000*** | Supported | 0.794 | | 0.543 | 0.734 |
| H2a | MR -> P | 0.193 | 0.087 | 0.027* | Supported | 0.045 | 0.042 | 0.043 | 0.327 |
| H2b | MR -> A | 0.332 | 0.078 | 0.000*** | Supported | 0.124 | | 0.212 | 0.472 |
| H3a | P -> BE | 0.104 | 0.063 | 0.100 | Not Supported | 0.014 | 0.007 | 0.000 | 0.211 |
| H3b | A -> BE | -0.027 | 0.066 | 0.682 | Not Supported | 0.001 | 0.000 | -0.125 | 0.087 |
| H4a | ATT -> BE | 0.602 | 0.050 | 0.000*** | Supported | 0.576 | 0.341 | 0.507 | 0.674 |
| H4b | PIQ -> BE | 0.149 | 0.056 | 0.007** | Supported | 0.035 | 0.019 | 0.059 | 0.246 |
| H5a | P -> WTB | 0.118 | 0.067 | 0.079 | Not Supported | 0.021 | 0.012 | 0.015 | 0.240 |
| H5b | A -> WTB | 0.071 | 0.060 | 0.235 | Not Supported | 0.007 | 0.003 | -0.019 | 0.173 |
| H5c | A -> P | 0.417 | 0.090 | 0.000*** | Supported | 0.220 | 0.198 | 0.248 | 0.551 |
| H6a | ATT -> WTB | 0.196 | 0.080 | 0.014* | Supported | 0.044 | 0.030 | 0.063 | 0.324 |
| H6b | PIQ -> WTB | 0.258 | 0.063 | 0.000*** | Supported | 0.116 | 0.074 | 0.155 | 0.356 |
| H6c | PIQ -> ATT | 0.185 | 0.093 | 0.050* | Supported | 0.021 | 0.013 | 0.027 | 0.328 |
| H7 | BE -> WTB | 0.379 | 0.076 | 0.000*** | Supported | 0.163 | 0.106 | 0.257 | 0.508 |

***p<0.001 **p<0.01 *p<0.05

MR=Media Richness; P=Pleasure; A=Arousal; ATT=Attitude; PIQ=Perceived Information Quality; BE = Brand Engagement; WTB =Willingness to Buy

4.2 Control Measures

Regarding the control variables of gender, a multi-group analysis (MGA) revealed there were no differences between gender groups (appendix 2). An interaction moderation analysis revealed that only the relationship between media richness and arousal is significantly moderated by age (appendix 3). All the other relationships are not affected by age in the current study. Although as people become older, the relationship between media richness and arousal tends to decrease, this does not affect the overall model.

5. Discussion

5.1 Theoretical Contributions and Implications

The current paper used a real-world scenario to understand how the use of wearable augmented reality glasses can affect consumer-brand engagement and willingness to buy in an in-store scenario. Despite the growing number of studies in AR and VR, most studies have been focused on a restricted number of theories such as technology adoption, which are unable to study the effectiveness of promotional messages in consumer attitudes (Shahab, Ghazali & Mohtar, 2021). Researchers have also shown that wearable technologies can have a positive effect on consumers' well-being, thus suggesting an effect on buying intention (Morozova & Gurova, 2021). However, the current study is the first to compare how media richness in AR devices can affect engagement and buying intention through the mediating roles of emotion (arousal and pleasure) and cognitive responses (attitudes and information quality).

The current paper manipulated media richness using two scenarios (without an avatar/with an avatar), which was then accessed by asking participants about how such differences in media richness affected their behaviour. The results show that brand engagement and willingness to buy increase with consumer attitudes and perceived information quality of the AR setting, after being exposed to an AR experience in a real-world scenario, which is heightened by media richness. On the contrary, the results show that emotional responses (pleasure and arousal) do not play a significant role in increasing brand engagement and willingness to buy in AR.

These results confirm, for the first time in an AR environment, the studies by Lu et al. (2014) in a web design scenario, which showed that consumers' attitudes mediated the relationship between media richness and consumers' behavioural intentions. However, in the case of AR, the current study shows that the relationship between media richness and brand attitude is partially mediated by perceived information quality and not a direct mediator (not supporting H1a). Media richness was shown to increase perceived information quality. In fact, this effect is the strongest relationship in the model, thus supporting H1b (MR → PIQ: $\beta=0.665$ and $p\text{-value} < 0.001$). This result agrees with the studies by Han and Stoel (2017), who showed that media richness affects information quality in online fair-trade purchases.

As suggested by previous research, the level of media richness often predicts the behaviour of emotional responses (Aljukhadar & Senecal, 2017; Moes & Vliet, 2017; Han & Stoel, 2017). Indeed, in the case of AR experiences, media richness was also positively associated with pleasure (MR → P: $\beta=0.193$ and $p\text{-value}<0.05$) and arousal (MR → A: $\beta=0.332$ and $p\text{-value}<0.001$), thus confirming H2a and H2b. However, when assessing the

Accepted Article

impact of pleasure and arousal on brand engagement, there is only a significant effect at 0.1. This explains why pleasure describes very little of brand engagement. Contrary to the results obtained by Kim and Johnson (2016) and Lee, Ha and Widdows (2011), in the present study no support was found for H3b. Furthermore, when it comes to the relationship between pleasure or arousal, and willingness to buy, the results show that pleasure does not significantly affect willingness to buy, therefore not confirming H5a. However, the p-value, although not significant, does not go beyond 0.1, and therefore, the results suggest the possibility of the two constructs being connected. Although the research by Moes and Vliet (2017), Aljukhadar and Senecal (2017) and others (e.g., Lee, Ha and Widdows, 2011; Eroglu, Machleit and Davis, 2003) sustains that arousal leads to positive behavioural responses, when it comes to the results gathered for this relationship in the AR experiment, the effect is not significant, thus not supporting H5b. A possible explanation lies in the utilitarian type of products used in the current study. Although as media richness increases, emotions increase, this increment is not translated into higher engagement levels.

Focusing on the effects of cognitive responses to AR experiences on consumers' buying behaviour and level of brand engagement, the results show that attitude has a highly significant and strong effect on brand engagement (ATT → BE: $\beta = 0.602$, p-value < 0.001 and $f^2 > 0.35$), thus supporting H4a. Indeed, although attitudes are usually connected with behavioural responses and other brand engagement variables such as use/visit intention, recommendation, approach/avoidance behaviour (Lee, Ha, & Widdows, 2011; Moon et al., 2013; Lu et al., 2014; Pantano, Rese, & Baier, 2017), the current paper confirms that such attitudes also play a fundamental role in the case of AR environments.

According to Kim and Johnson (2016), perceived information quality significantly influences several behavioural responses, including brand engagement, but also intention for word-of-mouth, impulse buying, and future purchase intention. Although this study shows that perceived information quality and brand engagement have a positive relationship in AR environments (PIQ → BE: $\beta = 0.149$ and p-value < 0.01), the effect is weak ($0.02 \leq f^2 < 0.15$, Cohen, 1992), as can be confirmed in Table 4. Nonetheless, support is found for H4b and H6b. Additionally, brand attitude shows a similar effect on willingness to buy, and therefore H6a is also supported. Finally, the relationship between brand engagement and willingness to buy shows a significant and strong path coefficient (BE → WTB: $\beta = 0.379$ and p-value < 0.001), as well as a moderate effect size, thus giving support to H7. These results show that even in an AR environment, the greater the engagement, the greater the willingness to buy,

which confirms previous results in online environments (Blasco-Arcas, Hernandez-Ortega, & Jimenez-Martinez, 2016; Papagiannidis et al., 2013; Mollen & Wilson, 2010).

The current paper contributes to the literature on AR showing that although the media richness of AR environments affects both emotional and cognitive reactions, behaviour (brand engagement and willingness to buy) is heightened only by the cognitive assessment of the experience (attitudes and perceived information quality).

The current findings suggest that consumer experiences with the AR environment trigger both an emotional and cognitive evaluation of the store. However, this augmentation is more relevant in explaining brand engagement (a higher cognitive processing effect, higher levels of affection and activation) and willingness to buy when mediated by cognitive appraisal of the environment.

5.2 Implications for Practice

Managerial contributions may help brands to develop their interaction with consumers better using these new digital channels, specifically to make sure that a rich experience is designed in order to enhance attitudes and increase information quality to attract the consumer. One of the strongest effects found was that media richness drives information quality in an AR environment, which drives consumer responses. Therefore, it is important to be not only media rich but also content rich. Results show that as brands use richer interactions in the AR environment such as the use of avatars, particularly if they communicate high quality information, the better the consumer experience and the intention to buy.

5.3 Implications for Consumers

Although today there are still a limited number of AR devices available in the market, Facebook, Xiaomi and other suppliers are working to democratize the use of such wearable glasses (Rayban, 2021; Moon, 2021). The current real-world scenario explores a potential use case in a near future where consumers can turn on or off world augmentation to help their buying decisions. For example, instead of going around the store to buy their preferred products, they can also discover what are the most up-to-date promotions and how much stock they have in their fridge or storeroom. The study shows that consumers prefer a more media-rich environment to help them (avatar) over a simple 2D superimposed information, which suggests that social presence elements are very important to improve an AR experience and share high quality information.

5.4 Limitations and Future Research Directions

Even though this study provides useful insights into the topic of an AR retail shopping experience, it is not without limitations. First, the sample size was restricted due to the limitations of conducting the experiment in a real-world scenario: although such an environment allowed studying how consumers behaved while making their usual purchases. Getting the consent of participants when they entered the store increased the time spent per participant. Second, although we were able to test the model with consumers that were motivated to buy at the time of the study, further studies could confirm the results by using a random sample of the retail store's loyalty card customers in order to test the model with a representative sample of the retail store's consumers. Another limitation concerns the age of the sample. The study attracted mainly young, tech-savvy consumers. Younger consumers are known to deal with and adopt new virtual technologies (Loureiro & Guerreiro, 2018) more easily. Therefore, future research could explore the findings for older groups of customers. Finally, another limitation is due to the technological constraints of Hololens. Despite being the latest AR headset in the market, AR headset technology is still heavy and rather intrusive, which may influence the regular purchase decision. However, future technological developments may help researchers test the same conditions using smaller AR glasses, or even contact lenses. Indeed, several companies are on the verge of presenting easy to use AR glasses such as Vuzix Next Gen Smart Glasses (Vuzix, 2021), which can open the field for future research through longitudinal studies that explore the long-term effects of AR usage in retail. Future research could determine the conditions in which consumers are willing to use AR devices (even technically better versions such as contact lenses) and why they would want a "shopping assistant", thus exposing themselves to more advertising? Do customers who have a positive attitude towards using wearable AR devices differ from those who have a negative attitude? What is the relevance of AR in marketing and shopping experience in the future? Do positive cognitive and affective states of mind result in actual purchases?

6. Conclusion

At a time when managers in any sector are vying for customers' attention, the present study demonstrates the importance of meaningful content in all forms of communication, including an exciting, augmented reality retail shopping experience. Indeed, AR is expected to change the way consumers have access to information at the point of sale as companies invest in easy to wear AR devices and the market continues to grow (Statista, 2020). The current study used

a real-world scenario to explore how consumers can be affected by the degree of media richness in a store environment with augmented layers of information. The results revealed that a media-rich augmented reality experience influences how customers behave in a retail store, and how they make their purchase decisions. More specifically, we show that cognitive appraisal of the environment is a fundamental mediator for engagement and willingness to pay. Although media richness has been studied as an antecedent of consumer behaviour in other settings (Li, Daugherty, & Biocca, 2002; Holzwarth, Janiszewski, & Neumann, 2006), the current study is the first to analyse its impact in an AR scenario and through the mediating lenses of emotional and cognitive responses.

REFERENCES

- Adelaar, T., Chang, S., Lancendorfer, K. M., Lee, B., & Morimoto, M. (2003) Effects of media formats on emotions and impulse buying intent. *Journal of Information Technology*, 18 (4), 247-266.
- Algharabat, R. S. (2018) The Role of Telepresence and User Engagement in Co-Creation Value and Purchase Intention: Online Retail Context. *Journal of Internet Commerce*, 17(1), 1-25.
- Aljukhadar, M., & Senecal, S. (2017) Communicating online information via streaming video: The role of user goal. *Online Information Review*, 41(3), 378-397.
- Allen, C. T., Fournier, S., & Miller, F. (2008) Brands and their marketing makers. In C. P. Haughtvedt, P. M. Herr, & F. R. Kardes (Eds.), *Handbook of consumer psychology*: 781-821. New York, NY: Psychology Press.
- APKMirror (2021) *Dressing Room*. Available at: <https://www.apkmirror.com/apk/avametric/dressingroom/dressingroom-1-4-02-release/dressingroom-1-4-02-android-apk-download/> [Accessed 9th June 2021].
- Bagozzi, R. P., & Yi, Y. (1988) On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74-94.
- Baker, J., Levy, M., & Grewal, D. (1992) An experimental approach to making retail store environmental decisions. *Journal of Retailing*, 68, 445-60.
- Billinghurst, M., Clark, A., & Lee, G. (2015) A Survey of AR. *Foundations and Trends® in Human-Computer Interaction*. 8(2-3), 73-272.
- Blasco-Arcas, L., B. Hernandez-Ortega, & J. Jimenez-Martinez. (2016) Engagement platforms the role of emotions in fostering customer engagement and brand image in interactive media. *Journal of Service Theory and Practice*, 26(5), 559-89.
- Brengman, M., Willems, K., & Van Kerrebroeck, H. (2019) Can't touch this: the impact of augmented reality versus touch and non-touch interfaces on perceived ownership. *Virtual Reality*, 23(3), 269-280.

Caboni, F., & Hagberg, J. (2019) Augmented reality in retailing: a review of features, applications and value. *International Journal of Retail & Distribution Management*, 47(11), 1125-1140.

Calder, B. J., Malthouse, E. C., & Schaedel, U. (2009) An experimental study of the relationship between online engagement and advertising effectiveness. *Journal of Interactive Marketing*, 23(4), 321-331.

Chen, C. C., & Chang, Y. C. (2018) What drives purchase intention on Airbnb? Perspectives of consumer reviews, information quality, and media richness. *Telematics and Informatics*, 35(5), 1512-1523.

CNET. (2021) *Google Tango bringing indoor AR mapping to 400 Lowe's stores*. Available at: <https://www.cnet.com/news/google-tango-bringing-indoor-store-mapping-to-400-lowes-stores/> [Accessed 9th June 2021].

Cohen, J. (1992) A power primer. *Psychological Bulletin*, 112(1), 155-159.

Daassi, M., & Debbabi, S. (2021) Intention to reuse AR-based apps: The combined role of the sense of immersion, product presence and perceived realism. *Information & Management*, 58(4), 103453.

Daft, R. L., & Lengel, R. H. (1984) Information richness: A new approach to manager information processing and organization design. In B. Staw & L. L. Cummings (Eds.), *Research in organizational behavior*. Greenwich, Conn: JAI Press.

Davis, F. D. (1989) Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13, 319-340.

Domina, T., Lee, S. E., & MacGillivray, M. (2012) Understanding factors affecting consumer intention to shop in a virtual world. *Journal of Retailing and Consumer Services*, 19(6), 613-620.

Ducoffe, R. H. (1996) Advertising Value and Advertising on the Web. *Journal of Advertising Research*, 36(5), 21-35.

Eroglu, S. A., Machleit, K. A., & Davis, L. M. (2001) Atmospheric qualities of online retailing: a conceptual model and implications. *Journal of Business Research*, 54(5), 177-84.

Eroglu, S. A., Machleit, K. A., & Davis, L. M. (2003) Empirical Testing of a Model of Online Store Atmospherics and Shopper Responses. *Psychology and Marketing*, 20(2), 139-150.

Faust, F., Roepke, G., Catecati, T., Araujo, F., Ferreira, M. G. G, & Albertazzi, D. (2012) Use of AR in the Usability Evaluation of Products. *Work*, 41(1), 1164-7.

Flavián, C., Ibáñez-Sánchez, S., & Orús, C. (2019) The impact of virtual, augmented and mixed reality technologies on the customer experience. *Journal of Business Research*, 100, 547-560.

Fraj, E., Matute, J., & Melero, I. (2015) Environmental strategies and organizational competitiveness in the hotel industry: The role of learning and innovation as determinants of environmental success. *Tourism Management*, 46, 30-42.

Gabisch, J. A. (2011) Impact of Virtual Brand Experience on Purchase Intentions: The Role of Multichannel Congruence. *Journal of Electronic Commerce Research*, 12(4), 302-320.

Goldsmith, R. E. (2012) Brand engagement and brand loyalty. In A. Kapoor, & C. Kulshrestha (Eds.), *Branding and sustainable competitive advantage: Building virtual presence*, 121-135.

Guerreiro, J., Rita, P., & Trigueiros, D. (2015) Attention, emotions and cause-related marketing effectiveness. *European Journal of Marketing*, 49(11/12), 1728-1750.

Hair, J., Black, W., Babin, B., & Anderson, R. (2010) *Multivariate data analysis*. Prentice Hall. London.

Hair, F. J., Hult, G. T. M., Ringle, C. M., & Sarstedt, J. M. (2014) A primer on partial least squares structural equation modeling (PLS-SEM). *SAGE Publications*, 26(2), 1-307.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011) PLS-SEM: Indeed a silver bullet. *Journal of Marketing theory and Practice*, 19(2), 139-152.

- Hajiha, A., Shahriari, M., & Vakilian, N. (2014) The role of perceived value on customer E-shopping intention using technology acceptance model, (TAM). In 2014 IEEE International Conference on Industrial Engineering and Engineering Management (pp. 1136-1140). IEEE.
- Han, T. I., & Stoel, L. (2017) Using rich media to motivate fair-trade purchase. *Journal of Research in Interactive Marketing*, 11(4), 361-379.
- Harman, H. H. (1967) Modern factor analysis. Chicago: University of Chicago Press.
- Hepola, J., Leppäniemi, M., & Karjaluoto, H. (2020) Is it all about consumer engagement? Explaining continuance intention for utilitarian and hedonic service consumption. *Journal of Retailing and Consumer Services*, 57, 102232.
- Hilken, T., Heller, J., Chylinski, M., Keeling, D. I., Mahr, D., & de Ruyter, K. (2018) Making omnichannel an AR: the current and future state of the art. *Journal of Research in Interactive Marketing*, 12(4), 509-523.
- Holdack, E., Lurie-Stoyanov, K., & Fromme, H. F. (2020) The role of perceived enjoyment and perceived informativeness in assessing the acceptance of AR wearables. *Journal of Retailing and Consumer Services*, 102259.
- Hollebeek, L. D., Glynn, M. S., & Brodie, R. J. (2014) Consumer brand engagement in social media: Conceptualization, scale development and validation. *Journal of Interactive Marketing*, 28(2), 149-165.
- Hollebeek, L. D., Conduit, J., & Brodie, R. J. (2016) Strategic drivers, anticipated and unanticipated outcomes of customer engagement. *Journal of Marketing Management*, 32(5-6), 393-398.
- Holzwarth, M., Janiszewski, C., & Neumann, M. M. (2006) The Influence of Avatars on Online Consumer Shopping Behavior. *Journal of Marketing*, 70(4), 19-36.
- Hsu, C. L., & Lin, J. C. C. (2016) Effect of perceived value and social influences on mobile app stickiness and in-app purchase intention. *Technological Forecasting and Social Change*, 108, 42-53.

IKEA (2021) *Mobile Apps*. Available at: <https://www.ikea.com/pt/pt/customer-service/mobile-apps/> [Accessed 9th June 2021].

Jetter, J., Eimecke, J., & Rese, A. (2018) Augmented reality tools for industrial applications: What are potential key performance indicators and who benefits?. *Computers in Human Behavior*, 87, 18-33.

Keller, K. L. (2001) Building customer based brand equity: A blueprint for creating strong brands. *MSI Report*, 1-107.

Kempf, D. S. (1999) Attitude formation from product trial: Distinct roles of cognition and affect for hedonic and functional products. *Psychology & Marketing*, 16(1), 35-50.

Kim, A. J., & Johnson, K. K. P. (2016) Power of consumers using social media: Examining the influences of brand-related user-generated content on Facebook. *Computers in Human Behavior*, 58, 98-108.

Kim, H., & Niehm, L. S. (2009) The Impact of Website Quality on Information Quality, Value, and Loyalty Intentions in Apparel Retailing. *Journal of Interactive Marketing*, 23(3), 221-233.

Lang, P. J. (1980) Behavioral treatment and bio-behavioral assessment: Computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), *Technology in mental health care delivery systems*, 119-137. Norwood: Ablex.

Lang, P. J. (1994) The motivational organization of emotion: Affect– reflex connections. In S. H. M. van Goozen & N. E. Van de Poll (Eds.), *Emotions: Essays on emotion theory* (pp. 61–93). Hillsdale, NJ: Erlbaum.

Lee, S. A., Lee, M., & Jeong, M. (2021) The role of virtual reality on information sharing and seeking behaviors. *Journal of Hospitality and Tourism Management*, 46, 215-223.

Lee, S., Ha, S., & Widdows, R. (2011) Consumer responses to high-technology products: Product attributes, cognition, and emotions. *Journal of Business Research*, 64(11), 1195-1200.

Lemon&Orange (2021) *Timberland – Virtual Fitting Room*. Available at: https://lemonandorange.com/portfolio_item/timberland-campaign/ [Accessed 9th June 2021].

Li, H., Daugherty, T., & Biocca, F. (2002) Impact of 3-D Advertising on Product Knowledge, Brand Attitude, and Purchase Intention: The Mediating Role of Presence. *Journal of Advertising*, 31(3), 43–57.

Lin, H. F., & Chen, C. H. (2017) Combining the Technology Acceptance Model and Uses and Gratifications Theory to examine the usage behavior of an Augmented Reality Tour-sharing Application. *Symmetry*, 9(7), 113.

Loureiro, S. M. C., & Guerreiro, J. (2018) Psychological Behavior of Generation Y: Living between Real and Virtual Reality. Millennials: Characteristics, Trends and Perspectives, 67-90.

Loureiro, S. M. C., Guerreiro, J., & Ali, F. (2020) 20 years of research on virtual reality and augmented reality in tourism context: A text-mining approach. *Tourism Management*, 77, 104028.

Lu, Y., Kim, Y., Dou, X., & Kumar, S. (2014) Promote physical activity among college students: Using media richness and interactivity in web design. *Computers in Human Behavior*, 41, 40-50.

Magic Leap (2021) *Magic Leap 1 is a wearable computer for enterprise productivity*. Available at: <https://www.magicleap.com/en-us/magic-leap-1> [Accessed 9th June 2021].

Maity, M., Dass, M., & Kumar, P. (2018) The impact of media richness on consumer information search and choice. *Journal of Business Research*, 87, 36-45.

McLean, G., & Wilson, A. (2019) Shopping in the digital world: Examining customer engagement through augmented reality mobile applications. *Computers in Human Behavior*, 101, 210-224.

Mehrabian, A., & Russell, J.A. (1974) *An Approach to Environmental Psychology*. Cambridge, MA: MIT Press.

Microsoft (2021) *Microsoft Hololens*. Available at: <https://www.microsoft.com/en-us/hololens> [Accessed 14th April 2021].

Milgram, P., & Kishino, F. (1994) A taxonomy of mixed reality virtual displays. *Institute of Electronics, Information, and Communication Engineers Transactions on Information and Systems*, E77-D (9), 1321-1329.

Miniero, G., Rurale, A., & Addis, M. (2014) Effects of arousal, dominance, and their interaction on pleasure in a cultural environment. *Psychology & Marketing*, 31(8), 628-634.

Mitchell, A. A., & Olson, J. C. (1981) Are Product Attribute Beliefs the Only Mediator of Advertising Effects on Brand Attitude? *Journal of Marketing Research*, 18(3), 318-332.

Moes, A., & Vliet, H. van. (2017) The online appeal of the physical shop: How a physical store can benefit from a virtual representation. *Heliyon*, 3(6), e00336.

Mollen, A., & Wilson, H. (2010) Engagement, Telepresence and Interactivity in Online Consumer Experience: Reconciling Scholastic and Managerial Perspectives. *Journal of Business Research*. 63(9-10), 919-925.

Moon, J. H., Kim, E., Choi, S. M., & Sung, Y. (2013) Keep the Social in Social Media: The Role of Social Interaction in Avatar-Based Virtual Shopping. *Journal of Interactive Advertising*, 13(May 2014), 14-26.

Moon (2021). *Xiaomi launches its own smart glasses, of course*. Available at <https://techcrunch.com/2021/09/14/xiaomi-launches-its-own-smart-glasses-of-course/> [Accessed 20th September 2021].

Morozova, D., & Gurova, O. (2021) Being like others vs. being different: Wearable technology and daily practices of 50+ consumers in Russia and Finland. *International Journal of Consumer Studies*, <http://doi.org/10.1111/ijcs.12656>.

Munoz-Montoya, F., Fidalgo, C., Juan, M., & Mendez-Lopez, M. (2019) Memory for object location in augmented reality: The role of gender and the relationship among spatial and anxiety outcomes. *Frontiers in Human Neuroscience*, 13, 113.

Nikhashemi, S. R., Knight, H. H., Nusair, K., & Liat, C. B. (2021) Augmented reality in smart retailing: A (n)(A) Symmetric Approach to continuous intention to use retail brands' mobile AR apps. *Journal of Retailing and Consumer Services*, 60, 102464.

Pantano, E., Rese, A., & Baier, D. (2017) Enhancing the online decision-making process by using AR: A two country comparison of youth markets. *Journal of Retailing and Consumer Services*, 38(April), 81–95.

Papagiannidis, S., Pantano, E., See-To, E., & Bourlakis, M. (2013) Modelling the determinants of a simulated experience in a virtual retail store and users' product purchasing intentions. *Journal of Marketing Management*, 29(13/14),1462-92.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003) Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879-903.

Porter, M. E., & Heppelmann, J. E. (2017) Why Every Organization Needs an AR Strategy. *Harvard Business Review*, December: 46-58.

Poushneh, A., & Vasquez-Parraga, A. Z. (2017) Discernible impact of augmented reality on retail customer's experience, satisfaction and willingness to buy. *Journal of Retailing and Consumer Services*, 34, 229-234.

Poushneh, A. (2018) Augmented reality in retail: A trade-off between user's control of access to personal information and augmentation quality. *Journal of Retailing and Consumer Services*, 41(December 2017), 169-176.

Rayban(2021). *Ray-Ban Stories*. Available at <https://www.ray-ban.com/usa/discover-ray-ban-stories/clp> [Accessed 20th September 2021].

Scholz, J., & Smith, A. N. (2016) Augmented reality: Designing immersive experiences that maximize consumer engagement. *Business Horizons*,59(2), 149-161.

Shahab, M. H., Ghazali, E., & Mohtar, M. (2021). The role of elaboration likelihood model in consumer behaviour research and its extension to new technologies: A review and future research agenda. *International Journal of Consumer Studies*, 45(4), 664-689.

Statista (2020) *Augmented reality (AR) market size worldwide in 2017, 2018 and 2025*. Available at: <https://www.statista.com/statistics/897587/world-augmented-reality-market-value/> [Accessed 12th May 2021].

Statista (2021) *Augmented reality (AR) glasses unit sales worldwide from 2019 to 2024*. Available at: <https://www.statista.com/statistics/610496/smart-ar-glasses-shipments-worldwide/> [Accessed 9th June 2021].

Suh, K. S. (1999) Impact of communication medium on task performance and satisfaction: an examination of media-richness theory. *Information & Management*, 35(5), 295-312.

Suh, K. S., & Lee, Y. E. (2005) The effects of VR on consumer learning: An empirical investigation. *MIS Quarterly*, 29(4), 673-697.

Suh, A., & Prophet, J. (2018) The state of immersive technology research: A literature analysis. *Computers in Human Behavior*, 86, 77-90.

Sundar, S. S. (2007) Social psychology of interactivity in human–website interaction. In A. Joinson (Ed.), *Oxford handbook of Internet Psychology* (p. 89–102). Oxford, UK: Oxford University Press.

van Doorn, J., Lemon, K. N., Mittal, V., Nass, S., Peck, D., Pirner, P., & Verhoef, P.C. (2010) Customer Engagement Behavior: Theoretical Foundations and Research Directions. *Journal of Service Research*, 13(3), 253-66.

Van Kerrebroeck, H., Brengman, M., & Willems, K. (2017) When brands come to life: experimental research on the vividness effect of Virtual Reality in transformational marketing communications. *Virtual Reality*, 21(4), 177-191.

Van Riel, A. C. R., Henseler, J., Kemény, I., & Sasovova, Z. (2017) Estimating hierarchical constructs using consistent partial least squares: The case of second-order composites of common factors. *Industrial Management and Data Systems*, 117(3), 459-477.

Verhagen, T., Vonkeman, C., Feldberg, F. & Verhagen, P. (2014) Present It Like It Is Here: Creating Local Presence to Improve Online Product Experiences. *Computers in Human Behavior*, 39(C), 270-80.

Vivek, S., Beatty, S. E., & Morgan, R. (2012) Customer Engagement: Exploring Customer Relationships beyond Purchase. *Journal of Marketing Theory & Practice*, 20(2), 122-46.

Vuzix (2021) *Vuzix Blade Upgraded Smart Glasses*. Available at: <https://www.vuzix.com/products/blade-smart-glasses-upgraded> [Accessed 9th June 2021].

Whang, J. B., Song, J. H., Choi, B., & Lee, J. H. (2021) The effect of Augmented Reality on purchase intention of beauty products: The roles of consumers' control. *Journal of Business Research*, 133, 275-284.

Yang, Z., Cai, S., Zhou, Z., & Zhou, N. (2005) Development and validation of an instrument to measure user perceived service quality of information presenting Web portals. *Information and Management*, 42(4), 575-589.

Yaoyuneyong, G., Foster, J. K., & Flynn, L. R. (2014) Factors impacting the efficacy of augmented reality virtual dressing room technology as a tool for online visual merchandising. *Journal of Global Fashion Marketing*, 5(4), 283-296.

Yim, M. Y. C., Chu, S. C., & Sauer, P. L. (2017) Is augmented reality technology an effective tool for e-commerce? An interactivity and vividness perspective. *Journal of Interactive Marketing*, 39, 89-103.

Appendix 1

| Items | Adapted Item Description | Scale | Adapted from |
|-------|--------------------------|-------|--------------|
|-------|--------------------------|-------|--------------|

| | | | | |
|------------------------------|------|---|----------------------|---|
| Media Richness | MR1 | While shopping at the store, the Shopping Assistant helped me make a good decision. | 7-point Likert scale | Maity, Dass & Kumar (2016); Suh, (1999) |
| Richness | MR2 | While shopping at the store, the Shopping Assistant made it easy for me to reach a decision. | | |
| | MR3 | While shopping at the store, the conditions provided by the Shopping Assistant slow down the decision-making process. | | |
| | MR4 | While shopping with the Shopping Assistant, I can easily understand things. | | |
| | | | | |
| Brand Attitude | BA1 | How do you rate the brand (w, x, y, z)? : Bad - Good | 5-point Likert scale | Mitchell and Olson (1981) |
| Attitude | BA2 | How do you rate the brand (w, x, y, z)? : dislike very much - like very much | | |
| | BA3 | How do you rate the brand (w, x, y, z) on quality? | | |
| | | | | |
| Perceived Information | PIQ1 | The information provided by the Shopping Assistant was relevant to me. | 5-point Likert scale | Yang et al. (2005) |
| Quality | PIQ2 | The information provided by the Shopping Assistant was customized. | | |
| | PIQ3 | The information provided by the Shopping Assistant had valuable tips about the products and brands presented. | | |
| | PIQ4 | The information provided by the Shopping Assistant is unique. | | |
| | | | | |
| Willingness to Buy | WTB1 | The likelihood of purchasing the products (w, x, y, z) suggested by the Shopping Assistant is high. | 7-point Likert scale | Kim and Johnson (2016) |
| | WTB2 | The probability that I would consider buying products from this brand is high. | | |

| | | | | |
|-------------------------|--------------------------|--|----------------------|-------------------------|
| | WTB3 | I would consider buying the products (w, x, y, z) suggested by the Shopping Assistant. | | |
| | WTB4 | My willingness to buy the products (w, x, y, z) suggested by the shopping Assistant is high. | | |
| Brand Engagement | Cognitive Processing BE1 | Using the brand (w, x, y, z) gets me to think about it. | 7-point Likert scale | Hollebeek et al. (2014) |
| | Cognitive Processing BE2 | I think about the brand (w, x, y, z) a lot when I'm using it. | | |
| | Cognitive Processing BE3 | Using the brand (w, x, y, z) stimulates my interest to learn more about it. | | |
| | Cognitive Processing BE4 | I feel very positive when I use... brand (w, x, y, z). | | |
| | Affection BE5 | Using brand (w, x, y, z) makes me happy. | | |
| | Affection BE6 | I feel good when I use the brand (w, x, y, z) | | |
| | Affection BE7 | I'm proud to use brand (w, x, y, z). | | |
| | Activation BE8 | I spend a lot of time using brand (w, x, y, z), compared to other brands of the same category of products. | | |
| | Activation BE9 | Whenever I'm using this category of products, I usually use the brand (w, x, y, z). | | |
| | Activation BE10 | Brand (w, x, y, z) is one of the brands I usually use when I use this category of products. | | |

Note: w: Spaghetti/Nacional Brand; x: Tomato Sauce/Guloso Brand; y: Olive Oil/Oliveira da Serra Brand; z: FrozenFish/Pescanova Brand

| Relationship | Coef. | -Diff | p-value |
|--------------|-------|-------|---------|
|--------------|-------|-------|---------|

| | | |
|------------|-------|------|
| A -> BE | -.021 | .875 |
| A -> P | .229 | .147 |
| A -> WTB | .025 | .818 |
| ATT -> BE | .057 | .593 |
| ATT -> WTB | -.009 | .934 |
| BE -> WTB | -.089 | .512 |
| MR -> A | -.114 | .488 |
| MR -> ATT | .154 | .535 |
| MR -> PIQ | -.050 | .729 |
| MR -> P | -.033 | .826 |
| PIQ -> ATT | -.211 | .298 |
| PIQ -> BE | -.058 | .598 |
| PIQ -> WTB | .018 | .879 |
| P -> BE | .062 | .669 |
| P -> WTB | -.161 | .299 |

Appendix 2 – MGA Results for Gender Groups

| Relationship | Std β | p-value |
|--------------|-------------|---------|
| A -> BE | -.092 | .225 |
| A -> P | -.014 | .871 |
| A -> WTB | -.127 | .053 |
| ATT -> BE | -.120 | .089 |
| ATT -> WTB | .031 | .672 |
| BE -> WTB | -.010 | .887 |
| MR -> A | -.252 | .010 |
| MR -> ATT | .070 | .580 |
| MR -> PIQ | .107 | .103 |
| MR -> P | .115 | .333 |
| PIQ -> ATT | -.062 | .427 |
| PIQ -> BE | .045 | .402 |
| PIQ -> WTB | .046 | .436 |
| P -> BE | -.055 | .410 |
| P -> WTB | .037 | .527 |

Appendix 3 – Interaction Moderation effect for Age Groups