Bridging physical and digital worlds: The use of AR in mobile commerce apps
Social and technological facilitating factors and their influence on consumers

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To Grandmama.

"I think that there is only one way to science – or to philosophy, for that matter: to meet a problem, to see its beauty and fall in love with it; to get married to it, and to live with it happily, till death do you part - unless you should meet another and even more fascinating problem, or unless, indeed, you should obtain a solution. But even if you obtain a solution, you may then discover, to your delight, the existence of a whole family of enchanting though perhaps difficult problem children for whose welfare you may work, with a purpose, to the end of your days."

Karl Popper, *Realism and The Aim of Science.*

Biography

Mafalda Teles Roxo got her Bachelor (BSc) in Languages and International Relations at the Faculty of Arts and Humanities of University of Porto (FLUP).

In 2014 she earned the MSc in Marketing at Católica Porto Business School, with the dissertation "Export Performance: The Case of the Exports of Cork Stoppers from Portugal to Emergent Economies", supervised by professor Susana Costa e Silva.

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She was a guest lecturer in Faculty of Economics of the University of the Algarve (FEUALG), teaching a seminar of Consumer Psychology in the MSc in Marketing. Currently, she is an Invited Assistant Professor at FEP, teaching the course of Marketing to undergraduate students.

Throughout her academic course, she presented her PhD related research in international conferences such as World CIST'17, 2019 International ARVR, 2019 AMS World Marketing Congress, as well as represented FEP in the UKCGE Annual Conference 2017. She is a member of the Scientific Committee of the International Conference on Information Technology & Systems (ICITS); International Conference on Marketing and Technologies (ICMarkTech), International Conference on Tourism, Technology & Systems (ICOTTS).

She published part of this research in the Asian Journal of Business Research. She is also a reviewer for the Journal of Business Research, Journal of Marketing Theory and Practice, European Journal of Marketing and Journal of Medical Systems.

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Abstract

Augmented Reality (AR) has been establishing itself as a new marketing tool, which allows the enhancement of the real environment with layers of computer-generated information. The purpose of this work is to study the efficacy of the effects of AR on consumers when promoting a social m-commerce experience.

A mixed-method methodology is followed. Thirty-four semi-structured interviews were conducted, followed by a between-subjects pre-test-post-test experimental design. The latter was conducted to examine the role that the physical presence of peers, the virtual presence of in-app reviews, and the type of body visualisation had on consumers, their attitude toward AR and purchase intention. This study was relevant to analyse the underlying mechanisms of such effects.

The results found that an m-commerce experience tends to be a lonely one, although subjects acknowledge the need to interact with others. When focusing on attitude toward AR, the elements that contribute most to explain it are those related to the AR affordances and media characteristics – AR experience – and mood. Conversely, when the emphasis is on purchase intention, the most salient variables are those related to the mental presence of others, attachment to the physical store and body image.

Our current research suggests that managers should create high-quality AR experiences (e.g. regarding imagery quality) with the social dimension incorporated (by facilitating the experimentation of AR with others or allowing users to share it with others.)

We present a novel approach to AR marketing-related experiences since the emphasis is on the technology as leverage for m-commerce. To the best of our knowledge, this is the first research to study the effect of a shared AR experience (induced by the physical presence of others) on consumers and to analyse the roles played by different groups of people that may influence an individual (family, friends, influencers) on a subconscious level.

Keywords: augmented reality, m-commerce, experimental design, consumer behaviour, social presence, attitude toward AR, purchase intention.

Resumo

A Realidade Aumentada (RA) tem-se estabelecido como uma nova ferramenta de marketing que permite um enriquecimento mundo real com camadas de informações geradas por computador. O objetivo deste trabalho é estudar a eficácia dos efeitos da RA sobre os consumidores ao promover uma experiência social de m-commerce.

Seguiu-se uma abordagem de métodos mistos com a realização de 34 entrevistas semiestruturadas, seguidas por um desenho experimental. O último foi conduzido para examinar o papel que a presença física de colegas, a presença virtual de comentários na app e o tipo de visualização corporal exerce sobre os consumidores e sua atitude em relação à RA e intenção de compra. Este estudo foi relevante para entender os mecanismos subjacentes a esses efeitos.

Os resultados apontam que uma experiência de m-commerce tende a ser solitária, embora os sujeitos reconheçam a necessidade de interagir com os outros. Focando na atitude em relação à RA, os elementos que mais contribuem para explicá-la são relacionados as *affordances* e as *media characteristics* e humor. Por outro lado, quando o foco é intenção de compra, as variáveis relevantes são relacionadas com a presença mental de outras pessoas, apego à loja física e imagem corporal.

A nossa pesquisa atual sugere que os gestores devem criar experiências de RA de alta qualidade (em termos de imagem) incorporando a dimensão social (facilitando a experimentação da RA com outros, ou permitindo que os usuários a compartilhem com outros).

Apresentamos uma nova abordagem para as experiências relacionadas ao marketing baseado em RA, uma vez que a ênfase está na tecnologia a alavancar o m-commerce O mais importante é que esta é uma das primeiras pesquisas a estudar o efeito de uma experiência conjunta de RA (induzida pela física presença de outras pessoas) nos consumidores e analisar o papel que os diferentes grupos de pessoas que podem influenciar um indivíduo (família, amigos, influenciadores) desempenham ao nível do subconsciente.

Palavras-chave: realidade aumentada, m-commerce, desenho experimental, comportamento do consumidor, social presence, atitude em relação à RA, intenção de compra

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List of Acronyms

APP – Mobile Application

AR – Augmented Reality

ARSG - Augmented Reality Smartglasses

ARX – Augmented Reality Experience

AV – Augmented Virtuality

CME - Computer-Mediated Environments

COV - Covariate

DOF – Degree of Freedom

DV – Dependent Variable

EDA – Exploratory Data Analysis

FOMO – Fear of Missing Out

FOV – Field of View

HMD – Head-mounted displays

HMPD – Head-mounted projector displays

HUD – Head-up displays

HW – Hardware

HWD – Head-worn displays

IV – Independent Variable

KMO - Kaiser–Meyer–Olkin Measure of Sampling Adequacy

MAR – Mobile Augmented Reality

MB AR – Marker-based Augmented Reality

MC – Media Characteristics

ML AR – Markerless Augmented Reality

MR – Mixed Reality

OST HMD– Optical see-through HMD

PC – Principal Component

PCA – Principal Component Analysis

SCO – Social Comparison Orientation

SCT – Social Comparison Theory

SME - Social Media Engagement

SNS – Social Networking Sites

SW – Software

TAM – Technology Acceptance Model

TPB – Theory of Planned Behaviour

TRA – Theory of Reasoned Action

U&GT – Uses and Gratifications Theory

UI – User Interaction

UTAUT - Unified Theory of Acceptance and Use of Technology

UX – User Experience

VE – Virtual Environment

VR – Virtual Reality

VST HMD– Video see-through HMD

WOM – Word of Mouth

XR – Extended Reality

Glossary

Augmented Reality (AR): This technology is a blend of real and virtual worlds that uses displays, tracking systems and other technologies to superimpose digitally registered objects onto the real.

Calibration: This is the process of comparing measurements made with two different devices, the reference device and the device to be calibrated, which translates into an offline adjustment of measurements. In the case of AR, this is necessary to calibrate the system components, especially those related to the tracking system.

Degrees of Freedom (DOF): This is an independent dimension of measurement. In the case of AR, there is a register of digital and physical objects in a three-dimensional space, which requires six DOF, where three are for position and three for orientation. There are tracking systems that only use 3 DOF, such as gyroscopes or single-tracked LED.

Human-Computer Interaction (HCI): It is an area of knowledge that studies all aspects of the relationship between people and interactive technologies, i.e., that analyses the communication between human and computer (LaViola Jr., Kruijff, McMahan, Bowman, and Poupyrev, 2017).

Input device: It is a physical device/ hardware (HW) that allows the user to communicate with the computer.

Interaction Technique: This is the method that allows anyone to perform a task through the user interface (UI), which includes HW (input/output devices) and software (SW).

Mixed Reality (MR): This is a set of approaches to reality that includes AR and VR, representing the different levels of the blend between the real and the virtual world.

Output device: It is the physical device /HW that allows the computer to communicate with the user. They are commonly known as displays and can convey any sensory information (visual, auditory, touch, taste, olfactory).

Registration: It is the process that allows the fusion of virtual objects created by computers, with the image of the physical world captured by the camera, translating into the alignment of spatial properties. Registration technology can be tracker-based, knowledge-based, or computer vision-based (Yi-bo, Shao-peng, Zhi-hua, and Qiong, 2009).

Rendering: This is the process of converting a virtual world model into an image. Rendering approaches are used for both AR and Diminished Reality, i.e. removing elements from the visualisation.

Smartglasses: Smartglasses are a form of wearable computing (OST HMD) that allows the addition of digitally created information wherever the user is looking at (e.g., Microsoft HoloLens, Vuzix Blade, Epson Moverio, and Snap Spectacles)

Tracking: Tracking corresponds to the dynamic sensing measurement of the AR system, which is responsible for dynamic recording, estimating the position and orientation of objects in the physical world.

Ubiquitous Computing (Ubicomp): This is the ability of computers and IT infrastructures to be mobile, allowing users to access their computing power anytime and anywhere.

Usability: It is the characteristic of an artefact (interaction technique, device, UI) that affects the user's use of the artefact. This concept involves elements such as ease of use, user comfort, user task performance, among others.

User Experience (UX): Hassenzahl and Tractinsky (2006) consider that UX is a broad concept that goes beyond its instrumental dimension, involving an emotional and affective component (therefore subjective, as it depends on the internal state of the subject - mood, motivation), system characteristics (such as usability, functionality) and the context/environment in which the experience occurs (whether it is dynamic or temporally-bounded). Thus, to have a UX one has to have a user who interacts with a product/system or any element with an interface, and this user's experience with the system is observable and measurable.

User Interface (UI): This is the medium through which the user communicates with the computer, and the UI translates the user's actions/state (input) into a representation that the computer understands and can translate into an action/state (output) (LaViola Jr. et al., 2017).

UX Evaluation: This is summarised in the process of gauging/measuring UX aspects of a given artefact.

Virtual Environment (VE): This is a synthetic, spatial environment (commonly 3D) viewed from the first-person perspective, and this view is under the user's real-time control.

Virtual Reality (VR): It is a virtual environment (VE) where the user is immersed in a digitally generated reality. Thus, all the sensory inputs it has (namely visual and auditory inputs are generated through a computer). VR represents the opposite extreme to the physical/real world in the virtual continuum.

Chapter 1 Introduction

We aim to address the efficacy of changes in some social, psychological, and technological/technical factors of augmented reality (AR) m-commerce applications (apps) in consumers' attitude toward technology and purchase intention.

This chapter provides a general overview of current research. Therefore, it starts with an introduction to the research motivation and context, where the increasing use of novel technologies in retail is explored, as well as the incorporation of AR technology in business models. Then, we present the research objectives, the statement of the problem, and the research questions. We also introduce the methodological approach, which is followed by the presentation of the outline of the thesis.

1.1. Research Motivation and Context

Several technologies are available for firms to implement in their business models to leverage their marketing strategies (Varadarajan et al., 2010). The applications of such technologies provide a wide range of benefits, from the development of unique and immersive shopping and customer experiences (Flavián, Ibáñez-Sánchez, and Orús, 2019), an increase in advertising interactivity, to drive consumer engagement, thus leveraging a company's competitive advantage. These innovations impact both firms and consumers (Grewal, Noble, Roggeveen, and Nordfalt, 2020; Varadarajan et al., 2010) (for a thorough review see Caboni and Hagberg (2019)), who are increasingly delivering and demanding, respectively, experiences instead of just goods/services (Pine II and Gilmore, 1998). Although the impact on firms can be assessed (through a quantitative means such as the number of likes on social network sites or the number of sales), their effect on consumers is not so straightforwardly measured. Therefore, there is a need to study the impact of the incorporation of new technologies on consumers.

The rise of novel technologies such as RFID (radio-frequency identification tags) (Rashid, Peig, and Pous, 2015), augmented reality (AR) (Cruz et al., 2019), robots (Bertacchini, Bilotta, and Pantano, 2017; Niemelä, Heikkilä, and Lammi, 2017), artificial intelligence (Huang and Rust, 2018) and the sophistication of the existing ones, e.g. internet-based interactive technologies, social networks, smartphones and wi-fi, have been reshaping the retail landscape. This change in the landscape promotes new types of communication (Hoffman and Novak, 1996; Novak and Hoffman, 1997), the reliance on omnichannel-based strategies (Berman, 2019), the rise of the mobile channel (Fulgoni and Lipsman, 2016; Kang, Mun, and Johnson, 2015), the growth of customer(s)-firm(s) interactions across multiple touchpoints and channels (Lemon and Verhoef, 2016).

In recent years, AR has grown to be one of the most heavily applied technologies by retailers (Grewal, Roggeveen, and Nordfält, 2017). This growth happens because AR is a highly suitable technology for retail, by providing a wide range of benefits for both firms and consumers, by enhancing human perception and blending elements from traditional and digital stores (Azuma et al., 2001; Caboni and Hagberg, 2019; Cruz et al., 2019; Grewal et al., 2020).

The impact of AR can be felt at different moments, helping the following aspects (for an overview see Hilken et al. (2018)):

- facilitating firms/retailers operations (Grewal et al., 2020),
- increasing customers engagement (Scholz and Smith, 2016),
- leveraging shopping experience (Javornik, 2016a; Poushneh, 2018),
- promoting customer(s)-brand(s) relationships (McLean and Wilson, 2019; Scholz and Duffy, 2018),
- affecting brands perceptions and attitudes (Brito, Stoyanova, and Coelho, 2018; Rauschnabel, Felix, and Hinsch, 2019), and
- the decision-making process (Sihi, 2018).

It also affects a wide variety of consumer responses, such as:

- behavioural intentions (Park and Yoo, 2020; Paulo, Rita, Oliveira, and Moro, 2018),
- cognitive responses (Javornik, 2016b), and
- engagement (tom Dieck, Jung, and Rauschnabel, 2018; Tsai, 2019).

Product experience is another dimension affected by AR technology because AR promotes more immersive and profound experiences (Bonnin, 2020; Yim, Chu, and Sauer, 2017). Thus, the impact created by AR is partly due to some novelty, but most importantly, due to its inherent characteristics and the responses it elicits in consumers.

When taking into consideration the media characteristics (MC) of interactive technologies such as AR, interactivity[1] is the one whose impact is most frequently studied (Javornik, 2016a). Studies found that the controllability, responsiveness and playfulness of interactivity are antecedents of the elaboration and quality of mental imagery (a process that involves brain processing) (Park and Yoo, 2020). Moreover, body image can play a moderating role in the relationship between this MC and intention to adopt AR (Yim and Park, 2019). It was also found that interactivity positively influences the perceived ease of use, usefulness and enjoyment (McLean and Wilson, 2019).

Another media characteristic that is studied is augmentation[2], with perceived augmentation quality having a positive and significative impact on inspiration (Rauschnabel et al., 2019). Moreover, high-quality augmentation facilitates shoppers purchases, assisting with their purchase decision process (Poushneh, 2018). Nonetheless, the topic of augmentation requires further study, and also requires validation of its measurement scales (Javornik, 2016b).

Another ability related to AR is the enhancement of users' mental imagery[3] since AR helps users to generate 3D product representations and this technology can allow users to manipulate the digital content, thus facilitating mental imagery processes (Heller, Chylinski, de Ruyter, Mahr, and Keeling, 2019a). Another process influenced by the enhancement of human perception caused by AR is mental intangibility. Therefore, using AR that enables sensory feedback and control modalities other than just the visual (e.g. touch and voice) reduces consumers' mental intangibility while strengthening their decision comfort and consequently increases consumers' willingness to pay for a product (Heller, Chylinski, de Ruyter, Mahr, and Keeling, 2019b).

More recently, new forms of AR have emerged; namely Social Augmented Reality. This type of AR allows users to try-out different products (e.g. clothes, make-up, decorate rooms) and to interact with others (peers, family) by sharing their created content using an AR platform (Grewal et al., 2020; Hilken, Keeling, de Ruyter, Mahr, and Chylinski, 2020). In this way, we realise these new technologies that enable high levels of social

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[1] Steuer (1992, p. 84) defines interactivity as "the extent to which users can participate in modifying the form and content of a mediated environment in real time".

[2] Augmentation can be understood as the ability of technology to add additional virtual and dynamic capabilities/content to real systems (Billinghurst et al., 2014).

[3] Mental imagery is "a process by which visual information is represented in the working memory" (MacInnis and Price, 1987, p. 473).

presence are becoming more relevant. At present, there is a paucity in studies focusing on their impact, because, on the one hand, even though it is positive to increase the levels of social presence within the retail environment, on the other hand, the downside of social presence is something that has yet to be explored (Grewal et al., 2020; Hilken et al., 2020).

Taking into consideration what was mentioned above, the conducting line of this study is supported by social psychology within mobile commerce (m-commerce). We adopt the social psychology standpoint, not only because of the call for an understanding of social presence in the context of new retail technologies (Grewal et al., 2020) but also because the human being is a social being who depends on others for their survival. Besides, and as the literature suggests, shopping is a social activity/experience (Borges, Chebat, and Babin, 2010) where subjects interact with “real, implied, or imagined” people (Latané, 1981), or even virtual, as the e-vendors (Martínez-López, Esteban-Millat, Argila, and Rejón-Guardia, 2015).

Trevinal and Stenger (2014) emphasise that the social perspective is one of the relevant dimensions of online shopping experiences, stressing the role of interaction with peers on social networks, the presence of companions in the mobile shopping process (friends and peers), and the inevitable role that online reviews play. Past studies on AR focus on the impact of social influence in the social context of attitude formation, drawing on the influence of subjective norms in AR acceptance (Perannagari and Chakrabarti, 2019). However, this positioning is somehow narrow, considering that there are multiple sources of influences, whose study is not segmented, and some of them are relatively new, like Social Networks Influencers.

This discussion about the rise of smart retailing and the novel technologies it regards is even more relevant for a specific fringe of the society – Generation Z (or Gen Zers, late millennials, young adults). These young people were born from 1995 onward and were educated according to a digital/wi-fi culture (Bassiouni and Hackley, 2014). As a consequence, they are tech-savvy/digital natives, and they attend(ed) college. These young adults are used to just-in-time information, are always connected to social media, and they can multitask (Prensky, 2001b; Roblek, Mesko, Dimovski, and Peterlin, 2019). Simultaneously they pursue innovation, convenience, security and escapism (Wood, 2013).

Gen Zers tend to favour mobile devices usage and being in control of the content they see, which should be innovative (Smith, 2019; Southgate, 2017). This generation values interactivity (one of the most salient media characteristics of AR) and pays particular attention to aesthetics (both visual and audio) (Mangold and Smith, 2012; Southgate, 2017). Moreover, this generational group is firstly influenced by their friends and family. Secondly by online reviews, thirdly by endorsements social media influencers (especially women) and finally by traditional celebrities (Droesch, 2020; Mangold and Smith, 2012; Morning Consult, 2019; Smith, 2019).

From an economic standpoint, this generation is expected to account for $29 to $143 billion in direct spending, in 2020, while they represent $143 billion in buying power, part of which is spent on clothes or cosmetics (i.e., products susceptible to be presented using AR technology) (Fromm, 2018). Also, a survey conducted in the USA found that the majority of Gen Zers use their smartphones/tablets to search for products information, to purchase products/services, or even to use mobile wallets or shared economy service apps (eMarketer, 2019).

Regarding Gen Z technological attachment to smart technologies, there is a consensus concerning that they use their smartphone for shopping, mobile payments, self-checkout, favouring convenience and time-saving processes (Priporas, Stylos, and Fotiadis, 2017). For the future of smart technology in retailing, Gen Zers expect that product selection, information and speed of transactions will be the areas most affected by smart technologies, and they anticipate a negative impact on such technologies in in-store retailing since they believe shopping is a social experience which cannot be replicated in a virtual environment (Priporas et al., 2017).

Some research gaps still need to be addressed with regard to the social context of the use of an AR m-commerce app. More precisely, the different roles played by people that have contact with the consumer: family, peers/friends, digital influencers, experts, online reviews & ratings, and their impact on attitude towards AR and purchase intention. Additionally, little is known regarding m-commerce experiences in the following scenarios:

- The circumstance when consumers are accompanied or unaccompanied and the respective impact on attitude towards AR, body image, purchase intention and a segmented mental influence of others,
- The event of having the virtual presence of others (materialised in reviews and ratings),

- The role that having a full-body visualisation against only a small part has on subjects.

1.2. Research Objective, Problem and Questions

Research goals and aims

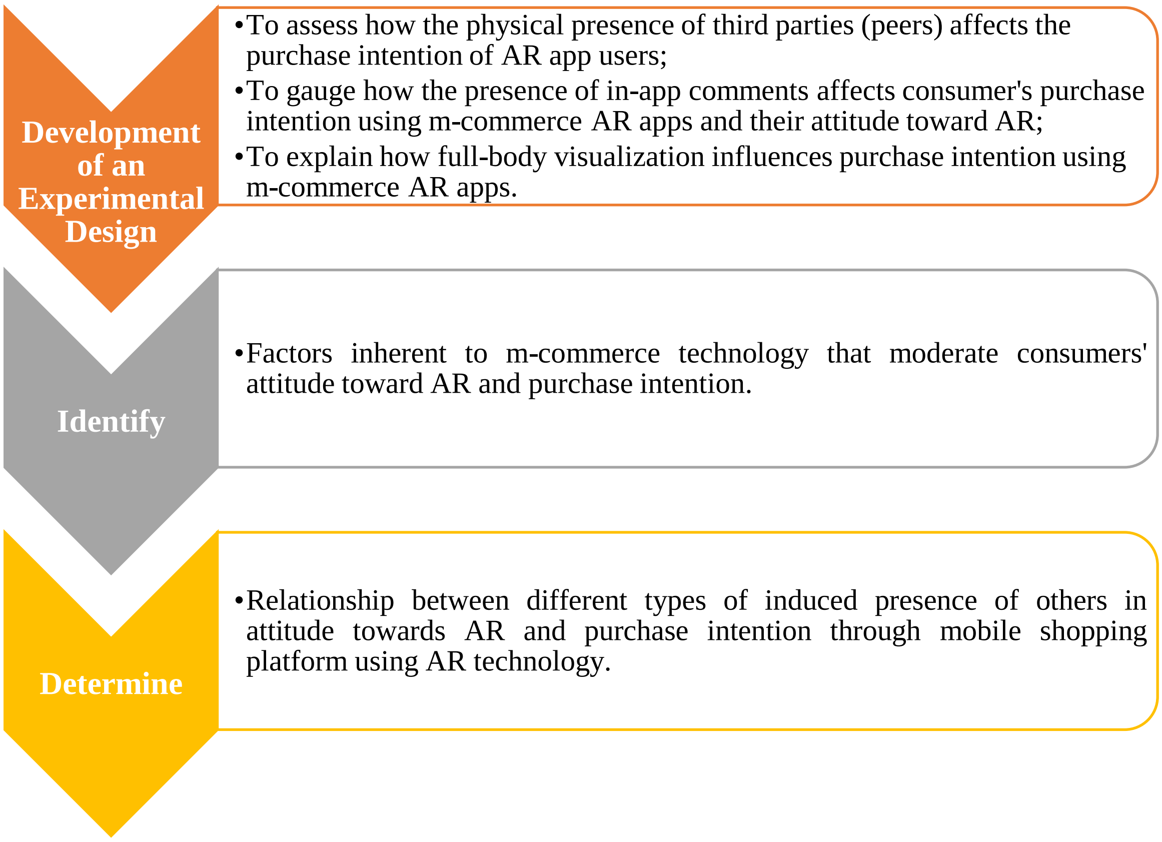
Main Goal

Our research demonstrates the efficacy of the change in technical, social and psychological factors that influence consumers when they use digital media as alternative ways of purchasing, namely m-commerce applications (apps) that incorporate augmented reality technology.

Operational Objectives

The main goal can be further subdivided into the following operational objectives (see Fig. 1. 1):

Fig. 1. 1 - Operational Goals of this study



Research Problem and Question

The motivation for this study is to answer the following question:

> *What is the efficacy of the change in the sociological, psychological and technical factors relevant to a mobile shopping experience using AR technology?*

From this problem, four main research questions can be extracted:

1. What is the role of social influence (induced by the presence of peers and reviews & ratings) in the **attitude toward AR** and **purchase intention**, in an AR m-commerce context?
2. What impact do the mental presence of others and mood have as moderators of consumers **purchase intention**?
3. What impact do the technological aspects inherent in augmented reality have as moderators of the consumers' attitude of toward AR?
4. What is the role of body image (introduced through the visualisation of the reflection of the whole body or only part of it) on consumer's **attitude towards technology** and **purchase intention**, in an AR m-commerce context?

1.3. Methodological Approach

Our study follows a positivist stance, although it has some elements of interpretivism. Consequently, a mixed-method methodological approach was adopted in this thesis. As such, the exploratory sequential design was followed, starting with the qualitative methods and then quantitative ones (Creswell and Clark, 2018).

In the qualitative part of the study, we conducted semi-structured interviews. The interviews were effective in providing new insights into the topic under study, as well as assisted in the development of the scales and the data collection instrument and identified new variables to be included in the quantitative study. This first part was also crucial to test the AR app that was developed for this study and to define the variables, both dependent and independent, among other factors that may influence the experimental design (Malhotra, Nunan, and Birks, 2017). The data collected in the interviews were analysed through content analysis (Krippendorff, 2004; Neuendorf, 2002).

After this first study, we carried out a pilot test of the experimental design. This step allowed us to refine and pre-test the questionnaire (the data collection instrument) and to find the optimal way to operationalise the experimental design.

The quantitative study was a between-subjects experimental design applied in conjunction with a questionnaire (Saunders, Lewis, and Thornhill, 2016). This method is based on the principle of causality (Malhotra et al., 2017; Vargas, Duff, and Faber, 2017). This study concerned a pre-test-post-test experimental design conducted in a laboratory setting. The participants were given the same pre-test measures, and then they were then assigned to only one of the five conditions in the study and interacted with an AR m-commerce app:

- Accompanied, full-length mirror, with ratings and reviews,
- Unaccompanied, full-length mirror, with ratings and reviews,
- Accompanied, small mirror, with ratings and reviews,
- Unaccompanied, small mirror, with ratings and reviews, and
- Unaccompanied, full-length mirror, with **no** ratings and reviews.

The post-test measures were taken for each group, and we analysed these data using techniques such as analysis of variance and covariance, that enable researchers to compare means between groups, and controlling for moderating the effects of covariates (Hair, Black, Babin, and Anderson, 2019). We ran a logistic regression to analyse the likelihood of the impact of the experimental conditions on the variables of attitude toward AR and purchase intention more precisely (Hair et al., 2019).

1.4. Thesis Relevance

The rise of new technologies created a call for further studies regarding the impact of such technologies on consumers, and how to use these technologies to leverage firms' business models and consequently their competitive advantage (Parise, Guinan, and Kafka, 2016).

In the concrete case of the use of AR in the field of marketing, this technology started to be scrutinised in the 2010s, focusing on human-technology interaction and the development of experiences (both utilitarian and hedonic) (Roxo and Brito, 2018). Moreover, the rising popularity of this technological development led to the study of its acceptance among the different displays that can be used (Rauschnabel, He, and Ro, 2018) and its categorisation (Chatzopoulos, Bermejo, Huang, and Hui, 2017).

Although sound research has been conducted studying the effects of AR in terms of marketing (for an overview, see Table 1.1), the social component of the influence of this technology remains unexplored.

As can be seen on Table 1.1, few studies focus on subjective norms (McLean and Wilson, 2019), social influence (Paulo et al., 2018) or social conformity (Rauschnabel, Brem, and Ivens, 2015). These authors supported their works based on the unified theory of acceptance and use of technology (UTAUT) stressing the influence of others expectations in their use of AR technology (McLean and Wilson, 2019) and mobile services influence (Paulo et al., 2018), but also in the use of AR smartglasses (ARSG) (Rauschnabel et al., 2015), and the fact that their use is driven by socialising needs (Rauschnabel, 2018).

Other researchers focus on the feature of social augmented reality, i.e., “a technology that enables two or more users to communicate by sharing and virtually enhancing a common view of the physical environment” (Hilken et al., 2020, p. 2). Social AR has become an emerging topic within augmented reality community because it allows its users to convey recommendations through an AR-enhanced visual (by customising the image they intend to send via social media) instead of simple written messages (Grewal et al., 2020; Hilken et al., 2020).

To the best of our knowledge, there is no research exploring yet the social variables segmented in the way it is presented in our study – including mental, physical, and virtual presence. Moreover, within the mental context, up until now no study segmented such influence under the groups of family, influencers, esteemed ones, other people and experts & sellers. Furthermore, on the topic of the virtual influence, although widely studied in the context of e-commerce and more traditional mobile platforms, the only study that has approximated thinking in any substantial way in respect of AR stressed how online reviews could replace surveys when using an AR mobile app (Rese, Schreiber, and Baier, 2014). Therefore, the impact that an AR app with reviews has on a consumer has yet to be studied.

Another issue that is still in its infancy is the study of body image when purchasing using virtual platforms. Until now only Yim and Park (2019) approached the topic, merely focusing on the intention to adopt AR technology, namely its moderating role when interactivity and media irritation are taken into consideration, and the relationship between an unfavourable body image and a greater intention to adopt AR versus traditional website. Taking this into account, the role played by body image in respect of how it relates to the attitude toward AR (when other variables are considered) and purchase intention should also be studied.

We aim to fulfil the following research gaps:

- To examine the influence of mental, physical and virtual presence induced when interacting with an AR m-commerce app and its consequent impact on efficacy,
- To analyse the effect that online reviews and ratings have in an AR m-commerce app,
- To study the role of body image in attitude toward AR and purchase intention.

The main contribution of our research is the study of the effect that the presence of third parties, whether real, imagined, induced or virtual has on an augmented reality mobile shopping experience. Furthermore, we explore the links between this dimension of social psychology and the characteristics that AR has as a technology incorporated in an m-commerce app, as well as the effect of consumers' body image on AR m-commerce experience.

Our study aims to contribute to the existing literature by clarifying some of the factors that influence mobile shopping behaviour, especially in its social dimension, advancing with one of the first empirical studies of its kind (Trevinal and Stenger, 2014).

Another contribution that our research provides is related to variables such as imagery, projection and (tele)presence (here subdivided into real and digital perceived presence). Their influence on subjects is documented in the literature, in the context of traditional media, e.g. their influence on attitude towards the ad (Bone and Ellen, 1992), brand recall (Babin and Burns, 1997; Mikhailitchenko, Javalgi, Mikhailitchenko, and Laroche, 2009), e-commerce websites (Argyriou, 2012; Gao, Liu, Liu, and Li, 2018; Laroche, Yang, McDougall, and Bergeron, 2005) and mobile advertising (Gavilan, Avello, and Abril, 2014). Although past research has used these variables, its impact in an AR m-commerce context and its efficacy has not yet been explored.

Moreover, our research ambition is to shed light on social-consumer research that examines other possible retail contexts where joint activity may be a crucial determinant of consumer outcomes. For example, comparing the impact of relative jointness in traditional retail purchases versus mobile app-based shopping (Hart and Dale, 2014).

Our study contributes to a better understanding of the human-technology relationship, in the development of an overall customer and purchase experience and the influences on decision-making. We also provide understanding in relation to how technology has been changing consumers, and some special attention is paid to young adults (millennials), due to the preponderant role they are expected to fulfil in the short-term (Marketing Science Institute, 2016, 2020).

Table 1. 1 - Overview of most recent Marketing-related empirical papers on AR

Author(s), Year	Title	Journal	Research Focus	Variables/Measures	Methodology
Yaoyuneyong et al. (2016)	Augmented Reality Marketing: Consumer Preferences and Attitudes Toward Hypermedia Print Ads	Journal of Interactive Advertising	Ad-format	Attitude toward the advertisement, irritation, entertainment, informativeness, advertising value	Experimental Design (n= 77)
Heller et al. (2019a)	Let Me Imagine That for You: Transforming the Retail Frontline Through Augmenting Customer Mental Imagery Ability	Journal of Retailing	Online retail & services	WOM intentions, processing fluency, decision comfort, imagery generation, imagery transformation, processing style, embedding, product contextuality	Experimental Design (n= 304; 238; 214; 158)
van Esch et al. (2019)	Anthropomorphism and augmented reality in the retail environment	Journal of Retailing and Consumer Services	Live retail store	Attitude toward brand/product, anthropomorphism, confidence, convenience of (digital) transactions, psychological comfort, product usage barriers, likelihood of side effects	Cross-sectional field-based study (n=319)
Sihi (2018)	Home sweet virtual home: The use of virtual and augmented reality technologies in high involvement purchase decisions	Journal of Research in Interactive Marketing	Decision-making	Usefulness, competitive asset, enhancement of information search, expedite evaluation of alternatives, can increase conversion	Market research + interviews (n=33)
Hilken et al. (2020)	Seeing eye to eye: social augmented reality and shared decision making in the marketplace	Journal of the Academy of Marketing Science	Social AR	Communicative acts (recommender and decision-maker), POV sharing (recommender) recommendation comfort (recommender), social empowerment (recommender), impression management concerns (recommender), persuasion goal (recommender), desire for the product (recommender), usage intention (recommender), WOM intentions (recommender), choice engagement (recommender), style-of-processing (recommender), inclusion of the other in the self (recommender), recommendation fit with preferences (decision maker)	Experimental Design (n= 92, 298, 126, 332, 360)

Table 1. 1 - Overview of most recent Marketing-related empirical papers on AR (continued)

Author(s), Year	Title	Journal	Research Focus	Variables/Measures	Methodology
Verhagen et al. (Verhagen, Vonkeman, Feldberg, and Verhagen, 2014)	Present it like it is here: Creating local presence to improve online product experiences	Computers in Human Behavior	Product presentation	Local presence, product likability, physical tangibility, mental tangibility, specificity, purchase intention	Experimental Design (n= 366)
Verhagen et al. (2016)	Making Online Products More Tangible: The Effect of Product Presentation Formats on Product Evaluations	Cyberpsychology, Behavior, and Social Networking		Mental tangibility, physical tangibility, specificity, perceived diagnosticity, purchase intention	Experimental Design (n= 366)
Yim et al. (Yim et al., 2017)	Is Augmented Reality Technology an Effective Tool for E-commerce? An Interactivity and Vividness Perspective	Journal of Interactive Marketing		Interactivity, vividness, novelty, immersion, media usefulness, enjoyment, previous media experience, attitude toward the medium, purchase intention	Experimental Design (n= 258; 801)
Zhao et al. (2017)	Analysis of Mental Workload in Online Shopping: Are Augmented and Virtual Reality Consistent?	Frontiers in Psychology		Cognitive style, mental workload, product value, sensory channel	Experimental Design (n= 36)
Beck and Crié (2018)	I virtually try it … I want it! Virtual Fitting Room: A tool to increase on-line and off-line exploratory behavior, patronage and purchase intentions	Journal of Retailing and Consumer Services		Perceptual specific curiosity about the tool and the product, online and offline patronage intention, online and offline purchase intention	Experimental Design (n= 228; 241)
Brengman et al. (2019)	Can't touch this: the impact of augmented reality versus touch and non-touch interfaces on perceived ownership	Virtual Reality		Perceived ownership, product attitude, purchase intention	Experimental Design (n= 277)
Morillo et al. (2019)	A comparison study of AR applications versus pseudo-holographic systems as virtual exhibitors for luxury watch retail stores	Multimedia Systems		Fun experience; ergonomics, interaction, satisfaction, suitability, difficulty, usefulness, depth perception	Experimental Design (n= 39)
Smink et al. (2019)	Try online before you buy: How does shopping with augmented reality affect brand responses and personal data disclosure	Electronic Commerce Research and Applications		Perceived informativeness, perceived enjoyment, perceived intrusiveness, brand attitude, purchase intention, willingness to share personal data	Experimental Design (n= 132)
Yim and Park (2019)	"I am not satisfied with my body, so I like augmented reality (AR)": Consumer responses to AR-based product presentations	Journal of Business Research		Body image, perceived interactivity, media irritation, media usefulness, media enjoyment, overall attitude toward AR/the website, adoption intention	Experimental Design (n= 406)
Xu et al. (2019)	How and when AR technology affects product attitude	Asia Pacific Journal of Marketing and Logistics		Product attitude, self-referencing simulation, curiosity, emotional and arousal states	Experimental Design (n= 92; 100; 130; 128)
Bonnin (2020)	The roles of perceived risk, attractiveness of the online store and familiarity with AR in the influence of AR on patronage intention	Journal of Retailing and Consumer Services		Hedonic evaluation, utilitarian evaluation, perceived product risk, attractiveness of the online store, patronage intention	Experimental Design (n= 98; 191)

Table 1. 1- Overview of most recent Marketing-related empirical papers on AR (continued)

Author(s), Year	Title	Journal	Research Focus	Variables/Measures	Methodology
Huang and Liu (2014)	Formation of augmented-reality interactive technology's persuasive effects from the perspective of experiential value	Internet Research	Online retail	Presence, narrative experience, media richness, aesthetics, playfulness, consumer ROI, service excellence	SEM (n=344)
Huang and Liao (T.-L. Huang and Liao, 2017)	Creating e-shopping multisensory flow experience through augmented-reality interactive technology	Internet Research		Perceived sense of self-location, haptic imagery, perceived sense of body ownership, perceived ownership control, self-explorative engagement, concentration, playfulness, time distortion, exploratory behaviour	Structural equation modelling (SEM) (n=336)
Pantano et al. (Pantano, Rese, and Baier, 2017)	Enhancing the online decision-making process by using augmented reality: A two country comparison of youth markets	Journal of Retailing and Consumer Services		Quality information, perceives ease of use, perceived enjoyment, perceived usefulness, attitude, behavioural intention, response time, aesthetic quality, interactivity	Experimental Design (n= 318)
Heller et al. (2019b)	Touching the Untouchable: Exploring Multi-Sensory Augmented Reality in the Context of Online Retailing	Journal of Retailing		Mental intangibility, decision comfort, assessment, willingness-to-pay; type of sensory control and feedback	Experimental Design (n= 139; 108; 106; 136)
Fan et al. (2020)	Adoption of augmented reality in online retailing and consumers' product attitude: A cognitive perspective	Journal of Retailing and Consumer Services		Cognitive load, cognitive fluency, product attitude, environmental embedding simulated physical control, product type	Experimental Design (n= 493)
Scholz and Duffy (2018)	We ARe at home: How augmented reality reshapes mobile marketing and consumer-brand relationships	Journal of Retailing and Consumer Services	Consumer-brand relationships	**Themes**: My space: re-configuring the branded app as personal space; My face: dissolving boundaries and foregrounding the consumer, and protecting and dissolving the consumer/brand fusion	Qualitative study (newspaper & industry publications, apps reviews, 31 subjects to app exploration + 16 in-depth interviews)
McLean and Wilson (2019)*	Shopping in the digital world: Examining customer engagement through augmented reality mobile applications	Computers in Human Behavior	Customer-brand engagement	Interactivity, vividness, novelty, perceived ease of use, perceived usefulness, perceived usefulness, enjoyment, subjective norm, brand engagement, satisfaction with the experience, brand usage intent	Structural equation modelling (N=441)

Table 1. 1- Overview of most recent Marketing-related empirical papers on AR (continued)

Author(s), Year	Title	Journal	Research Focus	Variables/Measures	Methodology
Brito et al. (2018)	Augmented reality versus conventional interface: Is there any difference in effectiveness?	Multimedia Tools and Applications	Brand	Emotional response, attitude toward the brand, interactive response, future relationship with the brand, emotional intensity, innovativeness, perceived risk, opinion leadership	Experimental Design (n= 150)
Rauschnabel et al. (2019)	Augmented reality marketing: How mobile AR-apps can improve brands through inspiration	Journal of Retailing and Consumer Services		Attitude toward using the app, Inspirations, utilitarian Benefits, hedonic benefits, perceived augmentation quality, changes in brand attitude	Experimental Design (n= 201)
Rauschnabel et al. (2015)*****	Who will buy smart glasses? Empirical results of two pre-market-entry studies on the role of personality in individual awareness and intended adoption of Google Glass wearables	Computers in Human Behavior	Adoption of Smartglasses (ARSG)	Extraversion, openness, neuroticism, knowledge, awareness, brand attitude, expected social conformity, functional benefits, adoption intention	Structural Equation Modelling (n=146; 201)
Rauschnabel (2018)*****	Virtually enhancing the real world with holograms: An exploration of expected gratifications of using augmented reality smart glasses	Psychology & Marketing		Life-efficiency, enjoyment, desired enhancement of reality, wearable comfort, socialising, self-expression, intention to use ARSG in private and public	Structural Equation Modelling (n=228)
Rauschnabel et al. (2018)	Antecedents to the adoption of augmented reality smart glasses: A closer look at privacy risks	Journal of Business Research		Expected utilitarian benefits, expected hedonic benefits, expected symbolic benefits, perceived risks to personal privacy, perceived risks to other people's privacy, perceived loss of autonomy, ease of use, familiarity with ARSGs, adoption	Mixed methods (SEM n=285 + interviews n=21)
Han et al. (2019)	Augmented Reality Smart Glasses (ARSG) visitor adoption in cultural tourism	Leisure Studies		**Themes**: Personal innovativeness, interaction, obtrusiveness, complexity/ease of use, perceived enjoyment, perceived usefulness, risk of use, cost, privacy, ARSG adoption	Interviews (n=28)

Table 1. 1 - Overview of most recent Marketing-related empirical papers on AR (continued)

Author(s), Year	Title	Journal	Research Focus	Variables/Measures	Methodology
Rese et al. (2014)	Technology acceptance modeling of augmented reality at the point of sale: Can surveys be replaced by an analysis of online reviews?	Journal of Retailing and Consumer Services	Consumer responses	Perceived enjoyment, perceived informativeness, perceived ease of use, perceived usefulness, attitude toward using, behavioural intention to use	Experimental Design (n= 255)
Chung et al. (2015)	Tourists' intention to visit a destination: The role of augmented reality (AR) application for a heritage site	Computers in Human Behavior		Technology readiness (optimism, innovativeness), visual appeal, facilitating conditions, perceived usefulness, perceived ease of use, AR attitude, AR usage intention, destination visit intention	SEM (n=145)
Javornik (2016b)	"It's an illusion, but it looks real!" Consumer affective, cognitive and behavioral responses to augmented reality applications	Journal of Marketing Management		Perceived augmentation, perceived control, perceived responsiveness, flow, behavioural intentions, affective responses, cognitive responses	Experimental Design (n= 60)
Kim and Hyun (2016)	Predicting the use of smartphone-based Augmented Reality (AR): Does telepresence really help?	Computers in Human Behavior		System quality, information quality, service quality, telepresence, usefulness, AR reuse intention	Structural Equation Modelling (n= 255)
Brito and Stoyanova (2018)	Marker versus Markerless Augmented Reality. Which has More Impact on Users?	International Journal of Human-Computer Interaction		Emotional response, usability, interactive experience, recommendation intention	Experimental Design (n= 100)
He et al. (2018)	When art meets tech: The role of augmented reality in enhancing museum experiences and purchase intentions	Tourism Management		Experiential value, virtual presence, willingness to pay more, imagery vividness	Experimental Design (n= 225)
Paulo et al. (2018)*	Understanding mobile augmented reality adoption in a consumer context	Journal of Hospitality and Tourism Technology		Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, task characteristics, technology characteristics, task technology fit, behavioural intention, use behaviour	Structural equation modelling (SEM) (N=335)
Poushneh (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		User satisfaction, User's Control of Access to Personal Information, augmentation quality	Experimental Design (n= 329)

Table 1. 1 - Overview of most recent Marketing-related empirical papers on AR (continued)

Author(s), Year	Title	Journal	Research Focus	Variables/Measures	Methodology
tom Dieck et al. (tom Dieck et al., 2018)	Determining visitor engagement through augmented reality at science festivals: An experience economy perspective	Computers in Human Behavior	Consumer responses	Aesthetics, education, entertainment, escapism, memories, satisfaction, visitor engagement	SEM (n=220)
Carrozzi et al. (2019)	What's Mine Is a Hologram? How Shared Augmented Reality Augments Psychological Ownership	Journal of Interactive Marketing		Psychological ownership. affect, customisation, differentiation, social interaction	Experimental Design (n= 120, 90, 120)
Tsai (2020)	Augmented reality enhancing place satisfaction for heritage tourism marketing	Current Issues in Tourism		Immersive experience, user engagement, perceived authenticity, place satisfaction,	SEM (n=503)
Hinsch et al. (2020)	Nostalgia beats the wow-effect: Inspiration, awe and meaningful associations in augmented reality marketing	Journal of Retailing and Consumer Services		Augmentation quality, hedonic benefits, ease of use, AR expertise, inspired-by, nostalgia, wow-effect, inspired-to, app/brand congruence	Experimental Design (n= 145)

1.5. Thesis Outline

This thesis is organised in four parts, divided into chapters (see Fig. 1. 2). Firstly, the reasoning for this study is presented, namely the research context, the relevance of the theme and the objectives, problem and research question are presented.

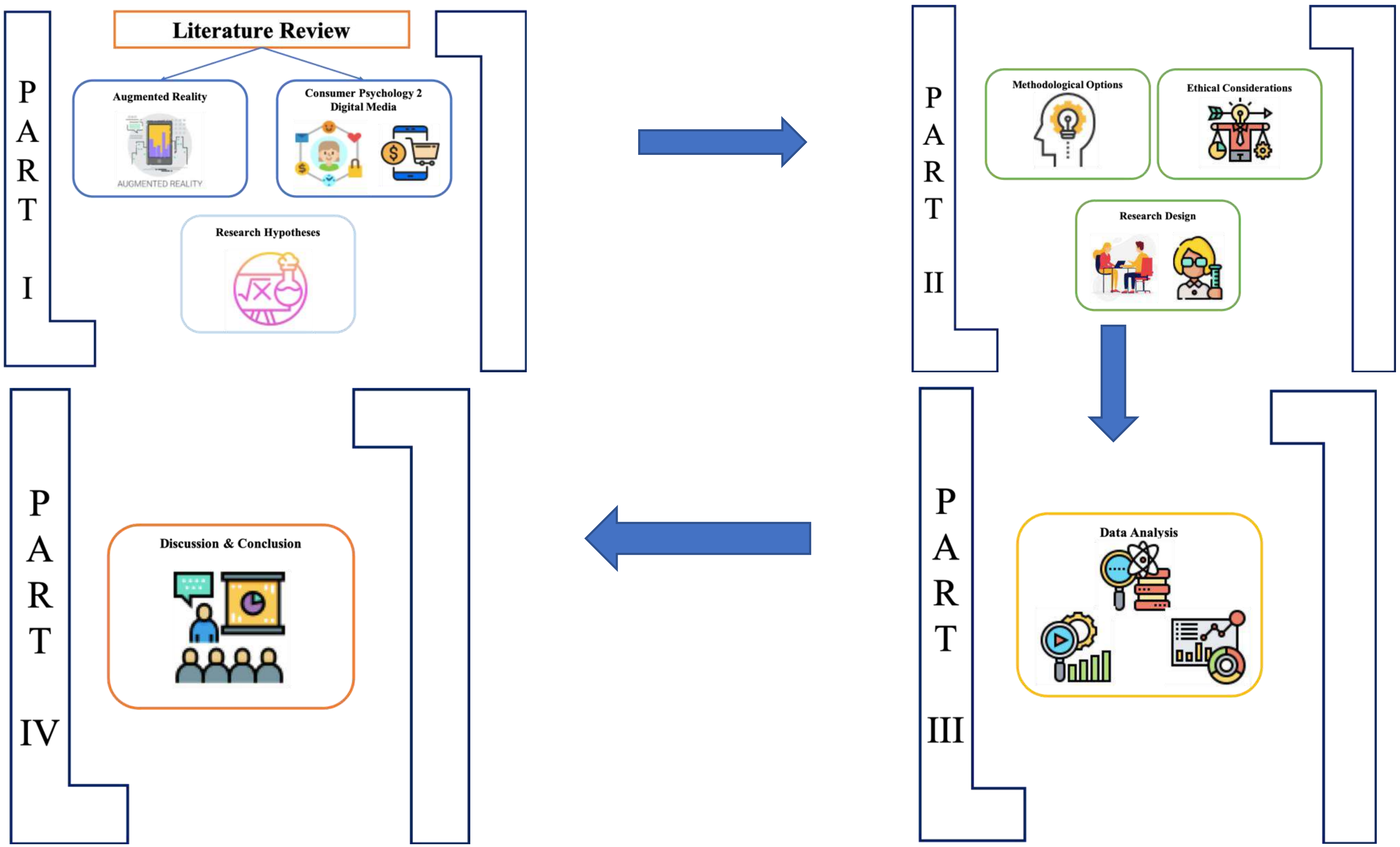
In **part I**, the literature review is introduced. This revision of the relevant literature is subdivided into two chapters. Chapter 2 introduces the field of Augmented Reality emphasising its technological features, the many domains where this technology can be applied and respective applications, and also its impact on subjects, i.e. users' responses to AR. Chapter 3 is related to Consumer Psychology within the scope of Digital Media. In this chapter, the impact of new media and new virtual platforms are analysed, considering cognitive and social psychology. Chapter 4 presents the reasoned deduction of the research hypotheses.

Afterwards, in **part II,** we introduce the methodological approaches followed, ethical considerations examined, and research design adopted. In this part not only a discussion regarding the ontological and epistemological standpoint is conducted, but also all the reasoning as to why a mixed-method approach should be followed (interviews - qualitative – and experimental design - quantitative) is analysed, as well as the data analysis techniques used are presented.

Part III corresponds to the presentation of the results of the data analysis of the qualitative and quantitative studies – chapter 8.

In **part IV**, the discussion of the results is presented in chapter 9, and this thesis ends with the conclusion of the study – chapter 10, its academic and managerial implications, as well as the presentation of some venues for future research.

Fig. 1. 2 – Thesis Outline



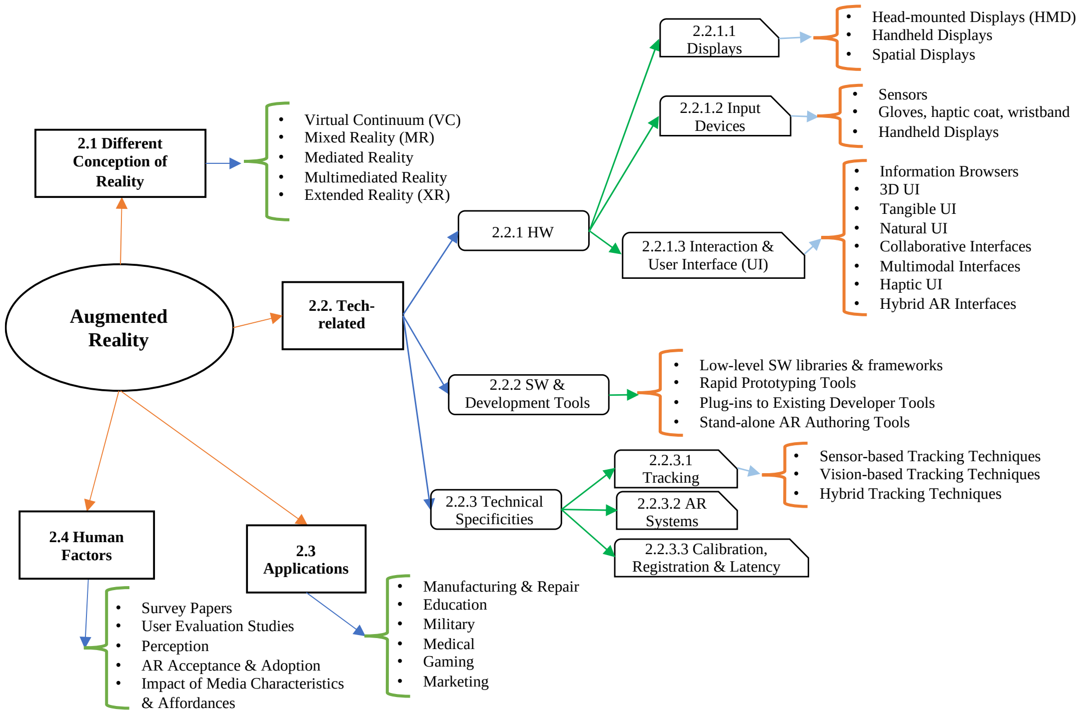
Part I
Literature Review

Chapter 2: An Overview of Augmented Reality

2.1. Summary

Fig. 2. 1 presents a summary of the literature reviewed in this chapter.

Fig. 2. 1 - Overview of chapter 2



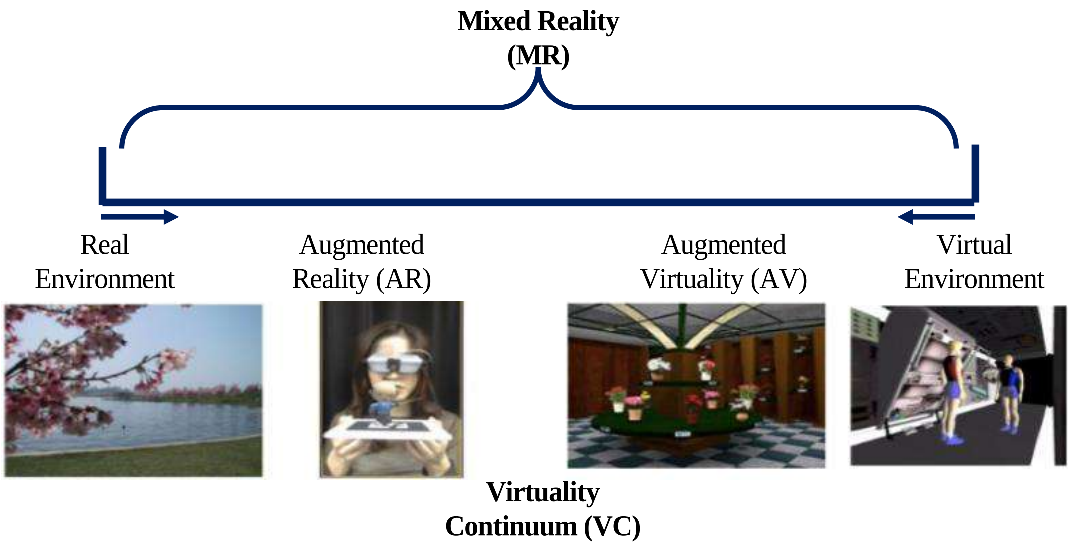
2.2. Introduction

Augmented Reality (AR) is a technology that expands human perception through the superimposition of 3D registered digital layers in the physical world, in an interactive and synchronised way (Azuma, 1997; Schmalstieg and Hollerer, 2016). This expansion of human perception involves not only sight, but also hearing [e.g., SonifEye gives haptic feedback through sound (Roodaki, Navab, Eslami, Stapleton, and Navab, 2017)], touch [e.g., the haptic jacket of Arafsha et al. (2015)], taste, and smell [like Narumi et al. (2011) Meta Cookie]. AR is also a medium that mediates communication between humans and computers (Craig, 2013).

The idea of digitally enhancing the physical world started in the 1950s, within the cinematographic industry. However, AR and virtual reality (VR) became relevant due to the work of Ivan Sutherland, who, in 1965, developed the ultimate display, a head-mounted display (HMD), that enabled AR experiences (Carmigniani and Furht, 2011; Schmalstieg and Hollerer, 2016; Sutherland, 1965).

Since then, research on 'digital realities' has matured and, in 1994, Milgram and Kishino presented their taxonomy of Mixed Reality (MR) (Kishino, Milgram, Kishino, and Milgram, 1994). These authors argue that there is a virtual continuum (VC) bounded by the physical world and, at the opposite end, the virtual world. If one is in the physical world and move to the virtual, it is AR. Conversely, if one is in the virtual world and moves to the physical world, it is the augmented virtuality (AV) (which represents the superposition of real-world artefacts, within a virtual context) (see Fig. 2.2) (Kishino et al., 1994).

Fig. 2.2 - Simplified representation of the virtuality continuum (Kishino et al., 1994)



In the late 1990s, Azuma published a survey where he systematised the main domains of application of AR: displays, types of head-mounted displays (HMD) [especially optical see-through (OST HMD) versus video see-through (VST HMD)] (Azuma, 1997). Azuma also addressed objects' registration issues, AR systems errors, tracking, and sensing, among others (Azuma, 1997). Azuma et al. supplemented this survey by presenting other types of displays, tracking techniques, they draw the attention to other technical aspects like rendering, latency, and stressed the importance of AR mobile applications and Mobile AR (MAR) (Azuma et al., 2001). However, the interest in AR research is not exclusive to technical-related domains of knowledge. As Roxo and Brito (2018) found, research on AR linked to the fields of Marketing, Consumer Psychology and Behaviour, and Business has risen substantially.

The relevance of AR is not exclusively academic. The social and economic value that this technology affords is noteworthy. Namely, in 2015, the AR market size was $640.2 million (Grand View Research, 2016), and it is expected to reach $165 billion by 2021, partially due to the increasing penetration of mobile devices and applications (apps) (Global Market Insights, 2016). Moreover, it is expected that in 2024, HMDs represent 50-65% of AR's market share (e.g., Microsoft HoloLens, DAQRI Smart Helmet, ...) (Global Market Insights, 2016; Grand View Research, 2016). Gartner believes that this expansion is also due to the immersive experiences that AR creates that fosters productivity; thus, AR is in the top 10 strategic technologies for 2019 (Gartner Reports, 2018a).

This growth can also be explained due to the increasing incorporation of AR technology in shopping experiences such as clothes' virtual fitting-rooms, the visualisation of furniture *in loco*, and so on. These experiences help customers' decision-making process, while it nurtures customer-brands relationships, engaging and converting them (Gartner Reports, 2018b; Global Market Insights, 2016; Grand View Research, 2016). Projections estimate that the impact of AR on the retail market will reach $7.951 million by 2023 (MarketsandMarkets, 2018).

From a societal perspective, AR is a hot topic because it promotes more transparent, immersive, and flexible experiences for its users, benefiting both people and companies by increasing productivity (Gartner Reports, 2016). Thus, this technology allows the development of context-aware, ubiquitous, and content-relevant experiences (Chess, 2014; Liao and Humphreys, 2015).

In short, this chapter provides an overall comprehension of what AR is as a technology through a state-of-the-art analysis of the theme. To that end, we can focus on the technical aspect [hardware (HW) and software (SW)], the factors related to the evaluation of AR, and the existing bridge between AR and human factors connected to Consumer Psychology and the evaluation of AR experiences.

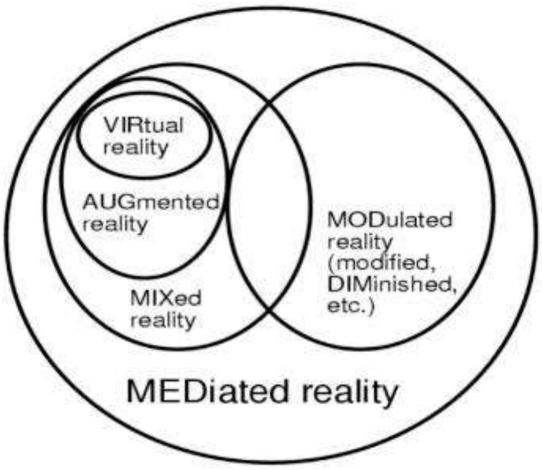
2.3. Definition of AR and the Different Conceptions of Reality

The definition of AR provided by Azuma garners the most consensus. Thus, AR is a technology that combines the virtual and real worlds, through the superimposition of interactive digital layers onto the physical world, in real-time and registered in 3D (Azuma, 1997).

Notwithstanding this consensus, the approach to AR can vary. As an example, Milgram et al. (1994) perceive AR as a type of Mixed Reality, where MR is an umbrella term that covers all types of realities from AR to AV.

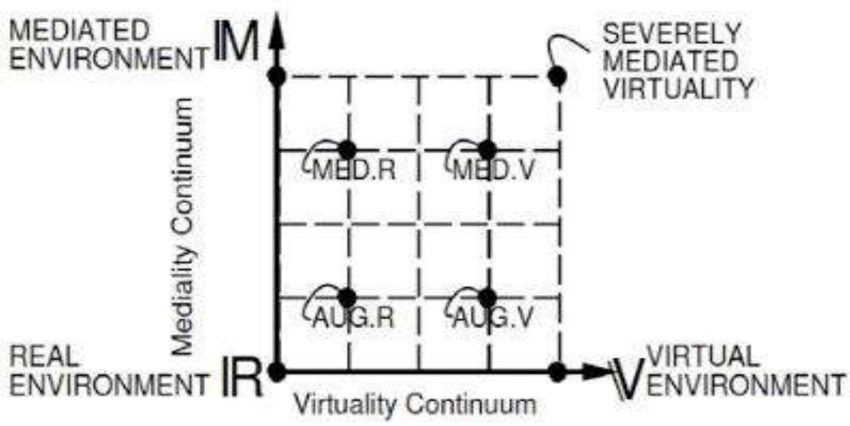
Another perspective is proposed by Mann, who frames AR within the concept of Mediating Reality (see Fig. 2.3), where it "augment[s], enhanc[es], deliberately diminish[es], or otherwise alter[s]" reality (Mann, 1994, p. 2). Mediating Reality means that reality is a filtered/artificially modified visualisation of the human perception of the real world (Mann, 1994, 2002).

Fig. 2.3 - Mann's diagram of Mediated Reality (Mann, 2002, p. 5)



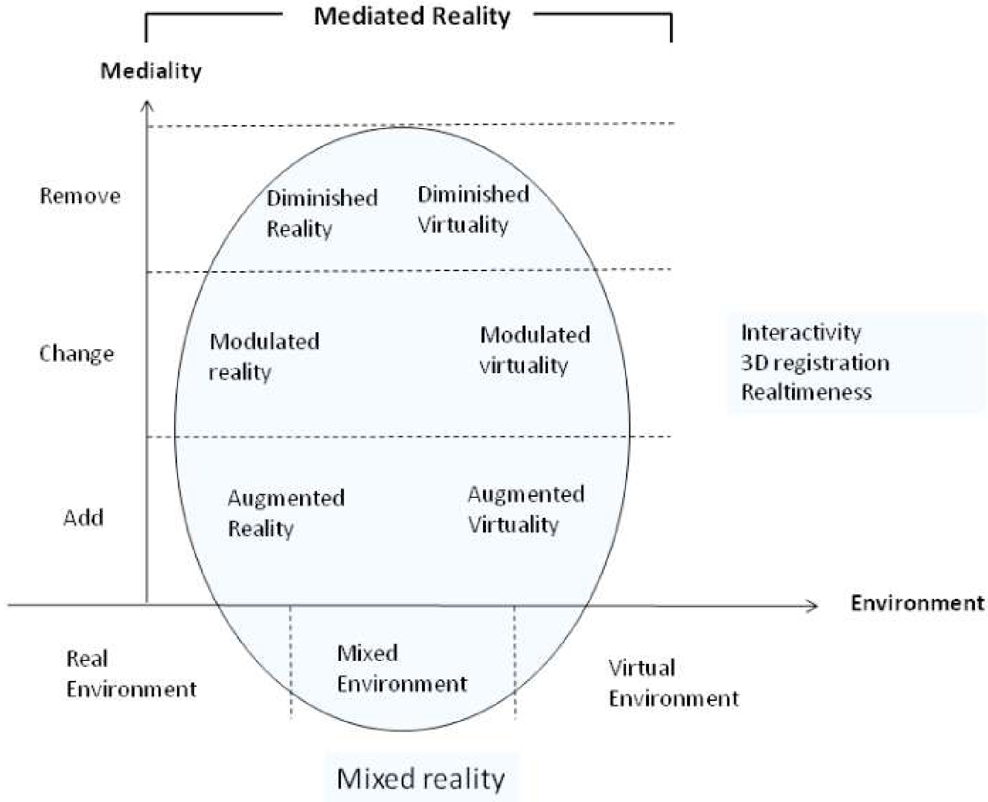
Mann also synthesises his ideas as a virtuality continuum where the origin (R) represents the real world; V is the virtual world and M is the axis of mediality (i.e., the amount of modification that is applied to the real or virtual world view of the user (Mann, 2002) (see Fig. 2.4). Thus, when one moves in the direction R $\rightarrow$ V, there is AR, and then AV (like Milgram and Kishino's continuum) (Mann, 2002). The novelty brought by this author lies in the M axis, where 'new' scenarios such as the Mediated Reality, Mediated Virtuality and their combinations arise, offering a more complete framework since it includes the following modifications of reality: mixing, modulation, diminishing (Mann, 2002). Mann's concept of Mediating Reality incorporates the Diminished Reality (where it is removed elements of the real world) (Mann, 1994, 2002).

Fig. 2.4 - Mediality/Virtuality Continuum de Mann (Mann, 2002)



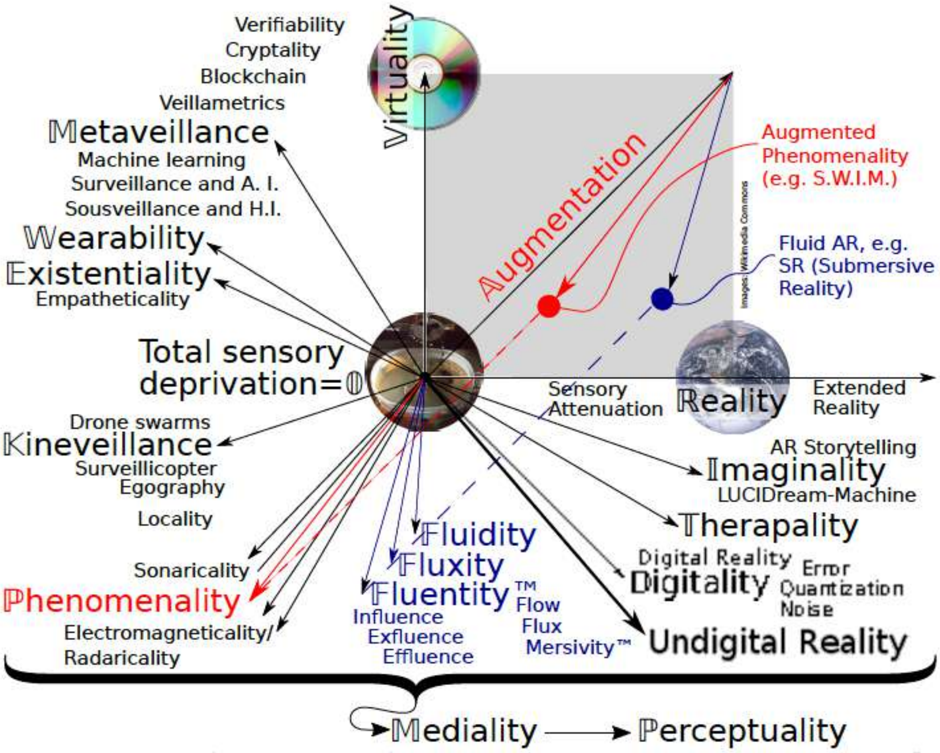
Siltaten introduces a more user-friendly version of Mediated Reality that explains different perceptions of reality depending on whether elements are added or removed (see Fig. 2.5) (Siltanen, 2012).

Fig. 2.5 - Siltaten's Taxonomy of Mediated Reality



The most recent 'conception' of reality and its different elements was created by Mann et al. (2018), who systematised reality in a Multimediated Reality Continuum (see Fig. 2.6). This continuum takes a multidimensional approach to reality. In its origin, sensory stimuli are absent and one can move to the axis of Extended Reality, Virtuality, Phenomenality, Fluentity, Metaveillance, Wearability, among others (Mann et al., 2018).

Fig. 2.6 - Multimediated Reality Continuum (Mann et al., 2018)



Another type of classification that emerged and has expanded to the Academy is Extended Reality (XR). XR is an umbrella term that aggregates AR, MR, and VR (Chuah, 2019), and that allows that machines to work at cognitive levels similar to humans, letting them interact with technology in a way that empowers people through sensorial immersion (Accenture, 2018; Andrews, Southworth, Silva, and Silva, 2019).

In our study, it is followed the perspective that MR is the umbrella term that encapsulates all forms of combination of digital and physical worlds elements, involving the concepts of AR, AV, VR, Modultated Reality, Diminished Reality, among others, and the focus of our research is Augmented Reality.

2.4. Creation of an AR Experience: Technical Features

The development of AR technology involves several technical features, both in terms of HW and SW. Azuma argues that to create an AR environment; three systems are needed (Azuma, 1997) which are:

1) Scene Generator: this must have some rendering capacity, but not as much as that of virtual environment (VE) systems, because AR digital images are only overlaid onto the physical world (there is no need to construct a VE);
2) Display Device: similarly to scene generators, these devices do not have to be as sophisticated as if they were for VE (since the basis of visualisation is the physical world);
3) Tracking and Sensing: AR systems have strict specifications for tracking and sensing since it is necessary to capture the physical world, to continue tracking to make the superimposition of the digital layers, and to minimise registration problems.

Consequently, HW and SW are essential components for the creation of the environment, since they must capture information from the physical world to reconstruct an augmented environment (Craig, 2013; Mihelj, Novak, and Beguš, 2014).

An AR experience involves several aspects, namely (Billinghurst, Clark, and Lee, 2014; Kim, Billinghurst, Bruder, Duh, and Welch, 2018):

1) The HW required to develop the AR experience (e.g., devices or sensors);
2) The SW used to create digital elements and to allow them to run on HW (e.g., development tools);
3) The AR technical specificities, like capturing of information from the physical world, latency or tracking techniques;
4) Applications of AR; and
5) Human factors, either in the assessment of AR systems evaluation (e.g., usability, perception), social acceptance of technology, the impact that the inherent characteristics of AR (Media Characteristics - MC) have on the users, or the affordances they support.

Therefore, based on six comprehensive studies/reviews conducted on the technological perspective of AR, the topics addressed by each article can be synthesised in Table 2. 1.

Table 2. 1 - Summary table of the technical aspects of AR addressed in surveys/reviews from 1997 to 2018

		Azuma (1997)	Azuma et al. (2001)	Zhou, Duh, and Billinghurst (2008)*	Carmigniani et al. (2011)	Billinghurst et al. (2014)	Kim et al. (2018)*
Hardware	Displays	x	x	x	x	x	x
	Interfaces				x		
	Input Devices				x	x	
Software	Development Tools					x	
	Authoring			x			x
Technical Specificities	Tracking Techniques	x	x	x	x	x	x
	AR Systems				x		
	Interaction Techniques and User Interface		x	x		x	x
	Rendering		x	x			x
	Visualisation		x	x			x
	Calibration nd Registration	x	x	x			x
	Sensing and Tracking	x					
	Reconstruction and Recognizing				x		
	Errors	x	x				
Applications		x	x	x	x	x	x
Human Factors	Evaluation			x		x	x
	Acceptance				x	x	
	Effect of AR long-term use		x				
	Privacy and security				x		

* These papers reflect a review of research trends on AR in two periods: 1998-2007 and 2008-2017, respectively. The object of analysis were papers presented at the leading conference on the theme International Symposium on Mixed and Augmented Reality (ISMAR) and published in the IEEE Transactions on Visualization and Computer Graphics (TVCG).

2.4.1. Hardware

The hardware involved in an AR experience is mainly related to the computational devices that create the digital elements that are superimposed on the physical world (e.g., computers and their specifics regarding RAM, CPU, among others). It also relates to the device that allows the augmentation, i.e., the interface that allows the interaction between the two realities, the input devices, the different sensors that capture the real world and so forth.

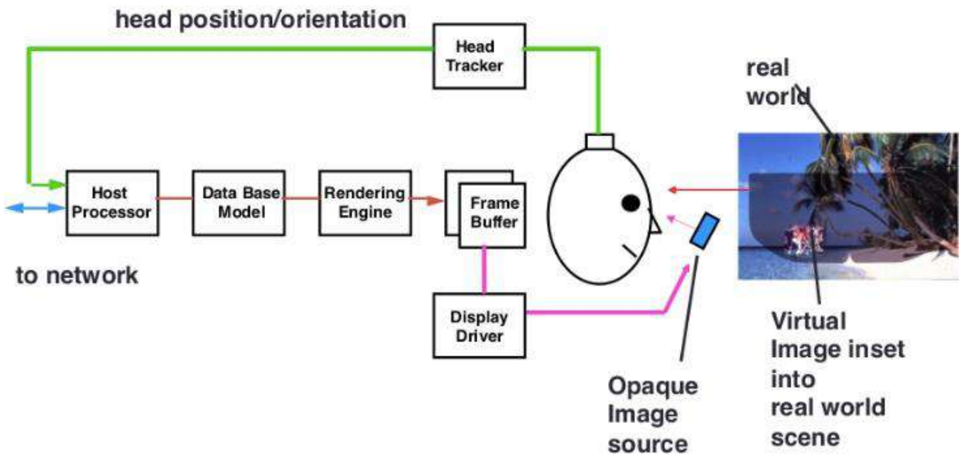
2.4.1.1. Displays

Displays are the systems that use a set of optical, electronic and mechanical components, that is, the HW that allows us to experience AR. Billinghurst et al. argue that visual displays can be segmented according to 1) the approaches used to combine and compose the digital images on the physical world, or 2) the positioning of the display regarding the eye of the user and the physical world (Billinghurst et al., 2014; Bimber and Raskar, 2005).

According to the first approach regarding the combinations of the images, there are the following displays (Billinghurst et al., 2014):

1) Video-based displays: they use digital processes to combine virtual images with real-world videos. The most common displays are Virtual Mirrors, PC/laptops, smartphones/tablets, Augmented Desk and Remote AR (i.e., those that involve HW with built-in cameras);
2) Optical see-through: these displays use optical sensors (with beam splitters – half mirrors or combined prims) to combine both digital and real images. E.g., HMD and Virtual Mirrors that use beam splitters, transparent and semi-transparent projections;
3) Projection-based: these displays allow the image to be directly projected over the element of interest, through projectors (placed on the ceiling, walls or in the head, like the head-mounted projections displays); and
4) Eye multiplexed: this method allows the user to combine the digital and real images through mental processes, i.e., the user sees the virtual image registered in the physical world (see Fig. 2.7).

Fig. 2.7 - AR Eye multiplexed system



When categorising the displays according to its position in respect of the human eye and physical world, this can be divided into the following categories (Billinghurst et al., 2014; Carmigniani et al., 2011; Zhou et al., 2008):

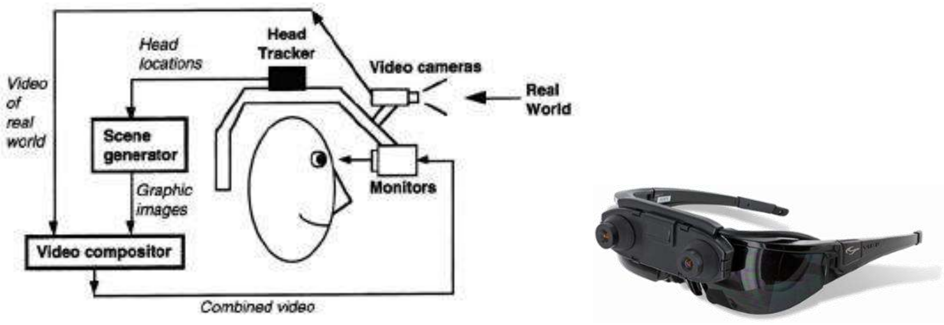
- **Head-attached/ Heads-up displays (HUD)**

These displays present the virtual image right in front of the user's eyes. There is a wide variety of HUDs, such as HMD (OST and VST), head-mounted projector displays (HMPD) and retinal displays (Bimber and Raskar, 2005).

HMDs consist of one or two screens that show the virtual image, where the right eye sees a different image from the left one to create a sensation of depth (Mihelj et al., 2014). Thus, HMDs can be divided into two broad categories depending on optical or video technology (Azuma et al., 2001; Carmigniani et al., 2011; Zhou et al., 2008):

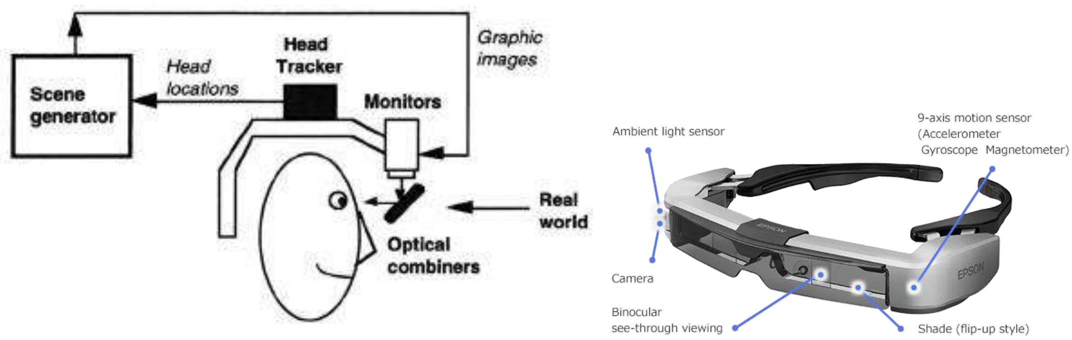
1) Video see-through (VST) HMD (see Fig. 2.8): these have two cameras placed on the head device that capture the physical world and then the digital layers are electronically combined into the real-world video representation (Rolland, Holloway, and Fuchs, 1995). These devices require the processing of data from both cameras to provide the physical and virtual part of the image (Carmigniani et al., 2011). The consistency between the real and virtual world and the availability of a wide range of processing techniques are some of the advantages of VSTs, which allow them to overcome occlusion problems more efficiently when compared to OSTs (Zhou et al., 2008). Additionally, VSTs allow greater control over increased vision through virtual image synchronisation, greater flexibility in image composition with matchable time delays (Carmigniani et al., 2011).

Fig. 2.8 - VST HMD representation (Azuma, 1997) and Vuzix Wrap 1200DXAR[4]



2) Optical see-through (OST) HMD (see Fig. 2.9): these devices allow the user to see the real world through semi-transparent mirrors placed in front of the user's eyes reflecting the digital images in the user's eyes by combining the views of the real and virtual world (Rolland et al., 1995). Such HMDs use half-silver mirror technology, which allows the real-world image to pass through the lens, and the digital layer to overlap and reflect in the user's eyes (Carmigniani et al., 2011; Zhou et al., 2008). The main advantages of these HMDs include offering an improved vision (better resolution), natural (less distortion), real-world instantaneous, and with no ocular displacement (Zhou et al., 2008). Despite these advantages, OST MHDs have a lag time higher than VST due to image and graphics processing, which can reduce the quality of the image as well as creating some problems, such as the occlusion effect between the real and virtual worlds (Carmigniani et al., 2011; Kim et al., 2018).

Fig. 2.9 - OST HMD representation (Azuma, 1997) and Epson Moverio[5]



A recent trend that is growing in the field of HMD and which has contributed to its increased popularity is the AR smartglasses (ARSG) like Microsoft Hololens (Kim et al.,

[4] Vuzix Wrap 1200 DXAR, https://www.vuzix.com/Products/LegacyProduct/4, accessed on 27/05/2019
[5] Epson Moverio BT-35E, https://tech.moverio.epson.com/en/bt-35e/, accessed on 27/05/2019

2018). Thus, researchers are studying the acceptance, adoption, and diffusion the uses of HMD (Han et al., 2019; Herz and Rauschnabel, 2019; Rauschnabel et al., 2018).

Kim et al. (2018) point out that, in the future, HMDs should overcome the following challenges: expanding FOV, improving resolution, improving focus distance, and filtering light into the eyes.

Head-mounted projector displays (HMPD) require ultralight optics, creating an immersive, collaborative, 3D and mobile view that promotes a better interaction with space, promoting the sense of social presence (Rolland, Biocca, Hamza-Lup, Ha, and Martins, 2005). These arise as an alternative to HMD, consisting of a "pair of miniature projection lenses, beamsplitters, and displays" placed on a HUD to project into the environment (Hua, Gao, Brown, Ahuja, and Rolland, 2001, p. 217).

Retinal displays project the objects through a single stream of laser pixels directly into the human retina through microoptoelectromechanical mirrors systems (MEMS). These displays generate a higher resolution and quality of the projection of digital elements as well as the field of view (FOV), superior to the screen-based displays (Bimber and Raskar, 2005; Chun-da Liao and Jui-che Tsai, 2009; Mihelj et al., 2014; Oehme, Schmidt, and Luczak, 2003).

- **Handheld Displays**

Handheld displays are small, portable, personal, computer-capable devices that contain a built-in camera, such as smartphones and tablets (Billinghurst et al., 2014; Carmigniani et al., 2011; Mihelj et al., 2014). These devices are not intrusive while being socially accepted and easily accessible (Zhou et al., 2008). They use the camera to capture the surrounding environment, as well as the device sensors (GPS, digital compasses, gyroscopes, or accelerometer) and allow an AR visualization of the scenario through the device screen (Azuma et al., 2001; Carmigniani et al., 2011; Mihelj et al., 2014). These devices often use VST techniques to create the superimposition of the digital layers in the real world (Carmigniani et al., 2011). However, devices using OST techniques are starting to emerge (Billinghurst et al., 2014; Bimber and Raskar, 2005).

- **Spatial Displays**

Spatial Displays are devices of limited mobility that are often fixed, projecting the digital information directly into the desired element (Billinghurst et al., 2014; Carmigniani et al., 2011).

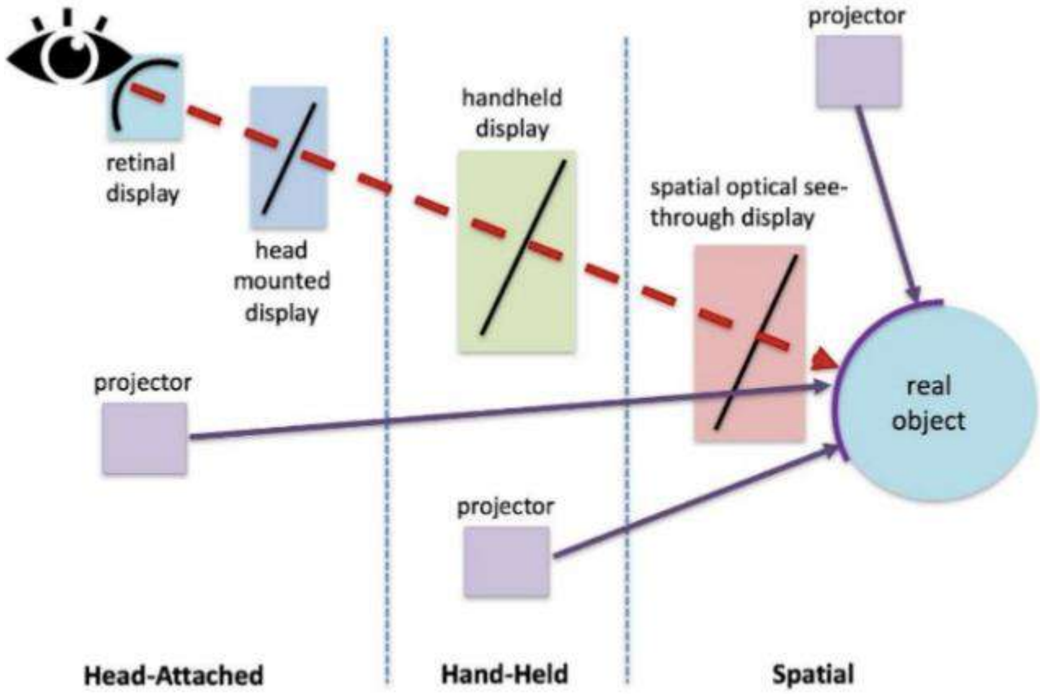
These displays can enhance the environment using the following devices (Billinghurst et al., 2014; Bimber and Raskar, 2005; Carmigniani et al., 2011):

1) OST: these create an overlap of the digital and real environment so that the images of both worlds are simultaneously visible due to the presence of an optical combiner that mixes the light emitted by the physical world with the light produced by an image source that displays rendered graphics. The main disadvantages of these displays are not supporting mobile applications, the limited number of observers, do not allow the mutual occlusion of the real and virtual environments, the limited size of the screens, and the optical combiners causes the virtual objects to be artificially limited/reduced. Notwithstanding these limitations, the spatial OST displays have better eye accommodation and convergence, resolution, FOV, ergonomic factors, calibration and a more controllable environment;
2) Screen-based VST displays: they use a mix of videos, and the images are projected onto a monitor. Its disadvantages are the reduced FOV (limited to the monitor) and the limited resolution of the merged images. However, they are the most cost-efficient technology;
3) Direct Augmentation/ Projection-based spatial displays: these displays use front-projection to directly project the image onto the intended surface, rather than relying on a flat image. They use different projectors to improve image quality. The use of front-projection has the disadvantage of creating a shadow of the objects and users that are interacting. Other shortcomings are the restriction of the display area (in terms of colour, size, shape of physical objects) and the restriction for single users when digital objects are displayed with non-zero parallax. Other disadvantages are the focus limitations of conventional projectors and high complexity for alignment and colour calibration (which comes with an increasing number of projectors). However, these projectors have better ergonomics (when compared to HMD), FOV, scalable resolution and better eye accommodation.

Summing up, considering the way the image is generated for AR applications and where the displays are placed relating to the observer and the real object, the displays can be grouped, as shown in Fig. 2.10 (Bimber and Raskar, 2005).

For a detailed review of the characteristics of AR visual displays, see van Krevelen and Poelman (2010).

Fig. 2.10 - Taxonomy of visual displays



Other authors consider other types of displays such as aural/sound displays (involving headphones and speakers, as well as haptic sound, i.e., sound sensed through vibration), there are also haptic (touch) displays, and olfactory and gustatory, which remain underdeveloped (Mihelj et al., 2014; van Krevelen and Poelman, 2010).

2.4.1.2. Input Devices

Within the input devices, there are the **gloves**, such as those developed by Piekarski and Smith (2007), which through pressure sensors and fiducial markers incorporated in them allow a computer to detect the commands/hand gestures. There is also Arafsha et al. (2015) **haptic coat** which provides feedback through induction of vibration, beating and heat sensations in the neck, chest, abdomen, shoulders and arms, allowing users to identify which emotions are associated with the received haptic stimulus. There are also **wristbands**, such as ReachMedia, which, through RFID technology, detect the objects with which the user is interacting, allowing socially accepted and more fluid interaction (Feldman, Munguia Tapia, Sadi, Maes, and Schmandt, 2005).

Other forms of input devices are **smartphones** because they are used as pointing devices, e.g., applications where the user must point the smartphone camera to the element of interest to be digitally enhanced (Gervautz and Schmalstieg, 2012).

The choice of input devices varies greatly, depending on the intended goal of the system and the displays involved (Carmigniani et al., 2011). For example, in interaction with handheld displays, the input device is a touchscreen. However, if one wants a hands-free interaction, the developed input devices must recognize parts of the body such as the body and arms (Arafsha et al., 2015), wrist (Feldman et al., 2005), or gaze (Lee et al., 2010; Xu, Stojanovic, Stojanovic, Cabrera, and Schuchert, 2012).

2.4.1.3. Interaction and User Interfaces

The user-content interaction of AR applications must be intuitive so that the connection between the real and virtual worlds causes user involvement (Carmigniani et al., 2011; van Krevelen and Poelman, 2010). Interaction and user interface are closely related since it is from the use of the interfaces that the interaction of the user with the AR system arises. There are several interfaces developed for AR, such as 1) information browsers; 3) 3D user interfaces; 3) tangible user interfaces; (TUI), 4) natural user interfaces; 5) collaborative interfaces; 6) multimodal interfaces; 7) haptic user interfaces (Billinghurst et al., 2014; Mihelj et al., 2014; van Krevelen and Poelman, 2010).

1) Information Browsers:

These interfaces show AR information in the real world (e.g., applications like Junaio or Wikitude) and the interaction is limited to viewing the AR scene and navigating the given information (Billinghurst et al., 2014). Users only need their human affordances (e.g., turning their heads when with an HMD) to interact with the physical world, graphical user interfaces (GUI), or traditional input devices such as a mouse or a joystick (Billinghurst et al., 2014).

2) 3D User Interfaces (UI):

These interfaces consist of UI (a medium that allows the communication between users and computers) that involves 3D interaction. So it is a human-computer interaction where the user's tasks are carried out in a real or virtual 3D spatial context through the use of gestures or walking (Billinghurst et al., 2014). This 3D interaction can be summed up into three categories: 1) Navigation (which involves the orientation and movement of the user from one point to another); 2) Selection (consists of acquiring /identifying an element /set of objects within a set; and 3) Manipulation (consists of SW components that map input from input devices) (LaViola Jr. et al., 2017).

3) Tangible User Interfaces (TUI):

This concept presented by Ishii and Ullmer (1997) is one of the most common AR interfaces since it allows manipulation of the virtual world through the manipulation of real-world physical objects/tools (e.g., pointers, pens, and gloves) intuitively and naturally (Billinghurst et al., 2014; Mihelj et al., 2014; van Krevelen and Poelman, 2010). Tangible AR Interfaces are those where each virtual object is registered on a physical object, and the user interacts with the virtual objects by manipulating the corresponding physical objects (Billinghurst, Grasset, and Looser, 2005). Despite their apparent simplicity, TUIs have the disadvantage that the user has to learn to operate these systems, as well as the fact that they may not be suitable for mobile/wearable solutions (Billinghurst et al., 2014; Carmigniani et al., 2011).

4) Natural User Interfaces:

These interfaces allow interaction through natural features, recognising body movement and hand and foot gestures (Billinghurst et al., 2014; Lv, Halawani, Feng, ur Réhman, and Li, 2015).

5) Collaborative Interfaces:

They use multiple devices to allow people to work together, whether nearby or remotely, allowing for increased vision sharing and improving face-to-face communication (Carmigniani et al., 2011; Mihelj et al., 2014; Zhou et al., 2008).

6) Multimodal Interfaces:

These interfaces result from the combination of TUI with natural user interfaces (gesture, look, movement, voice) (Mihelj et al., 2014; Wang, Ong, and Nee, 2016b). By combining multiple sensory channels, it is intended to overcome the disadvantages of the other interfaces (Schmalstieg and Hollerer, 2016).

7) Haptic User Interfaces

These are TUI that allows two-way human-computer communication, where robots or gloves provide kinesthetic (force and movement) and tactile (touch) feedback (van Krevelen and Poelman, 2010).

8) Hybrid AR Interfaces

Hybrid Interfaces are the result of the combination of complementary interfaces, increasing the options and flexibility of interaction, as well as the possibility of interacting through several devices (Carmigniani et al., 2011; Mihelj et al., 2014; Zhou et al., 2008).

In respect of interaction techniques and UI, there are three significant areas that should be further explored in the future (Kim et al., 2018):

1) Multimodal Interaction, through a combination of natural human interaction with intelligent virtual agents, directing studies in the area towards a social user interface;
2) Natural User Interfaces, focusing on a two-way interaction (especially in the case of the virtual world affecting the physical state); and
3) The rising of 'magic' interaction based on brain-computer interaction (BCI) (Billinghurst et al., 2014).

2.4.2. Software and Development Tools

Intrinsic to HW, there is the need to have SW that allows making physical devices into systems capable of creating an AR experience.

There are two main perspectives of SW systematisation: 1) one that focuses on the perspective of creating the AR application, and 2) another that subdivides the SW according to the degree of programming skills required (Billinghurst et al., 2014; Craig, 2013).

Focusing on the first approach, there are the following (Craig, 2013):

1) SW involved directly in the application of AR: as is the case of the SW required for the sensors that allow the acquisition of the physical world, and the integration of the sensors, for the application engine and the rendering SW;

1) SW used to create the AR application like AR libraries;
2) SW used to create content: consists of SW to create 2D and 3D graphics, or to create and edit sound; and
3) Other SW related to AR, like simulators and debuggers, tools to manage multimedia elements, among others.

In the second perspective (based on programming skills), there are the following elements (Billinghurst et al., 2014; Craig, 2013):

1) Low-level SW libraries and frameworks: it is the SW required for the tracking and display functionality of the AR application and the SW involved directly in the AR application. These require vast programming/coding knowledge, and the most well-known tool is ARToolkit[6];
2) Rapid Prototyping Tools: These require some programming knowledge, design and prototyping skills. One of the most well-known tools is Adobe Flash that has the AR Plug-in FLARToolkit[7] or FLARManager[8];
3) Plug-ins to Existing Developer Tools: they require a skilled developer. These plug-ins add the tracking functions and AR visualisation. As examples there are the AR Toolkit Designers (DART)[9], AR-Media[10] and the Vuforia and Unity plug-ins;
4) Stand-alone AR Authoring Tools: they allow the creation of AR experiences without requiring programming knowledge, e.g., Wikitude Studio, Layar Creator, or Snapchat Lens Studio.

Thus, it was found that there are several SWs available to develop an AR application according to the developer's programming skills.

2.4.3. Technical Specificities

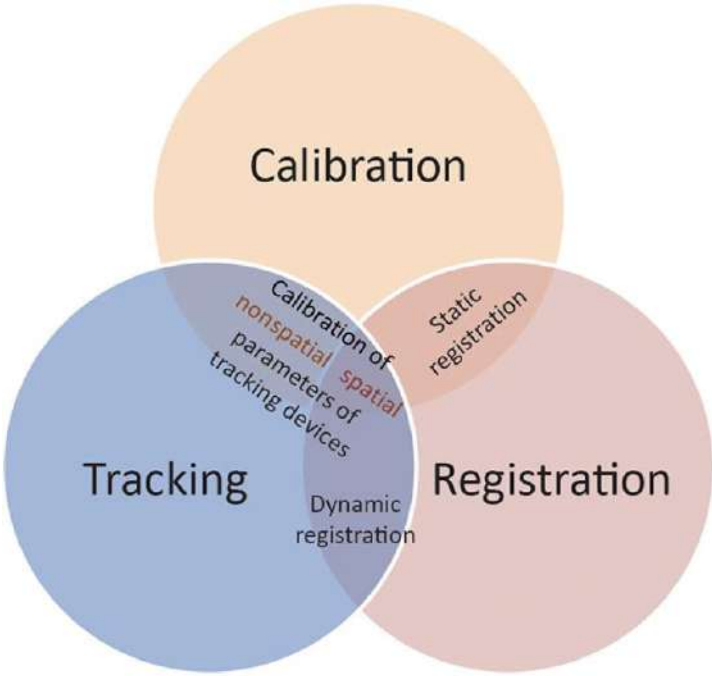
An AR application does not depend exclusively on the HW and SW mentioned above. Several associated techniques are crucial for an AR application to run and augment reality

[6] ARtoolkitX, http://www.artoolkitx.org, accessed on 27/07/2019
[7] FLARToolKIt, http://www.libspark.org/wiki/saqoosha/FLARToolKit/en, accessed on 27/05/2019
[8] FLARManager, http://words.transmote.com/wp/flarmanager/, accessed on 27/05/2019
[9] DART, http://ael.gatech.edu/dart/, accessed on 27/05/2019
[10] AR_Media, http://www.armedia.it, accessed on 27/05/2019

successfully. There are techniques for determining the location of the viewer relating to a real-world anchor, for the real-world tracking, which has to be digitally recorded, reconstructed, there must be calibration, management of latency times, rendering, modelling of the environment, visualisation of the AR environment, among others.

Thus, Fig. 2.11 shows how the concepts of tracking, registration and calibration are organised and 'mixed' (Schmalstieg and Hollerer, 2016, p. 86).

Fig. 2.11 - Key-concepts of an AR system



In order to understand such concepts, we draw explanations from the field of Computer Science, especially computer graphics (i.e., computer-generated images).

2.4.3.1. Tracking Techniques

Tracking is the generic term used to describe the dynamic sensing and measurement of the AR system (Schmalstieg and Hollerer, 2016). Sensing involves technologies used to collect information from the physical environment (i.e. sensors), such as digital cameras, magnetic sensors, GPS, among others (Mihelj et al., 2014).

Tracking techniques can be divided into 1) sensor-based; 2) vision-based, and 3) hybrid (Billinghurst et al., 2014; Zhou et al., 2008).

Sensor-based tracking techniques

Sensor-based tracking techniques involve a multiplicity of sensors: magnetic, acoustic, inertial, optical, or mechanical (Zhou et al., 2008).

Magnetic sensors consist of devices with magnetic field properties that allow the estimation of the position (location and orientation) of a receiver in relation to a transmitter (anchor in the real world) (Billinghurst et al., 2014; Welch and Foxlin, 2002).

This tracking technology has the advantage of dealing with the phenomenon of occlusion, and to track in six degrees of freedom (DOF), which makes them very precise and accurate, despite being sensitive to ferromagnetic material and electromagnetic disturbances, thus requiring further calibration (Craig, 2013; Schmalstieg and Hollerer, 2016).

Inertial sensors include accelerometers (to measure linear acceleration), gyroscopes (to measure rotational velocity), and magnetometers (that provide timed ambient measurements, and do not have to be pre-prepared) (Schmalstieg and Hollerer, 2016; van Krevelen and Poelman, 2010). These sensors allow the measurement of three DOF, having no range limitation, no interference with other sensors, providing a band-wide measurement of movements with negligible latency (Billinghurst et al., 2014).

Acoustic sensors can be used with optical tracking systems sensors, such as microphones, where there is a need for acoustic information to be captured by a microphone (Craig, 2013). These sensors are small in size, have low power consumption and no lighting constraints, although they cannot be used in environments with noise at the same frequency as the signal, and also have a limited range (Craig, 2013; Foxlin, Harrington, and Pfeifer, 1998).

Ultrasonic sensors provide estimates of the posture and speed of information, presenting high accuracy, temperature sensitivity, occlusion and ambient noise (Chatzopoulos et al., 2017).

van Krevelen and Poelman (2010) suggested a new category of sensors - biometric - that collect information on the physiological status of users, such as heartbeat, galvanic skin response, electroencephalogram, among others, allowing a man-machine symbiosis.

GPS-based tracking (Global Positioning System) is often used for outdoor AR applications, based on the network of 24 satellites that make up the American 24-satellite Navstar, and has an average accuracy of 1-3 meters (Billinghurst et al., 2014; van Krevelen and Poelman, 2010).

Vision-based tracking techniques

Vision-based tracking techniques involve the image captured by optical sensors. They require cameras that capture light information, which allows them to obtain data on the user's pose:

- Such techniques can use infrared sensors, where there are targets that emit and reflect the light, allowing, through their brightness, their detection (Billinghurst et al., 2014). These sensors, although scalable, precise and robust, depend on the emission of light (Billinghurst et al., 2014). They also require more power and synchronisation of light sources, so they are more expensive, sophisticated and invasive (Billinghurst et al., 2014).
- Visible light is the most common sensors (including webcams, smartphones, among others), given their versatility in capturing the real world and registering the digital content in the physical world (Billinghurst et al., 2014). Billinghurst et al. (2014) subdivide them into:
  - Marker-based (MB)

This tracking system relies on the recognition of fiducial markers (an image or a set of points) placed artificially in the physical world (Craig, 2013; Katiyar, Kalra, and Garg, 2015). Through the camera, the system recognises the marker, estimating the position of the camera relative to the marker (Craig, 2013). Craig (2013) points out that a fiducial marker is: 1) a physical object (e.g., a sheet of paper), 2) that has a unique pattern, easily recognisable by computer vision SW, 3) it is asymmetrical, and 4) can or cannot be moved.

There are two types of fiducial: the point fiducials and the planar fiducial. In point fiducial, each point is assigned a correspondence between the scene and the image, and its accuracy is superior to that of natural features (Lepetit and Fua, 2005). Planar fiducials contain more information than points since a single planar fiducial has six spatial constraints, which can take on rectangular forms, in black and white (Chatzopoulos et al., 2017; Lepetit and Fua, 2005). These fiducials have improved precision and robustness in scenarios of lightning variation (Chatzopoulos et al., 2017; Lepetit and Fua, 2005).

- Markerless (ML)

This tracking system presents a higher precision (compared to MB), not requiring a fiducial marker, allowing the tracking of physical positions (Comport, Marchand, and Chaumette, 2003; Comport, Marchand, Pressigout, and Chaumette, 2006; van Krevelen and Poelman, 2010).

- Natural Feature

The images to be recognised are more complex than the fiducial markers, involving the recognition of points and regions in sequences of images in order to calculate the corresponding relations to calculate the pose estimate (i.e. the system recognises optical features). For each estimate, a descriptor is calculated that allows the identification and differentiation between each feature (Billinghurst et al., 2014; Chatzopoulos et al., 2017; Siltanen, 2012). This method has the advantage of not requiring previous information from the environment and having a frame-by-frame tracking that reduces mismatch errors (compared to sensor-based methods), and its shortcoming is its high cost (Chatzopoulos et al., 2017).

- Model-based

This method uses 3D structures as object models and planar parts created from automatic CAD techniques (Lepetit and Fua, 2005).

Hybrid tracking techniques

Hybrid tracking techniques arise from the integration of data from different sensors, increasing the number of DOF and system accuracy, as it exceeds the limitations of the use of a single sensor (Billinghurst et al., 2014). This tracking can combine optical tracking with GPS and other inertial sensors (Kim et al., 2018; Mihelj et al., 2014).

These techniques are the best venue for mobile AR systems tracking, not only because of the higher precision but also because of its general improvement of tracking quality (Kim et al., 2018).

Despite all the investment made in the improvement of the tracking techniques, there are still some challenges to be overcome, namely tracking in the outdoors, improving hybrid tracking and Simultaneous Localization and Mapping (SLAM), mainly using depth cameras and inertial sensors (Kim et al., 2018; van Krevelen and Poelman, 2010).

2.4.3.2. AR Systems

AR systems can be divided into five categories, depending on their degree of mobility (mobile or fixed) and location (interior versus exterior). Thus, Carmigniani et al. (2011) enumerate the following categories: 1) Fixed indoor systems, 2) Fixed outdoor systems, 3) Mobile indoor systems, 4) Mobile outdoor systems, and 5) Mobile indoor and outdoor systems. The choice of the type of system to be used influences the decisions regarding the sensors, the tracking techniques, the displays and even the interface (Carmigniani et al., 2011).

2.4.3.3. Calibration, Registration and Latency

Calibration

Calibration is “the process of determining the internal camera geometric and optical characteristics (intrinsic parameters) and/or the 3D position and orientation of the camera frame relative to a certain world coordinate system (extrinsic parameters)” (Tsai, 1987, p. 323). In this process, data from the sensors correlate with verifying and adjusting the accuracy of the sensors, making it responsible for the static register (Schmalstieg and Hollerer, 2016). This process can be performed only once, or several times, at the start of the operation or whenever the tracking starts - self-calibration (Schmalstieg and Hollerer, 2016).

The elements that can be calibrated are the camera (by measuring its internal parameters and the non-linearities of lens distortion) and the display (Schmalstieg and Hollerer, 2016).

Registration

Registration refers to the alignment of the objects created by the computer, where registration errors are the most common errors in the creation of an AR view (Azuma, 1997; Holloway, 1997).

Registration can be spatial, where the digital image must be placed in the real world with the maximum of overlap between the coordinates. It can be absolute (depending on the GPS) or relative (when it depends on another entity), e.g. when one sees the inside of an object (Craig, 2013). There is also temporal registration, which is even more challenging to achieve because it depends on information processing times (Craig, 2013).

Moreover, Holloway (1997) identifies the following as the main registration errors: acquisition/alignment, head-tracking, display, and viewing errors.

Latency

Latency represents the amount of time that aspects of the virtual world are delayed relating to the time when they should occur (Craig, 2013).

When comparing VST HMDs versus OST HMDs, VST presents a significant advantage in the management of latency, since they depend on the video that allows the alignment of the virtual elements (Schmalstieg and Hollerer, 2016).

Craig argues that there is no way to eliminate latency of AR systems, and the only issue that can be addressed is the amount of latency the user can accept, which may even be desirable, especially in the case of cybersickness (Craig, 2013; Schmalstieg and Hollerer, 2016).

2.5. Applications

When analysing the evolution of the applications given to the AR solutions since Azuma's (1997) article up to the present day, it was found that these have started to be very specific, for a very restricted target, but have become more diverse. In recent years there has been a growing supply of AR to the general public, and it is hoped that it will become a "social medium beyond domain-specific applications" (Kim et al., 2018, p. 2958).

Thus, since AR has inherent versatility, innovative character, and is becoming a more and more accessible technology, it has several applications, especially in the following areas:

- Manufacturing and repair: AR assists in the process of developing products, processes, assembly lines, making them more efficient, economical, and of better quality since the simultaneous visualization of the physical and virtual worlds enhances the capabilities of the human being (Ong, Yuan, and Nee, 2008; Wang, Ong, and Nee, 2016a);
- Education: AR has multiple uses, from the creation of digital layers that add information and interactivity to school books. It can portray 3D representations of the solar system, without the input of the school book, or it can be an alternative to traditional teaching methods (Huang et al., 2019; Yip, Wong, Yick, Chan, and Wong, 2019);
- Military: the use of AR in pilot training is one of its older uses. AR allows the pilot to receive navigation and potential targets information during flight, but also for ground operations, and combat training (Azuma, 1997; Azuma et al., 2001; van Krevelen and Poelman, 2010);
- Medical applications: AR applications in the area of medicine range from guiding surgeries through the overlay of diagnostic imaging/videos, to areas such as Psychology/Psychiatry for phobia treatment (Meola et al., 2017; Suso-Ribera et al., 2019);
- Gaming: the increasing incorporation of AR elements in games, the flow (as a feature of the medium) associated and the player's gratifications when playing the game, are some of the drivers in the adoption of this technology (Rauschnabel, Rossmann, and tom Dieck, 2017). Also, van Krevelen and Poelman (2010) present a sample list of application of AR in games;
- Marketing: within this context, AR has been incorporated into advertising and brand communication strategies, and the use of AR apps leads to consumers having a better brand attitude. Moreover, AR impacts the purchase intention (through perceived information and enjoyment caused by AR), and the promotion of customer value perceptions (Hilken, de Ruyter, Chylinski, Mahr, and Keeling, 2017; Rauschnabel et al., 2019; Smink et al., 2019).

2.6. Human Factors in Augmented Reality

Similarly, with other technologies, AR is intrinsically related to the human being in its impact on human's assessment of technology. This fact is further proved given the ease that AR has in influencing human perception, cognition and physiology through the immersion of the subjects in blended environments, where one can manipulate (increasing or decreasing) the AR stimulus (Kim et al., 2018).

Thus, one can realise the growing importance that the study of human cognition and perception has been gaining in recent years. Also, researchers started to pay attention to the evaluation/testing of AR applications. More specifically, in the surveys conducted on articles published in ISMAR between 1998-2007 and 2008-2017, it was found that the evaluation of AR techniques and/or systems in the first decade represented 5.8% of published articles, whereas in the second decade it reached 13.7% (Kim et al., 2018; Zhou et al., 2008). According to Kim et al. (2018), this AR assessment can be segmented into three broad classes for better understanding: 1) surveys, 2) user evaluation, and 3) perception.

Having that said, it is also noteworthy the growing importance that AR has gained in the Marketing field with sound studies focusing on its acceptance (Huang and Liao, 2015; Rauschnabel and Ro, 2016; Rese, Baier, Geyer-Schulz, and Schreiber, 2017) and on its uses on product presentation (Bonnin, 2020; Morillo et al., 2019; Yim et al., 2017).

2.6.1. Survey Papers

Surveys are the type of evaluation papers that generate most interest since they consist of choosing a topic of interest and from there, researchers develop a comprehensive review of all related work, systematising the knowledge generated and presenting directions for future research. In the field of MAR, the work of Papagiannakis et al. (2008) analyses AR systems used for MAR, focusing on computing devices, indoor versus outdoor systems, tracking and registration, displays and content. Further, these authors present the importance of social acceptance and the mobility of MAR technology (Papagiannakis et al., 2008).

Olsson and Salo conducted an online survey to 90 users of MAR apps (namely AR browsers and AR recognition applications) where they tried to gauge the overall use of apps, user experience (UX) and technology acceptance (Olsson and Salo, 2011). This work allowed the authors to realise the strengths and weaknesses of AR mobile apps, a general measure of UX and user acceptance, and to understand the context and motivation in the use of MAR apps (Olsson and Salo, 2011).

Irshad et al. (2016) later conducted a cross-sectional survey involving nine sessions and 15 participants in order to gain insights regarding marketing-related AR apps, concluding that this is a positive platform for the development of advertising campaigns, and to achieve positive values of user perception.

More recently, Chatzopoulos et al. (2017) presented a survey of the elements required for a MAR application: UX/UI issues (crucial in user engagement with MAR), mobile computing platforms (data-based, monitoring-based and hybrid tracking methods), network connectivity, data management, system performance, sustainability, and applications. These authors further identify that the significant challenges for MAR apps are the technological limitations (e.g., energy efficiency, low-level MAR libraries), user safety and privacy, and social acceptance, especially HMDs (Chatzopoulos et al., 2017).

2.6.2. User Evaluation Studies

One of the critical elements to be considered when developing experiences with technology is the evaluation of the usability of the application. Thus, user evaluation studies are crucial tools in the assessment of users' opinions. To this end, Swan II and Gabbard (2008) argued that user-based experiences are crucial in design and usability activities. In their survey, the authors found that until 2005, user-based studies focus on three broad lines as follows (Swan II and Gabbard, 2005):

1) Perception: the study of low-level tasks (understanding how human perception and cognition work in AR contexts);
2) Performance: evaluation of the performance of tasks of specific AR applications, to understand how technology influences underlying tasks; and
3) Collaboration: studies that evaluate user interaction and communication among multiple users.

To this segmentation Dünser et al. (2008) added the system usability category and divided the scientific production regarding user-based experiences into five types: 1) objective measurements (time, precision, error rates), 2) subjective measurements (user ratings), 3) qualitative analysis (user observations, formal interviews), 4) usability assessment techniques (evaluation heuristics, task analysis), and 5) informal assessments (informal user assessments, informal feedback collection).

More recently, Dey et al. (2018) conducted a systematic review of the usability studies on AR published between 2005 and 2014 (indexed on Scopus) and verified the emergence of studies using handheld displays, the predominance of educational applications, of formal user studies, and that the preferred method of data collection was questionnaires (Dey et al., 2018). Another of the authors' findings was that the areas of education and tourism were those that applied more field experiments (versus lab experiments), and the predominant type of research design is within-subjects.

A recent example of the use of hermeneutics and qualitative analysis in understanding what users expect from an interaction with AR mobile services and insights related to UX is the work of Olsson et al. (2013) who conducted individual and group interviews with 28 individuals. This study allowed them to perceive the role of expectations in influencing users' perception of product values (Olsson et al., 2013). Lv et al. (2015) conducted a user study through an experiment where participants were invited to interact with a touch-less interaction AR device, after which they answered a questionnaire that assessed the social acceptance of AR games, the usability of the gestures, the user's workload, their emotions and satisfaction levels.

In turn, Gandy et al. (2010) employed a series of qualitative, quantitative and physiological tests to test an AR testbed. In a study of AR applications for smartphones, Ko et al. (2013) developed usability principles for the development and evaluation of AR applications for smartphones and subsequently, heuristically evaluated some apps.

2.6.3. Perception

Perception, in this context, is seen as a complex phenomenon of reconstruction and interpretation of multisensory stimuli, involving image and space (Hecht, Schwartz, and Atherton, 2003).

In a review on the issues of perception, Kruijff et al. (2010) identified and classified the issues related to AR perception into five elements as follows:

1) Environment: reflects the problems resulting from the interaction between environment and augmentation (e.g., structure and environmental conditions, colours);
2) Capture: issues related to the scanning of the environment in VST systems as well as optical and lighting problems in VST and OST systems (e.g., image resolution and filtering, lens issues, exposure, colour accuracy and contrast, and frame-rate capture);
3) Augmentation: involves issues related to the design, layout and registration of augmentation (e.g., the error of registration, occlusion, layer interference and layout, rendering and resolution mismatch);
4) Display: aspects associated with display devices (e.g., stereoscopy, FOV, angle offset visualisation, display properties, colour fidelity, reflections and latency); and
5) Individual differences of users: characteristics related to user perception of content (e.g., depth cues, disparity planes, and accommodation).

The question of perception has been studied in areas such as retail, where Meißner et al. (2019) used a VR system since it retains the 3D perception and movement of people by bringing the experience closer to reality. Additionally, AR purchasing environments provide better information and pleasure perception (Rese et al., 2014).

2.6.4. AR Acceptance and Adoption

The democratisation of AR technology has moved it from the laboratory into the real world. The issue of social acceptance is mainly related to wearable and mobile AR solutions, either through the use of handheld displays (smartphones) or with HMDs/smartglasses (Billinghurst et al., 2014; Carmigniani et al., 2011).

Regarding the users' acceptance and adoption of new technologies, it is noteworthy the impact of Technology Acceptance Model (TAM) among scholars. In this model, Davis (1989) expands Ajzen and Fishbein's (Ajzen and Fishbein, 1980) Theory of Reasoned Action (TRA), thus explaining that behavioural intention is a function of one’s attitude toward behaviour and the related subjective norm. TAM states the variables Ease of Use (EoU) and Perceived Usefulness (PU) influence the attitude toward using the technology, thus influencing the behavioural intention (Davis, Bagozzi, and Warshaw, 1989). Davis argues that EoU is "the degree to which a person believes that using a particular system would be free of effort", and that PU is "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320).

This theory was further expanded into TAM 2 (Venkatesh, 2000; Venkatesh and Davis, 2000); Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, and Davis, 2003), and TAM 3 (developed for e-commerce) (Venkatesh and Bala, 2008).

Given the relevance of this theory (and its expansions) on the acceptance and use of new technologies, it becomes crucial to understand the implications of EoU and PU on AR.

Regarding the adoption of ARSG, several authors have analyzed the adoption and acceptance of this technology based on different theories: the Big Five Model of Human Personality (Rauschnabel et al., 2015), Uses and Gratifications Theory (U&GT) (Rauschnabel, 2018; Rauschnabel et al., 2018), Technology Acceptance Model (TAM) (Rauschnabel and Ro, 2016). Thus, Table 2. 2 presents a synthesis of the studies related to the adoption and acceptance of ARSG.

Regarding the acceptance of MAR, there is a wide variety of applications offered to users, from those related to shopping, entertainment, lifestyle, tourism, and these applications are changing consumer behaviour (Dacko, 2017). Drawing on TAM Rese et al. (2017) evaluated users’ perceptions through four experiments: two with marker-based AR (MB AR) and two with markerless AR (ML AR), discovering some factors that explain the adoption of AR in marketing and retail. In this study, the authors concluded that ML AR presents better values in TAM constructs than MB AR, namely regarding the intention of recommendation and use (Rese et al., 2017). They also concluded that TAM is a robust and valid model for AR apps and that the importance of hedonic and utilitarian aspects is relative to the type of apps under evaluation (Rese et al., 2017).

Table 2. 2 - Table summarising the studies related to the adoption and acceptance of ARSG

Study	Theoretical Approach	Main Findings
Rauschnabel et al. (2015)	Big Five Model of Human Personality	Rauschnabel et al. found that emotionally stable consumers are more aware of Google Glasses and that consumers who find functional benefits and social conformity in smartglasses are more likely to use them. Also, the authors found that the impact of these effects is moderated by the consumers' personality. Namely, the degree of openness and extraversion are positively associated with the adoption of ARSG. In contrast, high levels of neuroticism are negatively associated with the adoption of this technology.
Rauschnabel and Ro (2016)	TAM	In this paper, the authors studied the drivers of the acceptance of ARSG and found that the main factors that lead to the use of this technology are the degree of technology innovativeness and social norms. Regarding the functional benefits and attitude toward the manufacturer brand, they have a mediating effect on the attitude towards the use of ARSG, which in turn influence the intention to adopt them.
Rauschnabel (2018)	Uses and Gratifications Theory (U&GT)	In an online survey of 228 North American students, Rauschnabel concludes that there are six gratifications related to the use of ARSG: utilitarian, hedonic sensual-visual (through augmentation of reality), sensual-physical (ergonomics), social and symbolic. He also discovered that the concept of fashnology (the combination of fashion and technology) is also relevant in the adoption of ARSG in terms of self-expression.
Rauschnabel et al. (2018)	Uses and Gratifications Theory (U&GT), emphasis on Perceived Risks	In an approach that combines the expected benefits (utilitarian, hedonic and symbolic) with the perceived risks (personal privacy, the privacy of others, and loss of autonomy), the authors discovered that the expected benefits affect the intention to purchase and that only the privacy issue of others discourages purchase intention. The qualitative study reveals that people tend to pay special attention to others' privacy risks over their own, especially when there are third parties present, or in situations where people are expected to have privacy.

Based on the Unified Theory of Acceptance and Use of Technology (UTAUT) and Flow Theory, Zhou concluded that the intention to use MAR applications is influenced by performance expectancy (UTAUT) and perceived enjoyment, perceived control and attention focus (Flow Theory), which will influence usage behaviour (Zhou, 2018).

In a study conducted by Rauschnabel et al. (2017) using the AR game Pokémon Go (the most downloaded AR game), and drawing on the U&GT, the authors found that the acceptance of this new game experience is motivated by social, emotional, and hedonic factors and social norms. However, it is deterred by the possibility of involving physical risks.

2.6.5. Impact of Media Characteristics and Affordances on AR Users

Another 'human' aspect of AR is related to the inherent characteristics of this technology (MC), its affordances and its impact on users.

With the rise of the new digital media, the need to comprehend the role of marketing in hypermedia computer-mediated environments (CME) has arisen. Thus, researchers verified that digital media are media that convey characteristics like interactivity, hypertextuality (many sources connected), modality (the content of the communication can be in the form of text, image, or video), with temporal synchronicity, several communication models (one-to-one, few-to-few and many-to-many), and with symmetrical feedback from the media (Hoffman and Novak, 1996). It is in this sequence that the flow construct arises. Csikszentmihalyi defines flow as a process of optimal experience, that allows a degree of immersion in the task to be performed, a temporal abstraction, as well as focused attention on the task (Csikszentmihalyi, 2014; Csikszentmihalyi and LeFevre, 1989), thus emerging as an essential element in CME communication (Hoffman and Novak, 1996).

In their synthesis of interactions in CME, Yadav and Pavlou (2014) segment them according to the parties involved: consumer-company, consumer-business, consumer-consumer and company-company interactions. They highlight the fact that AR is a communication medium to be used because it allows consumers to enjoy new forms of interaction with companies and it is relevant to convey information, through multiple devices, which represents a challenge for marketers (Yadav and Pavlou, 2014). Notwithstanding this importance, the study of the media characteristics in the light of theories of consumer psychology is still in its infancy, and this knowledge has been supplemented from studies related in particular to MC interactivity and augmentation (Javornik, 2016a, 2016b).

In this way, we can consider that the relevant MCs for AR technology are: interactivity, modality, hypertextuality, location-specificity, connectivity, mobility, virtuality, augmentation, flow, personalisation, agency, and navigability (Blom, 2000; Javornik, 2016a; Roxo and Brito, 2018), as described in Table 2. 3.

Table 2. 3 - Synthesis table of relevant MC for AR (Roxo and Brito, 2018, p. 98)

Media Characteristics	**Definition**	**Authors**
Interactivity	The degree to which two or more parties communicate in a technologically mediated environment synchronously or asynchronously by exchanging reciprocal messages.	(Kiousis, 2002)
Augmentation	The ability of technology to add additional virtual and dynamic capabilities/content to real systems.	(Billinghurst et al., 2014)
Flow	The result of MC that allows a holistic interaction experience with the environment leading to immersion in the activity performed within the medium.	(Csikszentmihalyi, 1990)
Telepresence	The experience of presence in an environment through a medium.	(Steuer, 1992)
Modality	It pertains to the way content is presented (e.g., image).	(Sundar, Xu, and Dou, 2012)
Hypertextuality	This is the number of available links. In AR, it is the connections between the different hyperlinks, devices, and applications.	(Javornik, 2016a)
Connectivity	Concerns the kind of communication that can be established (one-to-one, one-to-many).	
Location-specificity	Concerns the geolocations of users that are relevant for AR as these data contribute to content production.	
Mobility	Relates to the ability to transport devices which is relevant, with the emergence of the MAR and wearable technologies.	
Virtuality	This is an inherent feature of AR that refers to the capability of the medium to overlap virtual elements to the real world.	
Personalisation	Envisaged as the process of adapting the medium regarding functionality, content, and interface to increase personal relevance.	(Blom, 2000)
Agency	The degree to which the self feels s/he is a relevant actor in the interaction with the environment, which may influence the content.	(Sundar, 2008)
Navigability	The ability of the user to explore the mediated environment system and functions.	(Sundar et al., 2012)

Another critical aspect of understanding human factors in AR is affordances. The affordance of a system/device/object can be defined as the things that can be done with it, resulting from a combination of the properties of the system/device/object and human capacities in handling it (Gibson, 1977). Affordances are of great importance because their perception contributes to increased interaction in AR environments through the creation of new affordances, which do not exist in traditional media. Affordances also stimulate the creation of mental models, spatial cognition, and situated cognition (as the case of rotation and manipulation of 3D objects) (Cheng and Tsai, 2013; Ibáñez, Di Serio, Villarán, and Delgado Kloos, 2014; Raja and Calvo, 2017).

2.7. Summary

From what was mentioned above, AR can be divided into two main areas: technological and human.

As far as the technological area is concerned, it is subject to extensive study in the area of Computer Science, and has very short innovation cycles, with the frequent appearance of improvements and innovations being common.

The 'human' component has recently begun to be studied in the disciplines of Marketing and Psychology/Consumer Behaviour. Roxo and Brito (2018) present a content analysis undertaken in respect of the research and conference papers published between 1997 and 2016, indexed in the Web of Knowledge and Scopus. In this study, the authors found that media characteristics are the topics that most influence the development of AR solutions, whether these are to serve utilitarian, educational, hedonic or interaction with technology motivations (Roxo and Brito, 2018).

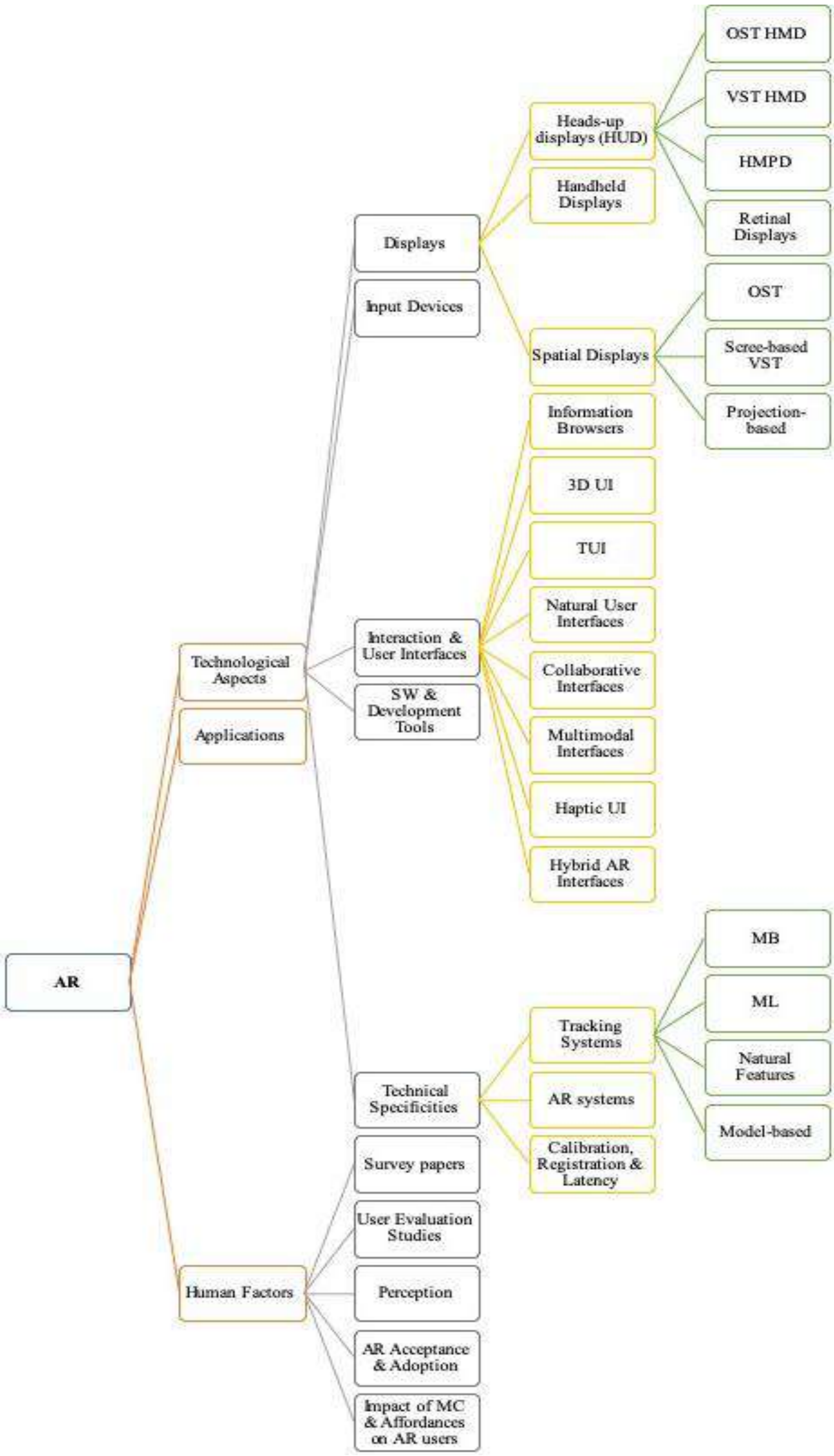
It was also found the support that technical elements, such as tracking techniques (ML versus MB) can influence consumers in different ways. Namely, ML AR creates a more significant impact on consumers than MB AR (Brito and Stoyanova, 2018). Moreover, the use of AR in corporate marketing strategies elicits cognitive, emotional, attitudinal responses, of value perception in consumers, which should be further explored (Hilken et al., 2017; Javornik, 2016b)

Thus, based on the systematisation that Roxo and Brito (2018) developed and updating it with the insights presented here, the AR area can be mapped, as shown in Fig. 2.12.

In this way, and analysing the summary of past researches presented in Table 1. 1, it can be found a gap regarding the impact of AR on consumers' psychology that can be fulfiled, more precisely, how social factors influence an AR purchase experience.

Noting the above, our research will explore which technology-related aspects that most influence consumers, focusing on the quality of AR, its ease of use, media characteristics involved, among other factors.

Fig. 2.12 - Synthesis diagram of AR



Chapter 3 Consumer Psychology Applied to Digital Media

3.1. Introduction

The first records of Consumer Psychology date from the XIX century, with studies related to the impact of advertising on people dating from this time (Schumann, Haugtvedt, and Davidson, 2008). Thus, Consumer Psychology is "the utilization of distinctively psychological concepts and methods to understand (explain and predict) the dynamics underlying, influencing, and determining consumer behavior." (Jacoby, 1976, p. 332).

Consumer Psychology is an interdisciplinary area that involves theories and methods from Psychology, Marketing, Advertising, Economics, Sociology and Anthropology (Jansson-Boyd, 2010).

Consumer Behaviour is defined as "the study of the processes involved when individuals or groups select, purchase, use, or dispose of products, services, ideas, or experiences to satisfy needs and desires" (Solomon, 2018, p. 28). Therefore, consumer behaviour tackles the dimension of the shopping experience: the buying (products/services), having (or not having products/services) and being (its influence on one's mind) (Solomon, 2018).

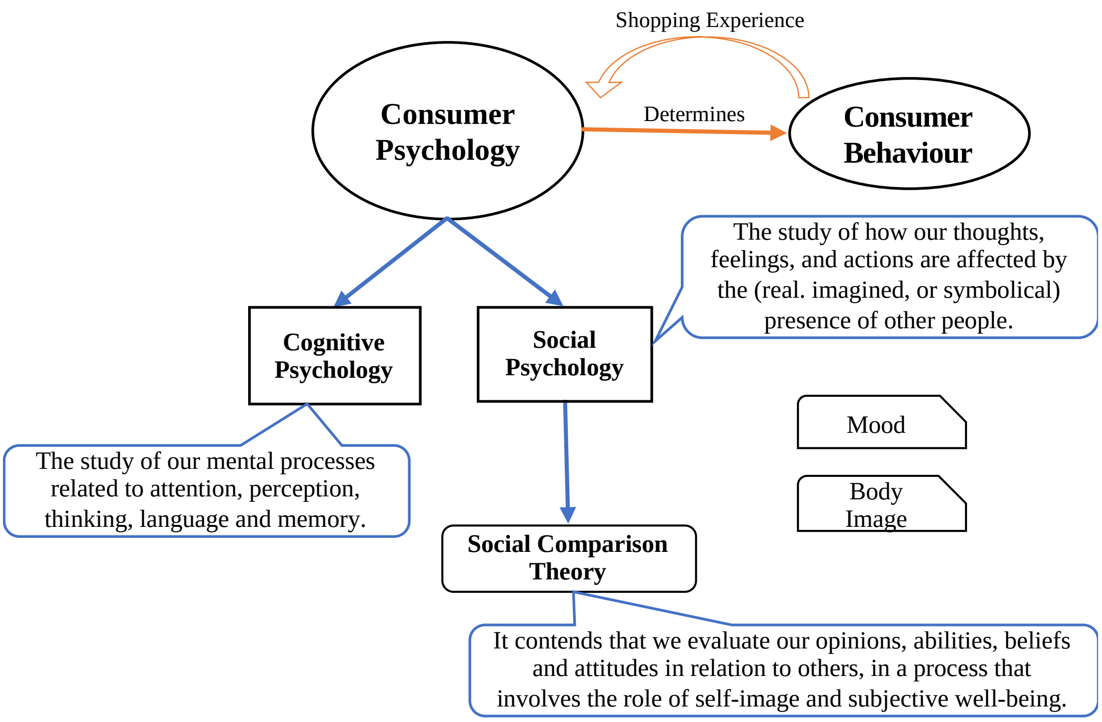
Since technology started to dominate the interaction between human beings, and due to its ubiquitous and mobile characteristics, human-technology interaction (HTI) emerges as a facet to which psychology has devoted some attention (Dix, 2017; Kool and Agrawal, 2016).

The study of Consumer Psychology can be divided into two major fields (Jansson-Boyd, 2010):

- Cognitive Psychology: this relates to the comprehension of the individuals' cognitive processes within a shopping context, and
- Social Psychology: this focuses on the influence that others exert on individuals and groups' behaviours.

Starting from this division, we study the relationships between Cognitive Psychology, technology (focusing on aspects such as attention and imagery and relating them to technology characteristics) and Social Psychology (drawing on the Theory of Planned Behaviour and Social Comparison Theory). Then we frame them within a mobile shopping experience. We also study the concepts of mood and body image, as predictors/explaining variables of human behaviour. Therefore, we analyse consumers' behaviour in an AR m-commerce context as a function of the variables mentioned below (see Fig. 3. 1).

Fig. 3. 1 - Synthesis of the chapter



3.2. Consumer Psychology: an Overview

3.2.1. Cognitive Psychology

Cognitive Psychology is the study of how the human mind is organised to produce intelligible thoughts (Anderson, 2015). It addresses processes such as memory, attention, perception, mental imagery, knowledge representation, language, decision-making, reasoning and problem solving (Anderson, 2015; Sternberg and Sternberg, 2012).

MEMORY/ATTENTION

Memory has been studied focusing on interactivity, one salient media characteristic (MC) of the digital media. For example, it can be seen that for the case of websites, subjects' memory (comprehension) increases due to interactivity (Macias, 2003).

Another measure of cognitive response used is the number of thoughts provoked by interactivity in both websites and mobile apps (with and without AR) (Javornik, 2016b; van Noort, Voorveld, and van Reijmersdal, 2012). van Noort et al. (2012) found that website interactivity enhances flow experience and, consequently, the magnitude of cognitive responses (especially the product-related). Javornik (2016b) replicated van Noort et al. (2012) experience using perceived augmentation as an MC, finding that in the presence of AR, flow elicits stronger cognitive responses (in terms of magnitude) for application/site related thoughts.

The relevance of these studies stems from the fact that one of the antecedents of flow – i.e. a state of optimal experience that comes from intense involvement in a positive/enjoyable activity (Csikszentmihalyi, 1990) - is focused attention. Focused attention is “a centering of attention on a limited stimulus field” (Csikszentmihalyi, 1975, p. 40), and is also one variable used to measure consumer experience in computer-mediated environments (Lin, Gregor, and Ewing, 2008; Novak, Hoffman, and Yung, 2000).

IMAGERY

Mental imagery is defined as “(1) all those quasi-sensory or quasi-perceptual experiences of which (2) we are self-consciously aware, and which (3) exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts, and which (4) may be expected to have different consequences from their sensory or perceptual counterparts.” (Richardson, 1969, pp. 2–3). Thus, mental imagery allows us to see with the eye of the mind (Wraga and Kosslyn, 2003). MacInnis and Price (1987) relate imagery with sensorial information, where it is a process where this information is stored in the working memory. Moreover, this process impacts consumption intentions and experiences, as well as purchasing timing (MacInnis and Price, 1987).

Mental imagery is a cognitive ability the enables us to: a) create mental models, b) predict the result of actions, c) visualise and retrieve memories, and d) learn (Moulton and Kosslyn, 2009; Wraga and Kosslyn, 2003). It also comprises a spatial (related to the position of objects in space) and a visual component (related to the visual attributes of objects like shape and colour) (Anderson, 2015).

The role of mental imagery in traditional media has been widely studied, e.g. its influence on attitude towards the advertising (Bone and Ellen, 1992) or in brand recall (Babin and Burns, 1997; Mikhailitchenko et al., 2009). This concept was also explored in the context of consumption activities/experiences, where Holbrook and Hirschman found an association between imagery and hedonic experiences (Hirschman and Holbrook, 1982; Holbrook and Hirschman, 1982). The quasi-experiences derived from mental imagery are even more 'real' in the context of digital media usage, where imagery is related to the concept of telepresence (Rodríguez-Ardura and Martínez-López, 2014).

Mental imagery involves the following attributes: vividness, its context, interaction with perception, and content (Horowitz, 1970). Vividness is the attribute most studied in the marketing literature (Argyriou, 2012; Choi and Taylor, 2014; Schlosser, 2003), and it is defined as "a combination of clarity and liveliness. The more vivid an image, therefore, the closer it approximates an actual percept" (Marks, 1972, p. 83). Clarity represents the brightness and sharpness of an image, whereas liveliness involves how dynamic, vigorous, and active an image is (Argyriou, 2012; McKelvie, 1995). Therefore, we can understand that aspects like websites' images animation (and, by extension, mobile apps), and products rotation causes higher levels of vivid mental imagery, which leads to increased intentions to revisit websites (Argyriou, 2012)[11]. Moreover, in a context of mobile advertising Gavilan et al. (2014) show that vividness has a positive impact on purchase intention and that imagery vividness mediates the effect of the type of mobile ad and type of content in ad trust.

TELEPRESENCE

Mental imagery is also relevant for telepresence (Rodríguez-Ardura and Martínez-López, 2014). "*Telepresence is defined as the experience of presence in an environment by means of a communication medium"* (Steuer, 1992, p. 76, emphasis in original). In contrast, Presence is understood as the sense of being in an environment (Gibson, 1979). Steuer (1992, p. 76) argues that "presence refers to the natural perception of an environment, and telepresence refers to the mediated perception of an environment", and the former is the 'type' of presence studied in the context of digital media.

From the perspective of telepresence for online brand engagement, Mollen and Wilson (2010, p. 921) define it as: "the psychological state of 'being there' in a computer-mediated environment, augmented by focused attention. It is characterised by cognitive and sensory arousal, control, and immersion (defined as perceiving oneself to be steeped

[11] For a review of the antecedents (imagery-eliciting stimuli) and behavioural, affective and cognitive consequences of mental imagery, see Gavilan, Avello, & Abril (2014).

in and interacting with an environment that sustains a continuous stream of stimuli and experiences)."

When in a state of telepresence, the individual is aware that s/he is using technology, but at some point and to some extent s/he no longer perceives the technology in the surrounding environment (Lombard and Snyder-Duch, 2001). The experience of telepresence can be enhanced, for example by the quality, resolution, and size of the digital images, and interactivity (Algharabat, Rana, Dwivedi, Alalwan, and Qasem, 2018). In sum, telepresence enhances subjects immersion in the digital world, influencing subjects' focused attention and, consequently, the flow experience (Mollen and Wilson, 2010; Rodríguez-Ardura and Martínez-López, 2014).

AUGMENTATION

As defined in the previous chapter, augmentation is a measuring instrument that allows assessing the ability of technology to add additional virtual and dynamic capabilities/content to real systems, which can come from any of the five senses (Billinghurst et al., 2014; Carmigniani et al., 2011). The perception of this MC, i.e., it psychological correspondent, is perceived augmentation (Javornik, 2016b).

Javornik (2016b) studied the impact that flow has as a mediator of the effects of perceived augmentation on consumers' affective responses toward an AR app, and behavioural intention to revisit and recommend an app. The author found that there is a negative outcome with flow mediating the relationship between perceived augmentation and cognitive responses because consumers who are more immersed in flow and have higher values of perceived augmentation report a smaller number of thoughts (Javornik, 2016b). It is noteworthy that in this study, when comparing elicited responses, participants referred only to the application and not to the brand (Javornik, 2016b). This reveals that during the perceived augmentation experience, subjects enter a state of flow where they focus on the experience of the app instead of the brand (Javornik, 2016b).

When this result is related with the fact that focused attention is one of the elements of flow and telepresence (both present in an AR experience) (Hoffman and Novak, 2009), this suggests that an AR experience impacts on the level of cognitive processing of sensory information received by the senses.

Another critical point is the fact that the scale available in the literature to measure the level of perceived augmentation is formulated in a way only to assess how subjects feel after an AR experience, whether their reality was enriched and how the augmented image was real and extends over time (Javornik, 2016b). Thus, it does not take into consideration the mental processes underlying image processing that are present in the MC augmentation, as well as in the mental intangibility/projection, i.e., the ability to mentally project a known tangible product (Laroche et al., 2005).

PROJECTION

The concept of projection derives from the concept of intangibility, i.e. “what cannot be seen, tasted, felt, heard, or smelled” (Kotler and Bloom, 1984, p. 147), reinterpreted by Laroche et al. who divide it into three dimensions: a) physical intangibility (i.e., something that is not accessible to the senses and which does not have a physical presence); b) generality (i.e., when a person can describe a specific product); and c) mental intangibility (i.e., a product that might be tangible, however, a person might not have a mental image of it) (Laroche, Bergeron, and Goutaland, 2001; Laroche et al., 2005).

In an AR context, the concept of intangibility in projection can be reframed. Thus, projection is the capability that AR possesses to enhance the presence of the product, both at the level of description, and its mental representation. Although the individual does not have that mental intangibility, seeing a digital representation of the product, helps to create such perception (Laroche et al., 2005).

MOOD

Past cognitive psychology studies did not acknowledge the emotional state of the individual. Therefore, as a way to overcome the lack of ecological validity, researchers started to recognise the role of emotion in cognition, by incorporating mood states (frequent in daily life) in their research (Eysenck, 2014).

There is no consensus among scholars regarding the definition of mood. Usually, mood is defined by comparing it with other concepts like emotions, affect, emotional state, and feelings (Luomala and Laaksonen, 2000).

It is instructive to distinguish the concepts of emotion and mood which are frequently used to refer to issues of affect, and are used interchangeably by academics (Davidson, 1994) (see Table 3. 1).

Table 3. 1 - Summary table of Mood versus Emotion (Davidson, 1994; Ekman, 1994)

	Mood	**Emotion**
Duration	Long (hours-days).	Short (seconds-minutes).
Facial Expressions	Devoid of facial expressions.	Usually accompanied by a facial expression.
Function	Modulate or bias cognition. Change information-processing priorities. Shifts modes of information processing. Accentuate or attenuate the accessibility of cognitive contents and semantic networks. It is the affective background of one's daily life. Reflected in subjective experiences. Lower the threshold needed to arouse the emotion.	Modulate or bias actions. Reflects phasic perturbation superimposed on one's daily lives. Reflected in one's autonomic response.
Antecedents	Not always identified.	Can be recognised.
Nature of the antecedents	Events perceived as occurring over a slower period. Can be the result of a series of cumulative intense events/emotional experiences with the same valence. Can be brought forth by changes in the neurohormonal and/or biochemical state.	Events perceived as occurring quickly and without warning. Physiological change in response to a significant and sudden event.

In their review of the definitions of mood, Luomala and Laaksonen (2000) argue that mood definition can be approached in two different ways:

(1) **Structural/Backdrop**: this is focused on the duration and intensity, as well as in stimulus and target specificity. According to this perspective, mood is commonly experienced unconsciously and continuously in daily life. Thus, it prejudices cognitive processes (memory, perception, evaluations, thinking), whose origin and target are not always determined. Mood presents lower levels of intensity than emotions; it is transitory and has a minimum amount of cognitive mediation.

(2) **Functional/Motivational**: in this regard, mood facilitates self-regulation, and subjects are conscious of their mood experiences. Therefore, individuals can specify their cause and target (mood can also be seen as an accumulation of experiences). To the proponents of this vision, mood intensity is variable, and its duration can be less transitory (when less intense), thus presenting moderate levels of cognitive mediation.

Notwithstanding the implications noted above for this study, mood is defined as (Bagozzi, Gopinath, and Nyer, 1999; Davidson, 1994; Ekman, 1994; Gardner, 1985):

- A transitory affective factor whose duration varies between hours to days, that modulates/regulates cognition. It is omnipresent (being present in daily life), and it is reflected in subjective experiences. Mood antecedents are unclear; however, they can be positive or negative, and the marketer may influence them.

Eysenck (2014) analyses the impact of mood states in cognitive processes like decision-making, using as parameters judgement, attitude to risk, and processing, finding that:

(1) The existing literature divides mood according to valence (positive versus negative), and that negative states involve anxiety, sadness and anger;
(2) Regarding judgement, a state of anxiety and sadness can lead to a pessimistic view and anger. For positive mood, the relationship with positive vision is not well established;
(3) People who score highly on anxiety and positive mood are more averse to risk-taking, contrary to those in states of sadness and anger;
(4) Regarding the issue of processing, people in positive moods and anger use a heuristic/shallow processing (characterised by its effortlessness and use of rules of thumb). Those in states of sadness use analytical processes (consciously controlled, slower, and requiring attention), whereas those in states of anxiety reveal inefficient processing.

Mood is a variable that plays a crucial role in the marketing literature because, regardless of the situation, the human being is always subjected to the influence of mental states that result from the assessment of the surrounding environment, thus affecting processes such as memory (e.g. retrieval, encoding and state-dependent learning), information processing, categorisation and creativity (Bagozzi et al., 1999). It should be noted that a positive mood (versus neutral) enhances brand name learning and promotes the creation of a relational network through the classification of brand name, according to the category to which they belong (Lee and Sternthal, 1999). This suggests that mood influences information processing, and relational elaboration when the objects of study are brands (Lee and Sternthal, 1999).

The role that mood plays in impulsive buying has also been studied. Thus, it was found that mood mediates the effects of resources (e.g. time and money), traits (e.g. consumers pre-dispositions), and marketing stimuli (e.g. store environment – music (Alpert, Alpert, and Maltz, 2005), price promotions) on impulse buying (Silvera, Lavack, and Kropp, 2008; Verhagen and van Dolen, 2011), both at the physical and online store. Moreover, in a meta-analysis, Iyer et al. (2020) reiterate these findings, highlighting the role of positive mood as a mediator of impulse buying when there are favourable subjective norms, high self-control, and strong hedonic motivations. Favourable subjective norms are also relevant for negative mood because this state also influences impulsive buying (Iyer et al., 2020).

The study of mood in decision-making has been examined by Etkin e Ghosh (2018) who found that a positive mood state difficult consumers' decision-making, leading to choice deferral because consumers are more focused on the salient attributes of the decision object. Moreover, decision-makers rely more on their mood when the outcome is related to a recent future or past, suggesting that temporal proximity increases the intensity and reliance on feelings (Chang and Tuan Pham, 2013). Also, incidental mood states have a stronger mood-congruent effect on behavioural intention (Chang and Tuan Pham, 2013).

The attitude-behaviour relationship is also influenced by mood. When comparing positive versus negative mood it was found that attitudes (e.g. preference, ratings) are better predictors of behaviour (e.g. choice); that the effect of mood on attitude-behaviour consistency is subject to a fit/match between the style of decision related to the constructions of the attitude and behavioural decision-making (Elen, D'Heer, Geuens, and Vermeir, 2013). Additionally, affective intensity (i.e. personality trait that translates the intensity of subjects response to emotion-eliciting stimuli) moderates the impact of mood on attitude-behaviour consistency (Elen et al., 2013).

Gender also plays a pivotal role in the effects of mood. Thus, men in whom a sad mood was induced rate more favourably advertisements, and there is no difference when they are in a happy mood (Martin, 2003). Women in a happy mood rate happy advertisements more favourably, and do not show any preference for advertisement when they are induced a sad mood (Martin, 2003). These gender differences are explained by a mechanism of mood repair implemented by each gender. In essence, while men use a distracting strategy to recover a happy mood, women focus on advantages/attributes of the advertised products to reach their mood repair (Martin, 2003). It is noteworthy that gender-mood relationship has a direct effect on the attitude toward the advertisement, and a lack of effect on brand attitudes, which may be explained because the effect of mood on brand attitude might be mediated by the attitude towards the advertisement (Martin, 2003).

Regarding mood-technology relationship, mood affects cognition and behaviour by influencing the way thoughts organised and are retrieved, facilitating the access to a network of positive-related material that is vast, flexible and related (Djamasbi, Strong, and Dishaw, 2010). Mood also affects the intention to use social networks, because positive mood states are positively related to the continued intention to use them, whereas a state of negative mood has a negative association (Yin, Liu, and Lin, 2015).

Notable is the effect that Social Network Sites (SNS) have on individuals' mood. More precisely, people who are prone to interpret ambiguous cues as negative ones, tend to have a more negative mood after using SNS (e.g., Facebook) (Macrynikola and Miranda, 2019). This means that belonging and cognitive differences among individuals can influence their perceptions of Facebook interactions, thus moderating the relationship between the use of SNS and mood (Macrynikola and Miranda, 2019).

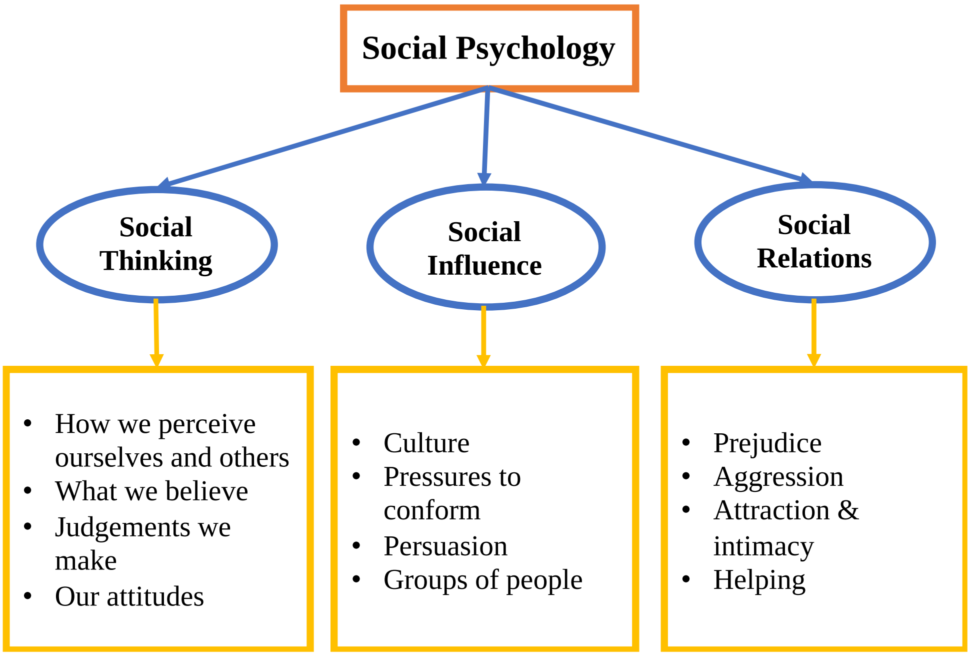
In the case of Decision Support Systems, it was found that a positive mood (versus control/neutral) affects the relationships of the Technology of Acceptance Model (TAM) variables, especially, when controlling for a moderate task uncertainty (Djamasbi et al., 2010). It was verified that positive mood influences directly ease of use (EoU), and behavioural intention, through EoU and perceived usefulness (PU) (Djamasbi et al., 2010). Also, the effect of positive mood on EoU is moderated by task uncertainty (Djamasbi et al., 2010). Thus, positive mood is expected to increase predisposition to adopt new technologies, whereas negative mood reduces this propensity (Karimi and Liu, 2020).

Concerning the adoption of mobile payments (m-payments), it was found that mood valence plays a significant role when relating it to decision-making style (maximisers versus satisficers), and need for gratification (Karimi and Liu, 2020). Thus, in a positive mood context, those who have a low tendency to maximise (satisficers), adopt m-payments when they have a high need for gratification from shopping activities (Karimi and Liu, 2020). In a negative mood context, the relationships previously explained are verified for those who are maximisers (Karimi and Liu, 2020).

3.2.2.Social Psychology

Social Psychology is the science that studies how one thinks, influences and relates to others (Myers, 2015), which can be translated by Fig. 3. 2.

Fig. 3. 2 - Scope of Social Psychology (Myers, 2013, p. 4)



Myers (2013) puts forward some relevant prepositions to understand what Social Psychology is, such as: (1) the reality one lives in is constructed by her/him; (2) one's attitudes shape and are shaped by one's behaviour, and (3) social influence shapes one's behaviour.

Social Psychology is based on the relationship between the self and the others, namely, their power to influence us. Thus, it is essential to understand the concept of Social Facilitation, which is based on the fact that the mere presence of a third-party influence one's performance. This phenomenon has its root in Triplett's (1898) seminal paper, where he studied the performance of cyclists alone versus in competition. He found that when they race against another person, their performance improved (Triplett, 1898). Later, the experiments carried out by Allport (1920) that studied the cognitive performance of individuals supporting Triplett's findings.

Zajoc (1965) complemented the idea that the mere presence of others intensifies arousal, which facilitates the dominant response of individuals, i.e., it eases a behaviour perceived as simple, and difficult one understood as complex. Additionally, Markus (1978) tested this 'third-person effect' by varying the type of audience (inattentive versus attentive) and found that the presence of others influences one's behaviour and that this effect was more intense for an attentive audience.

Social Perception allows us to grasp how opinions are created and how inferences about others are arrived at (Gilovich et al., 2016). Thus, the understanding of the self in social contexts (i.e., the study of a set of beliefs one has about one's attributes) is influenced by factors such as culture and a two-level comparison (Gilovich et al., 2016):

1) **Individual**: where one assesses and compare her/his behaviour with her/his code of values and internal standards – Self-Awareness Theory;
2) **Collective**: where the existence of others helps one to shape one's opinions and capabilities, through a process of comparison with others as per Social Comparison Theory.

Underlying the concept of Social Psychology there is the notion of a group, which "is defined as two or more persons who are interacting with one another in such a manner that each person influences and is influenced by each other person" (Shaw, 1981, p. 8).

Myers (2013) summarises group influence in two types:

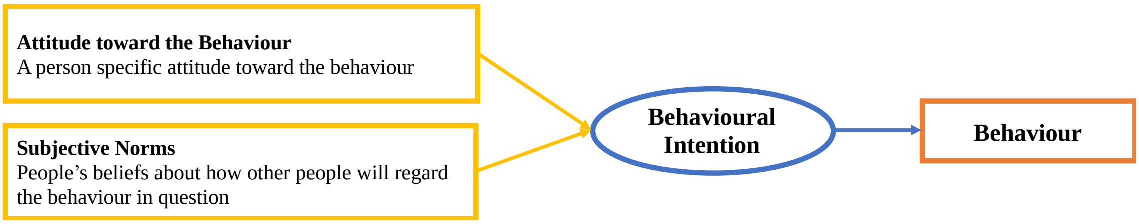
1) **Informational Influence**: which results from the acceptance of the evidence/arguments from the real world, and
2) **Normative Influence**: which is based on the desire one has to be accepted/admired by others

For this study, it is considered the normative influence is the most relevant because it is related to two theories that are associated with the concept of Social Influence and that helps to explain social human behaviour: Theory of Planned Behaviour (TPB) and Social Comparison Theory (SCT).

3.2.2.1. Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) was formulated by Icek Ajzen and Martin Fishbein, and it is a development of the Theory of Reasoned Action (TRA). TRA aims to predict and understand human behaviour by stating that behavioural intention is the main predictor of actual behaviour, whereas it is also influenced by attitude toward the behaviour and subjective norms (Ajzen and Fishbein, 1977; Fishbein and Ajzen, 1975) (see Fig. 3. 3).

Fig. 3. 3 - Theory of Reasoned Action. Adapted from: Ajzen and Fishbein (1977)

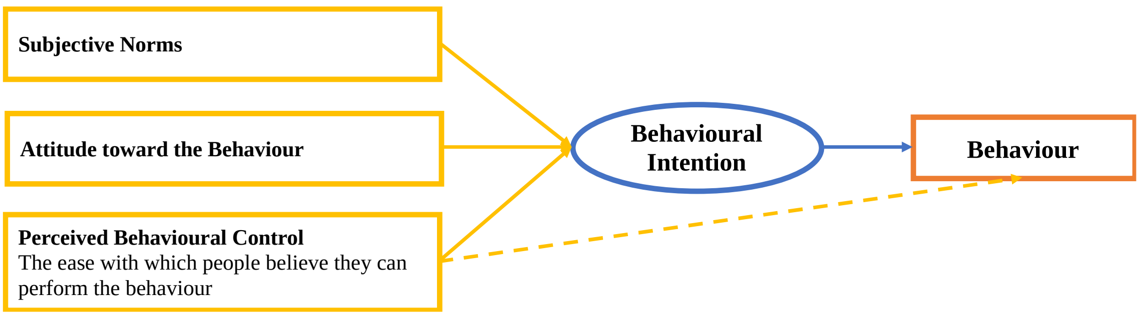


Attitude toward the Behaviour, Subjective Norms e Behavioural Intention can be defined as follows (Ajzen, 1985, 2005):

- Attitude toward the behaviour: this is an individual-related variable that concerns the psychological tendency/learned predisposition to evaluate an entity on a scale of acceptability ranging from goodness/favourable to badness/unfavourable that is believed to guide/influence behaviour (Eagly and Chaiken, 1993; Fishbein and Ajzen, 1975).
- Subjective norms: it is related to social influence, and reflects the social pressure towards the fulfilment of a specific behaviour;
- Behavioural intention: it pertains to the intention of a subject to follow a specific behaviour.

The Theory of Planned Behaviour adds a new variable that influences behavioural intention - perceived behaviour control (PBC) (Ajzen, 1985, 2005). As shown in Fig. 3. 4, PBC is a control issue variable that expresses the self-efficacy/capability to follow or not a specific behaviour (Ajzen, 2005). The inclusion of this variable increases the predictive power of intentions and target behaviour (versus TRA) and relates the predictive power of the target behaviour with the PBC (Madden, Ellen, and Ajzen, 1992).

Fig. 3. 4 - Theory of Planned Behaviour. Adapted from Ajzen (1985)



The importance of such theories within this study has to do to the fact that the Technology Acceptance Model (TAM) (Davis, 1989) is an adaptation of the TRA (Fishbein and Ajzen, 1975), and consequently of the TPB (Ajzen, 1985), used to explain the acceptance of Information Technologies (IT). TPB is also relevant due to the role that subjective norms play on the subject's intentions and behaviours, through internalisation, leading to the incorporation of social influence within their perceptions, and identification processes (as a way to achieve status) (Venkatesh and Davis, 2000).

3.2.2.2. Social Comparison Theory

Social Comparison Theory (SCT) has its origins in Festinger's seminal paper: *A Theory of Social Comparison Processes* (Festinger, 1954). In that work, Festinger (Festinger, 1954) argues that the individual has an innate drive to evaluate her/his capabilities, thoughts, feelings, behaviours, and opinions by comparing her/himself with others (i.e. s/he evaluated the self, concerning others) in the absence of an objective standard.

This phenomenon occurs because the human being does not live in isolation, living surrounded by other people (whose presence can be physical, imaginary or symbolic) (Guimond, 2006). Thus, SCT helps to explain one's social behaviour (Guimond, 2006). Later, Woods (1996, pp. 520–521) defines SCT as "the process of thinking about [consciously or unconsciously] one or more people in relation to the self [identifying similarities and/or dissimilarities between the self and the other]", which involves the process of acquiring, thinking about and reacting to social information.

Social comparison allows the individual to assess how s/he positions her/himself in relation to the other at the same, superior or inferior level. Therefore, there are two types of social comparison. These are (Collins, 1996; Festinger, 1954; Wheeler, 1966; Wills, 1981):

- **Downward Social Comparison:** when people compare themselves to those who are not as good as themselves, to increase their well-being;
- **Upward Social Comparison**: when people compare themselves to those whose capabilities and attributes are superior to theirs, thus helping them to reach/maintain the superiority through self-evaluation and self-improvement functions, which may mitigate differences in status

More recently, SCT is no longer solely used to evaluate present and past results, but it is also used to predict future outcomes (Suls, Martin, and Wheeler, 2002). Moreover, it was found that an individual self-evaluation is not always unbiased (because s/he might try to reach some goal with the assessment), the social environment may impose some undesired comparisons (i.e., the social context is not a passive agent), it is bidirectional and may assume different configurations according to the goals sought by the subject (Wood, 1989).

SCT and Marketing

In one of the first marketing investigations using SCT, Moschis (1976) showed that this theory explains the extent to which one selects and is influenced by informal reference groups. He demonstrates that one relies on peers to look for credible information and that peers influence her/his purchase decisions because they share a set of similar attributes (Moschis, 1976).

With regard to advertising, it promotes social comparison, especially for female college students (Richins, 1991). In his study, Richins (1991) verifies that individuals tend to change their comparison standard and self-perception, which results in lesser levels of satisfaction when exposed to idealised advertising images. Moreover, further research found that the higher women's attitude toward an advertised product, the higher the level of **social comparison orientation** (i.e. individual willingness to compare their standing to others, regarding accomplishments, situations and experiences) (Buunk and Dijkstra, 2011; Gibbons and Buunk, 1999). Buunk and Dijkstra (2011) found that women with high levels of social comparison orientation have less positive attitudes when a product is advertised by attractive models (versus moderately attractive), and are willing to pay less for it.

SCT is also studied within SNS namely, the impact that Instagram and Facebook have on self-related concepts like self-objectivism, self-image and body image (Fardouly, Willburger, and Vartanian, 2018; Fox and Vendemia, 2016). Social comparison appearance influences selfie-editing propensity, and it is a mediator between selfies' edition and variables linked to the use of SNS, appearance satisfaction, selfie-taking, and public self-conscious (Chae, 2017). Moreover, social comparison mediates, along with self-objectification, mental health, self-esteem and body shame (Hanna et al., 2017).

In the case of service recovery, downward social comparison introduced by others mitigates the effects of service failure on post-purchase behavioural intentions (Bonifield and Cole, 2008). Comparison with goals below ours leads to a decrease in consumer anger, whose effect varies with the reward level (i.e., when the reward is relatively low, downward social comparison decreases anger; when the reward is high, it increases the feeling of anger) (Bonifield and Cole, 2008).

Turning the focus to brand's word of mouth (WOM), it was found that the need for social comparison equally affects the propensity to engage positive and negative WOM (Alexandrov, Lilly, and Babakus, 2013).

When studying impulsive buying, upward social comparison on SNS is directly linked to impulsive buying behaviours, and indirectly with negative affect, which functions as a mediator (Liu, He, and Li, 2019). Under such circumstances, rumination is a moderator for both relationships (Liu et al., 2019).

Social comparison also has an essential role in "bandwagon" luxury consumption behaviour patterns. It was shown that social comparison has a positive effect on this behaviour, notwithstanding the different conceptions of the self (interdependent/sensitive to external influences versus independent/less sensitive to external influences) do not have a significant effect on social comparison (Bahri-Ammari, Coulibaly, and Mimoun, 2020). Still, about luxury goods, Zhang e Kim (2013) tried to understand which factors most influenced Chinese people in their consumption of luxury fashion products. Among others, social comparison was one of the determinants that increased the attitude toward the purchase, because it depicted a situation where consumers compared themselves to celebrities and their role models (an inherent characteristic of Chinese people) and to their peers (people they identify with) (Zhang and Kim, 2013).

Related to the use of SNS to follow brands and to brand-related participation on SNS, Phua et al. (2017) found that the concept of attention to social comparison moderates the relationships between the SNS and the identification within the brand community. They found that the lower the degree of attention to social comparison, the higher the brand-related participation o SNS, thus, the higher the identification with the brand community (Phua et al., 2017).

SCT and Technology

Recent studies in the field of SCT focus on the influence of SNS on individuals.

For Group Support Systems (GSS) (i.e., the use of technologies to facilitate group meetings), it was verified that the presence of social comparison feedback (through a shared table) has a positive impact on the productivity and creativity of the group members, in the case of asynchronous electronic brainstorming (Michinov, Jamet, Métayer, and Le Hénaff, 2015; Michinov and Primois, 2005). The authors also note that highly creative participants (upward comparison) have a higher quality of ideas and levels of attention when compared with their peers (Michinov et al., 2015).

In a study conducted among Facebook users, Park and Baek (2018) show that their psychological well-being is influenced by the type of Social Comparison Orientation (SCO), through four related emotions: optimism, depression, pride and worry. Researchers found that social comparison increases the psychological well-being status of individuals who show emotion like optimism/inspiration, or worry/sympathy, while it diminishes the well-being status of those who experience envy/depression (Park and Baek, 2018). The way subjects compare themselves on Facebook influences their well-being status, and the emotions they experience mediate the relationship between users' SCO and their well-being status (Park and Baek, 2018).

Still, on the topic of the individual's psychosocial state, Reer et al. (2019) found that SCO predicts social media engagement (SME), fear of missing out (FOMO) and that SME mediates the link between psychosocial well-being and FOMO. They also discovered that psychosocial well-being is directly and positively connected to SME through the joint mediation of FOMO and SCO (Reer et al., 2019).

Moreover, in a longitudinal study, Schmuck et al. (2019) found that continued use of Facebook increases upward social comparison on SNS, and this decreases self-esteem and subjective well-being.

Thus, SCT proves to be a relevant theory when the goal is to study processes where there are comparison I-others (both implicit and explicit, as well as unconscious and conscious). It also supports the role that the physical and mental presence of others exerts in one's decisions.

3.3. Social Influence

The concept of Social Influence relates to how subjects change their thoughts, attitudes, beliefs, feelings, and behaviours, due to the presence of others (real, imaginary, symbolic, or induced) in order to adapt to a social environment (Gilovich et al., 2016; Myers, 2013).

In the case of innovations adoption, some authors define this concept as being related to the perceived social pressure exerted by a social group (e.g. family or friends) on individuals to adopt innovations (Park, Ahn, Thavisay, and Ren, 2019; Venkatesh et al., 2003).

There are three processes/types of social influence (Deutsch and Gerard, 1955; Gilovich et al., 2016; Kelman, 1958):

1) **Compliance/Normative-Utilitarian Social Influence:** when one conforms to other positive expectations or responds favourably to an explicit request from others. One follows their beliefs and behaviours to avoid their disapproval and social sanctions in public, however, privately, one may not accept them.
2) **Identification/Normative-Value-expressive Social Influence:** when one accepts others influence because s/he wants to create/maintain a connection to someone/group, i.e., to increase a sense of belonging.
3) **Internalisation/Informational Social Influence:** in this type of influence, the information given by others is accepted as proof of reality. Thus, the behaviour is shaped accordingly to this information. In this kind of influence, it is believed that others' interpretation of a situation one perceives as ambiguous is correct, appropriate and effective. One adopts the behaviour that s/he is induced to emulate, as this is consistent with her/his value system and because it allows them to maximise one's benefit.

According to Cialdini et al., there are six principles influence behavioural compliance decisions: 1) reciprocity, 2) consistency, 3) social validation, 4) liking, 5) authority, and 6) scarcity (Cialdini and Griskevicius, 2010; Cialdini and Trost, 1998). Focusing on the principle of social validation, it is driven by the rule: "*[w]e should be more willing to comply a request for behavior if it is consistent with what similar others are thinking or doing*" (Cialdini and Griskevicius, 2010, p. 393, emphasis in original). Therefore, this principle is based on comparison with others, and it underpins Social Comparison Theory, where people use others' beliefs, attitudes, and actions to gauge how appropriate their own beliefs, attitudes, and actions are (Cialdini and Griskevicius, 2010; Cialdini and Trost, 1998).

Another relevant principle is the liking, which is postulates that: "*[w]e should be more willing to comply with the requests of friends or other liked individuals*" (Cialdini and Griskevicius, 2010, p. 398, emphasis in original). Consequently, peers and family tend to be groups who have the most influence over one's decisions, including those related to consumption.

Understanding Social Influence is relevant because it can result in a change in the individuals' attitude, and it depends on the contexts in which the subject is: public versus private (Wood, 2000). In a public context, the individual feels that others may exert some surveillance over them, while in private, subjects believe that others are unaware of their choices (Wood, 2000). Nevertheless, the presence of others can always condition individual action in both contexts due to its nature (Wood, 2000).

Moreover, the process of social influence serves three objectives: a) self-concept management, b) to build and maintain relationships, and c) to behave effectively (Cialdini and Trost, 1998).

Social Influence within technology and innovation

In the context of the acceptance of new technologies, Venkatesh et al. (2003) summarise and operationalise the concept of Social Influence as a function of the following constructs:

- Subjective Norm (Davis, 1989; Fishbein and Ajzen, 1975);
- Social Factors (Thompson, Higgins, and Howell, 1991; Triandis, 1979, p. 210): "the individual's internalization of the reference groups' subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations";
- Image (Moore and Benbasat, 1991): the extent to which the use of an innovation enhance an individual's image/status within a social group.

From this perspective, one realises that social influence reflects group pressures (Venkatesh et al., 2003).

Some researchers have studied the effect of social pressure on the individual, which makes her/him to adopt innovations and to accept/use new technologies to conform to a reference group (Park et al., 2019). As such, Venkatesh et al. show that social pressure is a determinant of the intention to use, especially older women with less experience are the most heavily influenced (Venkatesh and Morris, 2000; Venkatesh et al., 2003). These findings were later reinforced by the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh, Thong, and Xu, 2012).

Studies examining the adoption of mobile payments (m-payments) have found that social influence impacts significantly and positively on the multiple benefits of a service, thus reinforcing the role of social pressure and reference group opinions (e.g. family and peers) on the individuals' decision and behaviour (Park et al., 2019). Furthermore, in a sample of remote m-payments non-adopters, it was found that social influence is the most relevant predictor of behavioural intention to use these services, surpassing technological usefulness (Slade, Dwivedi, Piercy, and Williams, 2015). Social influence also contributes to the reduction of perceived risk, it has a positive impact on intention to use these services and on perceived usefulness and enjoyment, and it was also found that the users of m-payments are the most affected by social influence (Koenig-Lewis, Marquet, Palmer, and Zhao, 2015). Thus, it can be inferred that individuals feel more socially 'pressured' to adopt and use new technologies.

Social Presence within a marketing context

One of the most relevant concepts for social influence is social presence. Given the different socialisation contexts facilitated by technology, this presence can assume two types: physical and virtual and may involve a direct/intentional or indirect/unintentional interaction (i.e. mere presence).

The underlying idea of social presence is that different media vary in its degree, which influences the way people interact with each other (Short, Williams, and Christie, 1976). In the case of new media and online shopping, the role that elements such as website/apps interface characteristics (e.g. presence of reviews and ratings, and chats) have on the degree of social presence has to be considered (Gefen and Straub, 2003; Kumar and Benbasat, 2002). Moreover, this presence can be “real, implied, or imagined,” with or without interaction among subjects (Latané, 1981, p. 343).

Several studies attest to the fact that social influence is the result of the interaction of subjects with others, namely with reference groups (Bearden and Etzel, 1982; Moschis, 1976). Nonetheless, this influence can also be exerted in contexts where there is no interaction among individuals (Argo, Dahl, and Manchanda, 2005; Kwon, Ha, and Im, 2016). In this context, Social Impact Theory is used to explain that any change in the individual's physiological, emotional, behavioural, and cognitive states is a consequence of three major social forces: 1) the number of others, 2) spatial and temporal distance with them (immediacy), and 3) their relevance (Latané, 1981).

Studies conducted in retail settings show that in general people do not like to be isolated. The fact that people are accompanied reduces the negative emotions they experience, thus increasing the positive ones, and when the number of people increases from one to three, this relationship dynamic is inverted (Argo et al., 2005). Proximity to others also moderates the impact that group size has on social presence in a non-interactive environment because when they are at a distance, the presence of a group of people does not affect one's emotional state (Argo et al., 2005).

When applying Latané's Social Impact Theory to shopping centres, it was found that consumers' satisfaction with the shopping centre increases with high levels of perceived similarity between the individual and the others since consumers prefer other customers to be similar to themselves (Brocato, Voorhees, and Baker, 2012; Kwon et al., 2016). It was also found that social cues like physical appearances (the way the individual perceives the physical characteristics of other clients) are relevant to the appraisal process of young (vs older) consumers (Brocato et al., 2012).

In the context of social presence in non-interactive environments, it was studied the impact of exposure of subjects to advertisements with healthy versus non-healthy food, and images depicting only food versus people indulging them (Poor, Duhachek, and Krishnan, 2013). In this study social presence was perceived as social proof, and was used as a justification for subjects to indulge eating unhealthy food, reducing their conflict and increasing their taste perceptions (Poor et al., 2013).

In the field of new digital media, when relating to Human-Computer Interaction (HCI), there are two salient concepts: physical presence (sense of being in a virtual place) and social presence, defined as: "the degree to which the medium permits users to experience others as being psychologically present", which is regulated and affected by interfaces (Biocca, Harms, and Burgoon, 2003; Fulk, Steinfield, Schmitz, and Power, 1987, p. 531). Consequently, social presence varies between the different media, according to their degree of "sociability, warmth, personalness, and sensitivity" (Fulk et al., 1987, p. 531). This definition was developed for the telecommunication sector, ranging from an audio call, video call, 3D social virtual environment, among others (Biocca et al., 2003).

A variable that influences social presence (i.e., the feeling of being together psychologically) is media richness, i.e., "the salience of another person in an interaction, [that] is said to depend on the number of channels or codes available within a medium" (Walther, Anderson, and Park, 1994, p. 462), because it conveys social cues through the continuous flow of communication, increasing psychological proximity (Choi, 2019, p. 9).

Social cues are one of the elements (although scarce) that increases social presence in computer-mediated communication (CMC). Nevertheless, a social presence can be enhanced through media capabilities (e.g. transmission velocity), characteristics of the medium (e.g., immediate feedback and feelings of privacy and responsiveness), and by the ubiquity inherent to smartphones-based SNS (Choi, 2019). These characteristics are not unique to SNS, and they may be extended to other mobile applications (e.g., m-commerce apps) because smartphones are a medium which allows immediate feedback, they have several affordances that provide verbal and non-verbal cues, generating personalised communication (Choi, 2019).

Regarding brands present on SNS (e.g. Facebook), their social presence is built upon the sense of human warmth, sociability and sensitivity induced by the incorporation of human images in the posts (transmitting, for example, nonverbal information and facial expressions) (Algharabat et al., 2018).

Furthermore, related to Social Media, Naylor et al. (2012) introduce the concept of mere virtual presence (MVP) where (for the case of Facebook) there are no social presence elements as defined by Latané (1981): proximity is non-existent, the number of individuals and the strength of the source is reduced (because people are anonymous), and the exposure is passive. Therefore, social presence is introduced by consumers' exposure to pictures of brand supporters, i.e., consumers are subjects to virtual exposure (Naylor et al., 2012). In this study, the authors demonstrate that exposure to MVP as well as demographic characteristics (gender and age) influence brand evaluations and purchase intention (Naylor et al., 2012).

In short, the levels of social presence can be increased in m-commerce scenarios in two ways:

- By including human-related attributes, like reviews sections, chats, and people's photographs, or
- By promoting shared experiences, i.e., having two/more people involved in these experiences (social presence outside the medium).

3.3.1. The Role of Online Reviews

Online Reviews are a particular type of WOM - electronic WOM (eWOM) -, generated by anonymous consumers who write their opinions and experiences of products/services on the Internet (Hernández-Ortega, 2018). This type of WOM is more effective and less invasive than traditional marketing activities, like promotions and advertising (Zhang, Craciun, and Shin, 2010) and eWOM influences purchase decision and increases sales (Chevalier and Mayzlin, 2006; Maslowska, Malthouse, and Bernritter, 2017; Ye, Law, Gu, and Chen, 2011; Zhu and Zhang, 2010).

Besides websites, more precisely recommendation systems, lack credible and meaningful relationships, the existence of online reviews offers consumers several sources to evaluate the reviews and to take advantage of them, thus inducing social presence (Smith, Menon, and Sivakumar, 2005). On the one hand, the information provided by an online review lets the consumer feel more confident about their decision (increasing their knowledge internally), influencing their purchase decision (Smith et al., 2005). On the other hand, if there is an identification between consumer-reviewer, consumers tend to believe and follow the reviewer's opinion, because they perceive the online review as having more quality (Smith et al., 2005). This shows that online reviews contribute to the development of social influence through two ways (Smith et al., 2005):

1) **Informational Influence:** where through the perception of the quality of the review a consumer evaluates more effectively and makes a more informed choice;
2) **Value-Expressive Influence:** where the influence of a set of reviews (reference group) increases the self-concept to make a decision. This is a joint function of perceived review quality and consistency and social presence.

It must be pointed out that high levels of social presence facilitate the creation of reliable links in a virtual world, and that whether or not the consumer has previous experience with the product/service, online reviews act only as a complementary element to the decision-making process (Smith et al., 2005).

Based on the premise that online reviewers are strangers to the receivers, Hernandéz-Ortega (Hernández-Ortega, 2018) studied the effect of the reviewer-receiver relationship, which is strongly influenced by Social Psychological Distance (SPD). SPD is the underlying mechanism that mediates the effect of some aspects on an online review (e.g. physical, psychological and experiential characteristics) in the receiver's response, and the most salient element is the physical characteristic (e.g. similarity in profile photo). Moreover, the SPD perceived by the receiver is essential to explain the effectiveness of the online review, and consequently, the purchase intention of the product/service (Hernández-Ortega, 2018).

Regarding the importance of flow states in online shopping contexts (website/mobile) and the virtual presence of reviews, Martínez-López et al. (2015) introduce the concept of e-vendor. An e-vendor is 'someone' that knows the consumer's preferences based on their purchase history and the profile of similar customers (Martínez-López et al., 2015). Thus, they have a virtual social presence that helps consumers' decision-making process, by offering tailored advice for their purchases, acting as if someone was actually there (Martínez-López et al., 2015).

The existence of reviews on an online platform (website/mobile) influence several variables related to the consumer. Therefore, the virtual presence induced by a recommender system (RS) impacts the willingness to buy through satisfaction with the e-vendor (Martínez-López et al., 2015). Moreover, the state of flow involving an online shopping experience, with the presence of an e-vendor, improves the psychological outcomes linked to the use of e-vendors RS, such as perceived performance, satisfaction, and willingness to purchase (both items related to the primary shopping goal and add-on selling recommendation, i.e., unplanned purchase) (Martínez-López et al., 2015).

Social commerce is defined as the "exchange-related activities that occur in, or are influenced by, an individual's social network in computer-mediated social environments, where the activities correspond to the need recognition, pre-purchase, purchase, and post-purchase stages of a focal exchange" (Yadav, de Valck, Hennig-Thurau, Hoffman, and Spann, 2013, p. 312). Social commerce also influences the presence of reviews and ratings increases social interaction, and the possibility to observe consumers' prior purchases; thus enhancing the sense of social presence and purchase intention (Li, 2019; Wang and Yu, 2017).

Online video reviews is a novel review format that is emerging on some vendor sites (e.g., Amazon), reviews website (e.g., CNET) and among social media (Xu, Chen, and Santhanam, 2015). These types of reviews increase social presence because they amplify social cues, which are perceived as more helpful and persuasive (Xu et al., 2015), and increases the sense of warmth, sensitivity and sociability (Fulk et al., 1987).

3.3.2.Social Presence of Companions

The shopping process is a social phenomenon (Borges et al., 2010; Falk and Campbell, 1997) in part because of the individual 'experiences' the real, imaginary or virtual influence of others (Latané, 1981; Martínez-López et al., 2015). If the presence is real/physical, the individual is accompanied by a shopping companion, i.e. “a person who joins a focal shopper during a shopping trip”, who may be a family member or a friend/peer (Borges et al., 2010).

Companion influence is primarily exerted by two groups: family and peers. Family is the first socialisation group, followed by peers (Moschis and Churchill, 1978). The term ‘peer’ is understood to mean a group of people of the same age group, who are part of the individual’s group of friends (Mangleburg, Doney, and Bristol, 2004).

Notwithstanding the preceding assertions, and based on Social Influence and Social Comparison Theory, it was found that shopping with a peer helps to grant a degree of ‘suitability’ of the purchases toward the group (**compliance**), helping individuals to have a certain sense of belonging to a group (**identification**), enabling them to build a desirable social identity (Kelman, 1958; Mangleburg et al., 2004).

Similar to Mangleburg et al. (2004), it is assumed that shopping experiences are a result of the process of social comparison with others, where family, peers, virtual agents, social influencers, or sellers/experts provide informative and normative standards that influence in this experience before, during, or after the purchase.

Therefore, as Bearden et al. (1989) have found this consumer susceptibility to others influence of is called ‘consumer susceptibility to interpersonal influence’. Consumer susceptibility to interpersonal influence is defined as “the need to identify or enhance one's image with significant others through the acquisition and use of products and brands [**normative value-expressive influence**], the willingness to conform to the expectations of others regarding purchase decisions [**normative utilitarian influence**], and/or the tendency to learn about products and services by observing others and/or seeking information from others [**informational influence**]” (Bearden et al., 1989, p. 474).

Moschis (1976) wrote about the importance of the influence of informal groups for marketing. In his article, the author explains the determinants for individuals to choose and to be influenced by informal groups of reference, i.e. the need to gather information and source credibility (Moschis, 1976). He also found that the higher the degree of identification of the subject with the group elements, the higher the influence that group members have on individual purchasing decisions (Moschis, 1976).

According to Childers and Rao (1992), these referents can be divided as:

a) **Normative:** when they provide the individuals with a set of norms, attitudes, and values through direct interaction, like family, peers, teachers; and
b) **Comparative:** when, in the absence of direct interaction (i.e. by observing their behaviour through the media), they influence individuals by providing them with standards they aim to emulate, such as celebrities, digital influencers, sports heroes and online reviews.

In a study on normative and informative influence on teens' shopping, it was found that **parents** exert **normative influence** (versus peers and media) for <u>higher economic value purchases</u>, and **informative influence** for <u>other purchases</u> (Mascarenhas and Higby, 1993). The authors also found that parents and media have a more significant **normative influence** over **boys** as opposed to girls (Mascarenhas and Higby, 1993). Moreover, teenagers' susceptibility to normative influence affects their tendency to shop with friends (Huang, Wang, and Shi, 2012).

Mangleburg et al. (2004) studied teens' behaviour when shopping accompanied by their peers and found that their susceptibility to interpersonal influence is related to teens' enjoyment and frequency of shopping with friends. Namely, their susceptibility to the **normative influence** exerted by peers may make young people less prone to shop with friends, to avoid the consequences of normative reactions (Mangleburg et al., 2004). Moreover, **informational influence** can leverage teens' ability and performance regarding shopping activity and evaluation of this phenomenon, where enjoyment is positively associated to accompanied shopping and with the frequency of doing so (Huang et al., 2012; Mangleburg et al., 2004). Furthermore, the susceptibility to normative and informative influence positively affects teens' perception about their peers' knowledge, causing subjects to abide by their friends' purchase suggestions, and attachment avoidance decreases teens' tendency to buy with their peers (Huang et al., 2012). It was also found that shopping motivation also influences teens' satisfaction with the experience (Wenzel and Benkenstein, 2018). Individuals who purchase in purely recreational contexts experience more positive emotions and greater experience satisfaction when accompanied (Wenzel and Benkenstein, 2018).

When studying the purchase of <u>luxury versus necessities</u> products for <u>private versus public</u> use, **peers** exert greater influence on **luxury** and **public consumption products**, and family's influence is stronger for **necessities** and **private consumption products** (Childers and Rao, 1992).

In the case of **impulse buying**, the imaginary impulse to make a purchase is more significant when the individual is accompanied by peers, who represent a cohesive group (the extent to which the group is attractive to its members), and when subjects have a high susceptibility level to social influence (willingness to accept others' opinions) because peers are more likely to reward spontaneity and the demand for hedonic goals (Luo, 2005).

People tend to have **less** impulsive buying tendencies when the **family** is present (cohesive group), and individuals are susceptible to social influence, because family represents an economic conscience, discouraging extravagancies (Luo, 2005). The presence of family members family effect also occurs in a shopping centre setting, because when subjects have a high level of identification with the shopping mall, with regard to positive affect and hedonic shopping values, they are influenced by an adverse effect generated by the presence of relatives (Borges et al., 2010). However, if the shopper does not identify with the shopping centre, this relationship is reversed (Borges et al., 2010). Notwithstanding this influence of family, the presence of friends increases positive emotions and hedonic value, both for adults and teenagers (Borges et al., 2010; Wenzel and Benkenstein, 2018).

When examining shopping centres experiences as against service encounters (e.g. restaurants) the influence of a companion on individual time spent, money spent, satisfaction, attitude toward the act and re-patronage intention is different for both settings (Hart and Dale, 2014). For shopping centres, the presence of a companion increases time spent and satisfaction with the experience, whereas for restaurants, being with someone increases the amount spent and the attitude toward the act. Hart and Dale (2014) verified that a shared shopping experience has a positive impact for men (amount spent) in terms of attitude toward the act and re-patronage intention, whereas the reverse happens for women. Thus, buying accompanied does not always yield benefits (Hart and Dale, 2014).

Social Media Influencers (SMIs) or Digital Influencers are a group of independent endorsers that due to the high number of followers they have on their social networks (Instagram, Twitter, Facebook) or blogs, can shape audience attitudes through their social media usage (De Veirman, Cauberghe, and Hudders, 2017; Freberg, Graham, McGaughey, and Freberg, 2011).

SMIs are seen as digital opinion leaders, who promote products/services on social media through, for example, partnerships with brands, nurturing more transparent, authentic, credible and close relationships with consumers (Lin, Bruning, and Swarna, 2018; Torres, Augusto, and Matos, 2019). Influencers/opinion leaders are relevant to consumers because they provide brand-related information by promoting them, thus influencing the consumers' decision-making process (Rogers and Cartano, 1962). Therefore, given the preponderance and omnipresence (by being present on social networks, they are within people's reach) of digital influencers for younger generations, they emerge as a group who influence purchasing processes, like family and peers. In the case of Instagram, Casaló et al. (2020) findings support that opinion leadership significantly influences the intention to follow the influencer's recommendation.

3.4. The Impact of Body Image on Shopping Decisions

Another concept that emerges from Social Psychology and that is intrinsically associated with a self-assessment is self-esteem.

The American Psychological Association (2019) defines self-esteem as: "the degree to which the qualities and characteristics contained in one's self-concept are perceived to be positive. It reflects a person's physical self-image, view of his or her accomplishments and capabilities, and values and perceived success in living up to them, as well as how others view and respond to that person. The more positive the cumulative perception of these qualities and characteristics, the higher one's self-esteem".

Related to this definition, there is a concept fundamental to the marketing literature – Body Image (Mellor, Fuller-Tyszkiewicz, McCabe, and Ricciardelli, 2010). Body Image refers to the mental representation one has of one's body, involving thoughts, perceptions, feelings, and behaviours related to it, as well body-related self-attitudes and self-perceptions (O'Dea, 2012; Schilder, 1950). Additionally, body image may be substantially different from the actual physical characteristics of the person (Myers and Biocca, 1992). Body image is commonly associated with body dissatisfaction, eating disorders, consumption of anabolic steroids, and cosmetic surgery (Birkeland et al., 2005; Ching and Xu, 2019; Griffiths, Murray, Krug, and McLean, 2018).

Taking this definition into consideration, one can conclude that body image is a concept associated with internalisation of one's appearance - a self-schema - which influences information processing and drives behaviour (Altabe and Thompson, 1996). In a poststructuralist analysis, Thompson and Hirschman (1995, p. 150), define body image as “the perceptions a consumer has of his/her body, and these perceptions are conditioned by a field of social relationships, cultural ideals, normative prescriptions, and moralistic meanings regarding self-control and discipline”. This perspective reflects a socialization process that leads to an internalised duty to discipline and normalise one’s own body, which in turn, leads to the concept of the socialized body (Thompson and Hirschman, 1995). Body perception involves consumer satisfaction with their appearance, the ideal body idea, and the consumption activities that these self-perceptions arouse (Thompson and Hirschman, 1995).

Simultaneously, this concept of body image is linked to social comparison theory because this self-concept leads to a comparison with others, the ideal body or even with the actual reality (e.g. when one tries on a clothing item that no longer fits her/him), thus influencing the subject's mood (Altabe and Thompson, 1996; D’Alessandro and Chitty, 2011; Thompson and Hirschman, 1995). In this logic, subjects’ exposure to social comparison leads to higher levels of body dissatisfaction (Cattarin, Thompson, Thomas, and Williams, 2000).

This susceptibility to a third-party influence is relevant when one of the elements that impact one’s buying decision-making process is the opinion of digital influencers because the subject has the opportunity to be in constant comparison with the ideal of the person they follow on SNS (i.e. the comparison target). Nevertheless, the results of such comparison are not always negative for the individual because SMI may have a more attainable image than celebrities/traditional models (Fardouly, Diedrichs, Vartanian, and Halliwell, 2015).

In their studies, Fardouly et al. (2015, 2018) found that browsing through social networks induces a negative mood, possibly because Facebook and Instagram provide several means for comparison, leading to self-objectification. However, the authors did not find any direct link between Facebook and Instagram exposure and body image satisfaction, and intentions to change weight or shape (Fardouly et al., 2015, 2018).

The concept of body image is particularly important for adolescents and young adults (O’Dea, 2012; Polce-lyn and Myers, 1998), especially for females, because they are the object of study of a significant part of the research on the subject (Fardouly et al., 2015, 2018; Hogue and Mills, 2019; Jones and Buckingham, 2005).

Tiggemann and Lacey (2009) studied the link between clothes' shopping experience and body image, highlighting that the lower the Body Mass Index (BMI), the higher the body satisfaction, the more pleasant the shopping experience. Furthermore, higher body image satisfaction is a consequence of personal (e.g. preferences), social (e.g. moral beliefs), and environmental (e.g. weather) factors which in turn positively influence purchase intention (Rieke, Fowler, Chang, and Velikova, 2016).

For e-commerce contexts, creating virtual models allows companies/brands to manipulate consumers making them create biased (but commercially attractive) images of their bodies, i.e., allows shoppers to create their virtual and extended-self on which these may overlay the desired apparel (Jordan, 2003). This capability of projecting the extended-self leads to an improved body image generated by e-tailers, without the subject being aware that s/he is being manipulated, thus skewing a possible purchase intention (Jordan, 2003).

Studies related to the concept of body image found that when comparing AR-based versus traditional e-commerce website, individuals who had a less favourable body image tend to have a better perception of an AR visualisation (versus traditional website) (because AR portrays an improved image of the self), and those whose body image was more favourable show no difference in attitudes towards the system (Yim and Park, 2019).

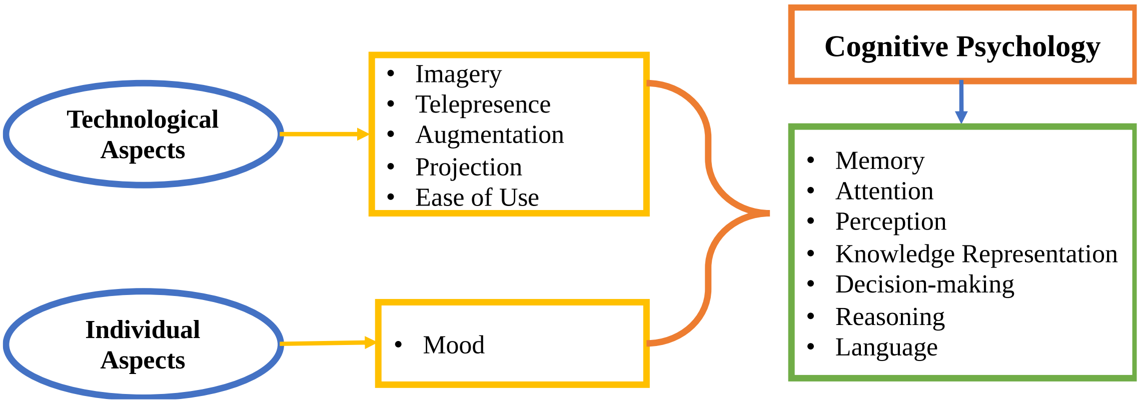
Thus, one realises that the better the perception and attractiveness of body image and body satisfaction, the more favourable the attitude toward products virtually experienced, the higher the intention to use virtual try-on models and the purchase intention, which demonstrates the relevance of body image to e-commerce (Jordan, 2003; Shin and Baytar, 2014; Yu and Damhorst, 2015).

3.5. Summary

In this chapter, we address the themes related to consumer psychology. Thus, we start from the frameworks of Cognitive and Social Psychology, and we explain the importance of aspects relevant to an AR technological experience have on consumers.

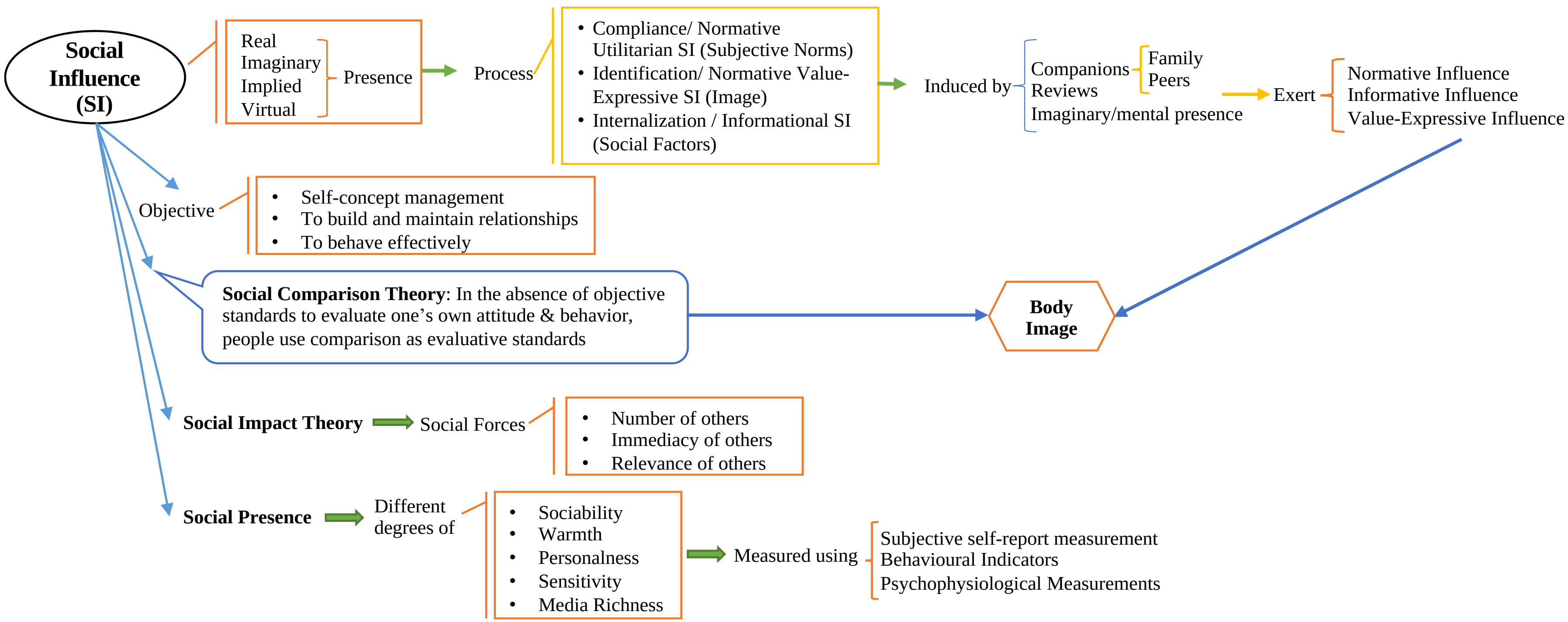
Thus, in the area of Cognitive Psychology, we study the topics of imagery, telepresence, perceived augmentation, projection, and mood, and the effect these variables have on subjects when used in more traditional marketing contexts and when used in technology-related contexts (see Fig. 3. 5).

Fig. 3. 5 - Visual summary of Cognitive Psychology literature review



Concerning Social Psychology (see Fig. 3. 6), we start from the concept of Social Influence to better understand the influence that others have on shaping one's beliefs, behaviours, feelings and attitudes. Then, we analyse the role of subjective norms in the I-Other relationship, through TRA and TPB. We examine this relationship under Social Comparison Theory, i.e., the constant comparison process one performs in order to act. Finally, these concepts were contextualised for online reviews and ratings, m-commerce platforms, and Body Image, and we present their implications on purchase intentions.

Fig. 3. 6 - Visual summary of Social Psychology literature review

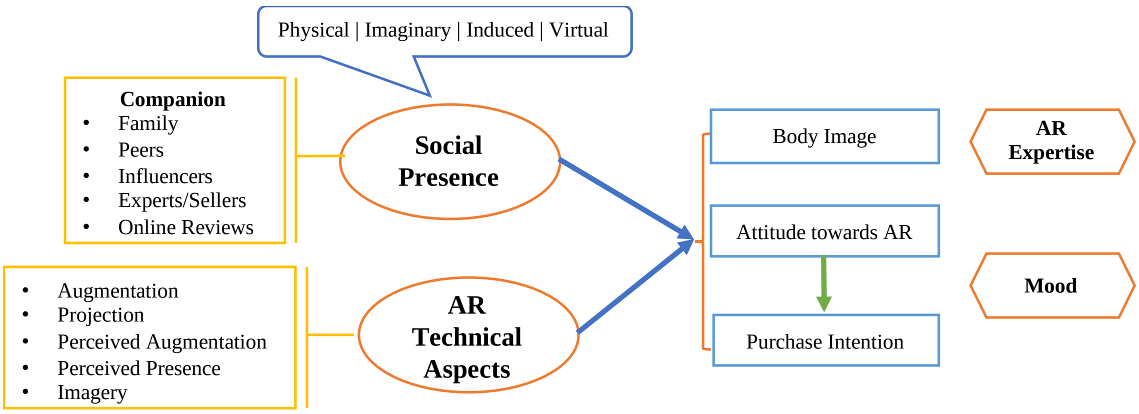


Chapter 4 Research Hypotheses

4.1. Introduction

After identifying the research questions that motivated this research and the literature reviewed in chapters 2 and 3, we elaborated a conceptual model (see Fig. 4. 1). The following research hypotheses were formulated (organised by experimental condition, see Table 4.1) that led to answer to the research questions.

Fig. 4. 1 - Conceptual Model of MAR Shopping Experience



Our research explores the multifaceted aspect of the concept of presence; thus, according to the Social Impact Theory (Latané, 1981), we manipulate the following aspects:

- The social presence derived from the physical presence of others (in this case peers) during a mobile consumer experience,
- The social presence induced by the app's reviews and ratings, and
- The implicit presence of reference groups.

Several authors have studied the impact of different elements of technology and AR on attitudes toward online shopping, e.g. ease of use (Childers, Carr, Joann, and Carson, 2001), purchase intention (Brengman et al., 2019; Brito and Stoyanova, 2018; Hilken et al., 2017), however, none of them explored the topic in the manner undertaken in our study.

Table 4. 1 - Experimental condition and related variables

Experimental Condition (IV)	**DV**	**Moderator**
Shopping Context: *Shopping with peers* *Vs.* *Shopping unaccompanied*	• Attitude toward AR (Att2AR) • Purchase Intention (PI) • Body Image (BI) • Family's Opinion • Influencers' Opinion • Online Reviews Influence • Friends/Peers' Opinion • Experts & Sellers Opinion • Esteemed ones'[12] Opinion • Group Acceptance	• AR Expertise → Att2AR • Perceived Augmentation → Att2AR • Perceived Simulation → Att2AR • Real Perceived Presence → Att2AR • Focused Attention → Att2AR • Mood → PI • Autonomy → PI • Others' Opinion → PI
App Reviews: *Presence of reviews* *Vs.* *Absence of reviews*	• Attitude toward AR (Att2AR) • Purchase Intention (PI) • Family's Opinion • Influencers' Opinion • Friends/Peers' Opinion • Experts & Sellers Opinion • Esteemed ones' Opinion • Group Acceptance • Others' Opinion • Online Reviews Influence • Autonomy	• Others' Opinion → PI
Mirror Size: *Full-length mirror (full-body visualisation)* *Vs.* *Small mirror*	• Attitude toward AR (Att2AR) • Purchase Intention (PI) • Body Image (BI)	• AR Expertise → Att2AR • Perceived Augmentation → Att2AR • Perceived Simulation → Att2AR • Real Perceived Presence → Att2AR • Digital Perceived Presence → Att2AR • Mood → PI

4.2. Presence versus Absence of Peers: Shopping Context

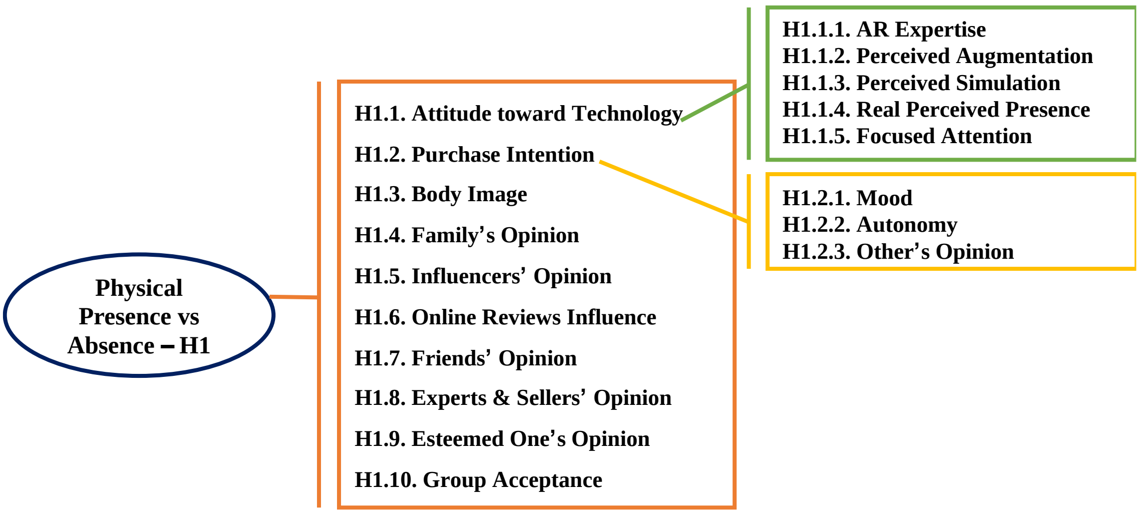
The experimental condition of presence versus absence of peers emerges because studies show that the presence of a companion affects a shopping experience and that the presence of peers have a positive impact on purchase intention and consumption experience (Borges et al., 2010; Childers and Rao, 1992; Hart and Dale, 2014; Luo, 2005).

Additionally, the formation of attitudes and behaviours within a shopping context is influenced by how individuals relate to their reference groups, like family, peers, or others (Mangleburg et al., 2004).

[12] Esteemed ones represent the group of family, friends/peers, colleagues that are close to a subject.

Another aspect of the influence caused by the physical presence of peers, and the mental presence of family, influencers, or even friends that merits our attention can be felt on three levels: normative, value-expressive, and informational (Argo, 2020; Deutsch and Gerard, 1955; Gilovich et al., 2016; Kelman, 1958). The effect of the presence of others can be felt at the level of adoption of new technologies (Park et al., 2019), mixed realities (Baker, Hubona, and Srite, 2019), purchase intention (Lee, Shi, Cheung, Lim, and Sia, 2011), and body image (Cattarin et al., 2000). Notwithstanding such assertions, we can deduce the following hypotheses (see Fig. 4. 2):

Fig. 4. 2 - Summary of Hypothesis 1



H1.1: The physical presence (versus absence) of peers leads to a more (versus less) favourable attitude towards technology.

H1.2: The physical presence (versus absence) of peers leads to a higher (versus lower) purchase intention.

H1.3: The physical presence (versus absence) of peers leads to a more (versus less) negative body image.

In purely recreational contexts, the presence of friends causes individuals to experience more positive emotions, which can induce a positive mood and as such affect mediates the relationship between accompanied shopping' and shopping experience (Borges et al., 2010; Hart and Dale, 2014; Wenzel and Benkenstein, 2018).

These characteristics are inherent to the impact of technology on individuals' mental processes, like decision-making, reasoning and problem solving (Anderson, 2015; Sternberg and Sternberg, 2012), so it can be expected that these aspects influence both purchase intention and attitude toward AR.

The media characteristic (MC) of perceived augmentation (one of the AR most salient MC) is an antecedent of flow, and flow mediates its effect on affective responses towards AR apps and behavioural intentions (revisit and recommendation intention) (Javornik, 2016b). As such, it is expected that perceived augmentation has an impact on attitude towards the technology utilised for different shopping contexts and mirrors size.

As far as technology is concerned, incorporating novel technologies in a computer-mediated environment can help to create more realistic experiences and serves as means of establishing relationships with small groups of people through the media richness of technology and its media characteristics (Choi, 2019). Thus, perceived augmentation and perceived presence, as elements related to flow and telepresence, reflects a more significant impact on individuals' trust and enjoyment (Baker et al., 2019).

Therefore, we anticipate that:

H1.1.1: The physical presence (versus absence) of peers leads to a more (versus less) favourable attitude toward technology, controlling for the moderator effect of AR Expertise.

H1.1.2: The physical presence (versus absence) of peers leads to a more (versus less) favourable attitude toward technology, controlling for the moderator effect of Perceived Augmentation.

H1.1.3: The physical presence (versus absence) of peers leads to a more (versus less) favourable attitude toward technology, controlling for the moderator effect of Perceived Simulation.

H1.1.4: The physical presence (versus absence) of peers leads to a more (versus less) favourable attitude toward technology, controlling for the moderator effect of Real Perceived Presence.

H1.1.5.: The physical presence (versus absence) of peers leads to a more (versus less) favourable attitude toward technology, controlling for the moderator effect of Focused Attention.

As happens with adolescents and adults, the presence of companions tends to have a positive effect on shopping attitudes (Borges et al., 2010; Hart and Dale, 2014; Wenzel and Benkenstein, 2018). However, in the case of family, this impact is negative (Childers and Rao, 1992; Luo, 2005).

The studies mentioned above analyse the impact of active social presence (i.e., when there is an interaction between subjects) in their attitudes and behaviours (Argo and Dahl, 2020). Both active and passive (i.e., when there is no interaction between subjects) social presence may exert different types of social influence. In the **utilitarian/normative social** influence, subjects act accordingly in respect of what they believe the others expect (e.g., behave accordingly to their family and friends expectations, or to be accepted in a group) (Argo, 2020). In the **value-expressive influence,** individuals behave to support their self-concept (Argo, 2020), and in the **informational influence**, the information conveyed by others is accepted as reality (Argo, 2020; Deutsch and Gerard, 1955).

Nonetheless, the effect of the interplay of active and social presence (Argo and Dahl, 2020) is not yet known. Therefore, we can consider the mental presence of others as passive social presence, and we can formulate the following hypotheses:

H1.4: The physical presence (versus absence) of peers leads to a less (versus positive) positive family's opinion.

H1.5: The physical presence (versus absence) of peers leads to a more (versus less) positive influencers' opinion.

H1.6: The physical presence (versus absence) of peers leads to a more (versus less) positive online reviews influence.

H1.7: The physical presence (versus absence) of peers leads to a more (versus less) positive friends' opinion.

H1.8: The physical presence (versus absence) of peers leads to a more (versus less) positive experts & sellers' opinion.

H1.9: The physical presence (versus absence) of peers leads to a less (versus more) positive esteemed one's opinion.

H.10: The physical presence (versus absence) of peers leads to a higher (versus lower) group acceptance influence.

In line with the research carried out by Wenzel and Benkenstein (2018), it was found that positive and negative emotions mediate the relationship between shopping situation, experience satisfaction, and the relationship between buying impulse and factors such as functional convenience[13] and representational delight[14] (Verhagen and van Dolen, 2011). Therefore, it can be anticipated that mood moderates the relationships between purchase intention, and the shopping context. So, we can formulate the following hypotheses:

H1.2.1: The physical presence (versus absence) of peers leads to a greater (versus less) purchase intention when controlling for the moderator effect of mood.

The presence of peers leads to impulse buying (Luo, 2005), which impacts subjects through normative (value-expressive and utilitarian) and informational influence (Mangleburg et al., 2004). This influence is exerted due to the higher level of consumer susceptibility (Bearden et al., 1989). Since the presence of peers increases the buying propensity of adolescents, this population is more susceptible to interpersonal influence (Childers and Rao, 1992; Moschis and Churchill, 1978; Wenzel and Benkenstein, 2018). In the case of adults, Borges et al. (Borges et al., 2010) verify that shopping with a company is always preferable. Thus, we anticipate that:

H1.2.2: The physical presence (versus absence) of peers leads to a higher (versus lower) purchase intention, controlling for the moderator effect of Autonomy.

H1.2.3: The physical presence (versus absence) of peers leads to a higher (versus lower) purchase intention, controlling for the moderator effect of Others' opinion.

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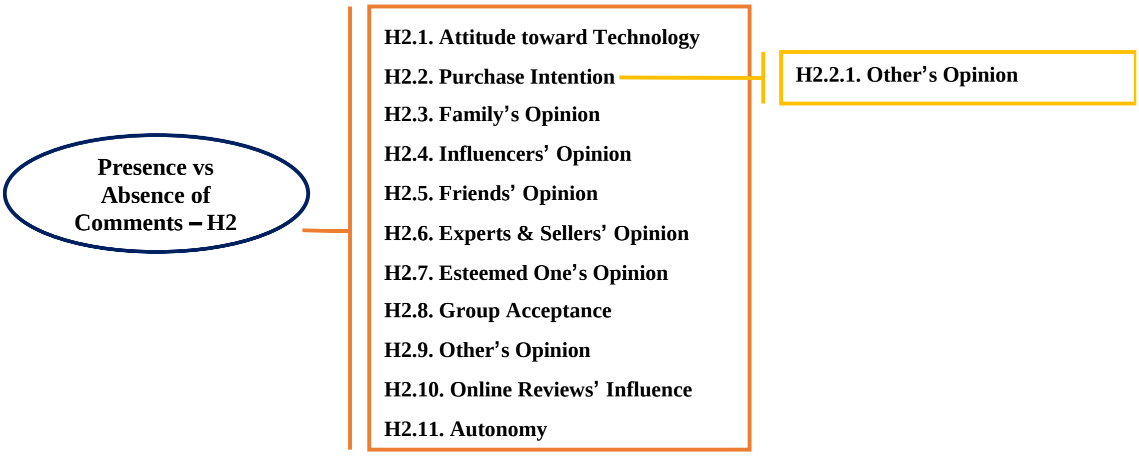
[13] Functional convenience "refers to the availability of convenient characteristics that help the consumer's interaction with the interface" (Valacich, Parboteeah, and Wells, 2007, p. 86).

[14] Representational delight "refers to the Web site characteristics that stimulate a consumer's senses (such as, atmospherics), primarily including what they see and hear" (Valacich et al., 2007, p. 86).

4.3. Presence versus Absence of Reviews

Feedback on a website or online shopping app is a common form of e-WOM (Hernández-Ortega, 2018; Zhang et al., 2010) that impacts subjects decision-making as it exerts informational and value-expressive influence (Chevalier and Mayzlin, 2006; Maslowska et al., 2017; Smith et al., 2005; Ye et al., 2011; Zhu and Zhang, 2010). Therefore, we deduce the following hypotheses (see Fig. 4. 3):

Fig. 4. 3 – Summary of Hypothesis 2



H2.1.: The presence (versus absence) of reviews on the app leads to more (versus less) favourable attitudes toward technology.

H2.2.: The presence (versus absence) of reviews on the app leads to more (versus less) favourable purchase intention.

H2.2.1.: The presence (versus absence) of reviews on the app leads to more (versus less) favourable purchase intention, controlling for the moderator effect of Others' opinion.

Opinions on websites can be from anonymous sources (Hernández-Ortega, 2018). However, these are sources of influence that positively impact on perceived decision quality (in the case of informational influence) and the usefulness of the platform on which they are available (informational and value-expressive influence) (Zhao, Stylianou, and Zheng, 2018). Despite this, online reviews are complementary elements in the process of individual decision-making (Smith et al., 2005).

There is a paucity of studies about the relationship between the influence of these anonymous people and the opinion of reference groups. One can anticipate that individuals, regardless of having online reviews, will not be influenced by them, remaining ‘loyal’ to their reference groups (whether they are family, peers, influencers), as there is greater identification with these groups (Hernández-Ortega, 2018; Moschis, 1976). Therefore, it is expected that the presence (versus absence) of reviews within the app will not affect the opinion of the reference groups unless there is an identification between the consumer and the reviewer (Smith et al., 2005).

H2.3.: The presence (versus absence) of reviews within the app does not vary with the family's opinion.

H2.4.: The presence (versus absence) of reviews within the app does not vary influencers’ opinion.

H2.5.: The presence (versus absence) of reviews within the app does not vary friends’ opinion.

H2.6.: The presence (versus absence) of reviews within the app does not vary experts & sellers’ opinion.

H2.7.: The presence (versus absence) of reviews within the app does not alter esteem one’s opinion.

H2.8.: The presence (versus absence) of reviews within the app does not vary group acceptance.

H2.9.: The presence (versus absence) of reviews within the app does not vary others' opinions.

H2.10.: The presence (versus absence) of reviews within the app leads to a more (versus less) positive influence of online reviews.

In respect of the sense of autonomy, the pressure exerted by opinions may limit the scope of the subjects’ action, unless the influence exerted is informational (Zhao et al., 2018), so:

H2.11.: The presence (versus absence) of reviews within the app leads to a more (versus less) negative values of autonomy.

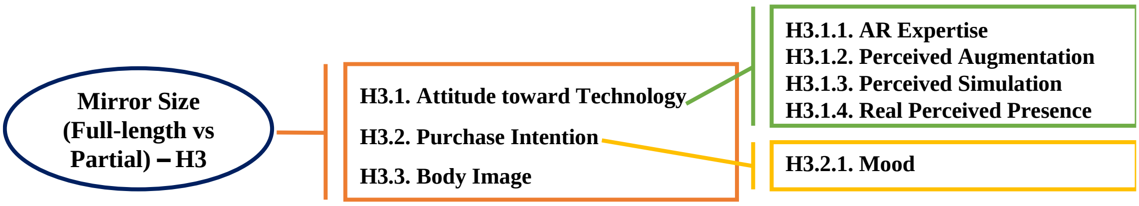
4.4. Full-length vs. Small Mirror: Mirror Size

The introduction of the mirror in the scope of this investigation is a necessity demanded by the AR app (marker-based AR). The mirror size issue emerges, because it is intended to bring the shopping experience with a mobile app closer to a real-world experience where individuals when in a store, are exposed to full-length mirrors (Tiggemann and Lacey, 2009). Besides, as it is a consumption experience, full-body visualisation allows a comparison between the actual body image and the individual's body image, leading her/him to confront his expectations with reality (Thompson and Hirschman, 1995).

That said, a consumer experience that is as close to reality as possible will lead to better attitudes toward technology, behavioural intentions (purchase intention) and body image.

Therefore, the following hypotheses are deduced (see Fig. 4. 4):

Fig. 4. 4 - Summary of Hypothesis 3



H3.1.: Full-body viewing (full-length mirror) (versus only part) leads to more (versus less) positive attitudes toward technology.

H3.2.: Full-body viewing (full-length mirror) (versus only part) leads to more (versus less) favourable purchase intention.

H.3.3.: Full-body viewing (full-length mirror) (versus only part) leads to more (versus less) negative body image perception.

In the context of the technology-related variables, it is expected that they will also be influenced by mirror size, following the same logic that a near-real shopping experience (similar to that of in-store) will encourage individuals to have a better attitude toward AR.

Perceived augmentation and presence, are inherent characteristics of digital media that influence consumers' experience and purchase intentions (Javornik, 2016b; Verhagen et al., 2014). Furthermore, imagery is a feature of websites/mobile apps that indirectly affects revisit and purchase intention (Argyriou, 2012; Gavilan et al., 2014), thus influencing attitude toward AR. Therefore, we anticipate that:

H3.1.1.: Full-body viewing (full-length mirror) (versus partial) leads to more (versus less) favourable attitude toward AR, controlling for the moderating effect of AR Expertise.

H3.1.2.: Full-body viewing (full-length mirror) (versus partial) leads to more (versus less) favourable attitude toward AR, controlling for the moderating effect of Perceived Augmentation.

H3.1.3.: Full-body viewing (full-length mirror) (versus partial) leads to more (versus less) favourable attitude toward AR, controlling for the moderating effect of Perceived Simulation.

H3.1.4.: Full-body viewing (full-length mirror) (versus partial) leads to more (versus less) favourable attitude toward AR, controlling for the moderating effect of Real Perceived Presence.

The relationship between subjects and her/his body may be indirectly influenced by their mood which moderates the impact of the size of the mirror on purchase intention (Rieke et al., 2016; Tiggemann and Lacey, 2009), so:

H.3.2.1.: Full-body viewing (full-length mirror) (versus only part) leads to more (versus less) favourable purchase intention, controlling for the moderating effect of mood.

4.5. Impact of the Experimental Condition on Attitude toward AR and Purchase Intention

In both **H4** and **H5**, two behavioural variables are contrasted with the experimental conditions manipulated in this study. Therefore, these hypotheses aim to test whether attitude toward AR and purchase intention are positively affected by any of the following conditions:

- Accompanied, full-length mirror, with ratings and reviews;
- Unaccompanied, full-length mirror, with ratings and reviews;
- Accompanied, small mirror, with ratings and reviews;
- Unaccompanied, small mirror, with ratings and reviews; and

- Unaccompanied, full-length mirror, with **no** ratings and reviews.

Under these conditions, two types of social presence are induced: physical (when accompanied) and virtual (when the app has reviews embedded within it). The issue of body image is introduced through the change in the mirror size that allows people to see their full-body or only their feet.

In an extension of the Theory of Acceptance Model 2 (TAM2) Venkatesh and Davis (2000) posit that subjective norms are a direct antecedent of intention to use a system/technology, showing a positive relationship between them and that subjective norm is related to social influence. The positive relationship between subjective norms and attitude towards the use of new ways of shopping and its intention to re-use and to purchase is a topic already studied for e-commerce platforms (Kim, Kim, and Shin, 2009), online services personalisation (and retail store that provides them) (Lee and Park, 2009).

In a study focusing on brand engagement, McLean and Wilson (2019) found that subjective norms (a variable of the technology acceptance model that serves as a proxy of others' influence on the self) influence is positively related to brand engagement when using an AR mobile app. In turn, they found that brand engagement, when using an AR app, positively influences customer satisfaction (with the experience) and brand usage intention (which can be interpreted as a proxy of purchase intention) (McLean and Wilson, 2019). Nonetheless, all these influences are the result of a passive social presence, where there is no interaction between subjects (Argo and Dahl, 2020).

Summing up, an optimal experience is the one when one is accompanied (in line with the findings of Borges et al. (2010)), using full-length mirrors (similar to a simulation of a retail store) and when the app has reviews (mirroring an e-commerce experience).

Therefore, it is anticipated that:

H4: The three elements manipulated in the experimental condition, the combination *accompanied, full-length mirror, with ratings and reviews* is that which enhances the maximum effect (i.e. this condition is the one that has the most significant impact), influencing the attitude toward AR positively. Thus, the other experimental conditions will negatively influence attitude toward AR.

Shopping is a social experience (Borges et al., 2010; Falk and Campbell, 1997). In every retail environment, there is a certain degree of social presence and influence, i.e. consumers feel the presence of other people, from staff to other customers (Argo and Dahl, 2020; Argo et al., 2005).

If this concept of social influence is extended to an online and mobile shopping context, and if it is not limited to the physical presence, the mental presence of others and the reviews and ratings present potentially persuading factors to take into consideration (Argo, 2020; Grewal et al., 2020).

Moreover, considering subjective norms as a proxy of social influence (Venkatesh and Davis, 2000) (namely the influence related to the mental presence), in a review of e-shopping acceptance it is asserted that subjective norms are a direct and positive antecedent of intention which is significant for some authors, and not significant for others, and a result no consensus has been reached (Ingham, Cadieux, and Berrada, 2015).

Nonetheless, an online and mobile purchase experience is typically a lonely experience. The only sources of social presence reported in the online retail/social commerce literature are those related to interaction through social media, where this presence is passive, primarily through ratings, recommendations and votes (Li, 2019; Naylor et al., 2012). Therefore, the context where there is a physical interaction between subjects using an AR m-commerce app may not yield the same effects as those found for retail environments (Wenzel and Benkenstein, 2018).

Based on the work of Yim and Park (2019) it can be said that body image plays a moderating role in the development of consumers evaluations when using an AR website (versus a traditional one) and that people who score lower on this variable tend to have more favourable intentions to adopt AR than those using a traditional website. Despite having found empirical evidence that links body image to attitude toward AR (Yim and Park, 2019), and that attitudes towards technology have a positive impact on its actual use (Kim and Forsythe, 2008), there are no studies that relate body image to purchase intention in the context of an AR m-commerce app.

From what has been explored above, it is hypothesised that:

H5: The three elements manipulated in the experimental condition, the combination *accompanied, full-length mirror, with ratings and reviews* is that which enhances the maximum effect (i.e. this condition is the one which has the most impact), influencing positively purchase intention; thus the other experimental conditions will negatively influence purchase intention.

Part II

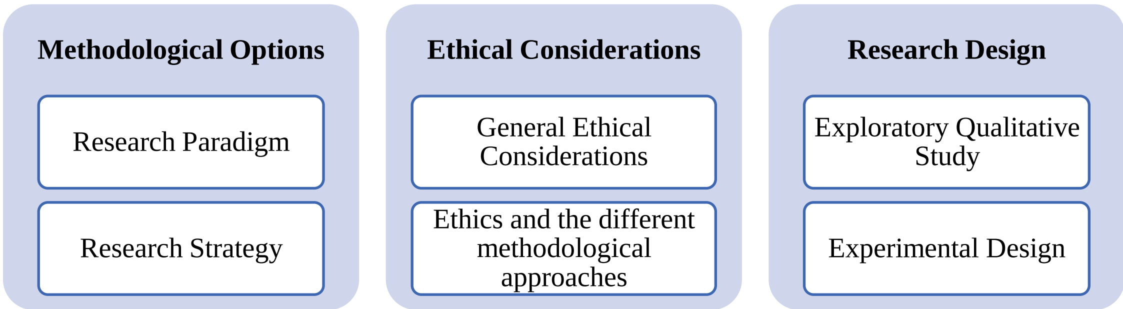
Research Method

PART II: Research Method

In this second part, the methodological approach adopted to answer the research questions is justified, as well as the techniques for data collection and analysis. Furthermore, the ethical issues inherent in the development of this research are addressed (see Fig. II. 1).

Given the complexity of the scope of the study, this part was divided into three chapters, beginning with the explanation of methodological options. Ethical considerations are then presented associated with the entire research process, followed by the research design, highlighting the methods, techniques and analytical tools involved.

Fig. II. 1 - Structure of Part II: Methodology



In brief, this study adopts a positivist stance with nuances of interpretivism, mainly driven by deductive reasoning, infused with some inductive aspects. Ontologically, this research fits within the scope of objectivism and is tinctured by a constructivist stance, namely in the qualitative exploratory approach that served as a basis for the development of the experimental design. Thereafter, a mixed-methods methodology was followed, where it started with a qualitative study, to adopt concepts, to refine the research questions, and to seek insights into the validation of the design to be adopted. In the second phase, an experimental design was used with questionnaires employed as the data collection instrument.

Chapter 5: Methodological Options

The chosen methodology represents the research logic that, along with the methods, i.e. data collection and analysis procedures, determine the appropriate manner to respond to the research questions (Teddlie and Tashakkori, 2010). Thus, the methodological approach influences the subsequent phases of the study, namely the research strategy, sampling, data collection and analysis.

The research paradigm influences the choice of methodology, i.e. the epistemological and ontological positioning of the researcher impacts on which suitable research strategy to be adopted.

5.1. Research Paradigm

The choice of the methodological approach adopted by a researcher is always based on a set of beliefs and assumptions about how science develops (Saunders et al., 2016). Thus, the methodology and adopted methods reflect the philosophical, epistemological and ontological positioning (Hatch and Yanow, 2008).

Epistemological Considerations

Epistemology deals with the assumptions about what is or should be accepted as knowledge, and the central theme in this discussion is whether the phenomena observed by is from a Social Science perspective and can be studied using the same principles and procedures as Natural Sciences (Bryman and Bell, 2011; Saunders et al., 2016).

In respect of epistemological positioning, in one extreme there is Positivism/Empiricism, and at the other, there is Interpretivism.

In Positivism, Social Sciences are studied in the same way as Natural Sciences, being governed by objective truth, and it is not subject to subjective inference to predict and control reality (Easterby-Smith, Thorpe, and Jackson, 2015).

Interpretivism emerges as an epistemological alternative to Positivism, being adopted by researchers who are critical of the adoption of the scientific model in Social Sciences (Bryman, 2012).

Table 5. 1 presents a synthesis of the differences between Positivism and Interpretivism (Bryman, 2012; Easterby-Smith et al., 2015; Saunders et al., 2016; Sekaran and Bougie, 2016).

Table 5. 1 - Positivism versus Interpretivism

Positivism	Interpretivism
• The observer is independent of the object of study; • The object of the study must be defined using criteria and not beliefs and interests; • Only phenomena and knowledge that are confirmed empirically by the senses are considered knowledge; • The theory exists so that hypotheses can be generated and tested; • A logic of cause-effect governs the world; • The concepts must always be formalised so that they can be measured quantitatively; • Knowledge must be generalised (through the use of random samples drawn from the population).	• Humans are different from natural phenomena since they create meaning, which is studied by interpretivism; • The challenge for social scientists is to capture the subjective meaning of the research object and its context, i.e., people and institutions, taking into account their inherent complexity; • Interpretivism uses the following as research logic: hermeneutics (focus on the study of cultural artefacts), symbolic interactionism (focus on observation and analysis of social interaction), and phenomenology; • Phenomenology focuses on how individuals perceive the world, focusing on how people remember and interpret their experiences.

In the recent years, the incorporation of the use of interpretivism in consumer behaviour and marketing research has increased (Wilson, 2012), as well as in the user experience research (Ghaffari and Lagzian, 2018).

Having said this, although this research has a **strong positivist positioning, it also has elements of interpretivism**. Thus, before explaining consumer behaviour using an experimental design, it should be understood what factors will influence purchasing at various levels, such as:

- The discrepancy between purchasing in a physical store versus a dematerialised store (online and mobile);
- The inherent factors of mobile commerce applications that influence the perception of the subject;
- Verification and validation of which variables to include in the experimental design.

The inclusion of a more interpretative logic has its impacts on methodological options, namely ontological positioning and the definition of the research strategy.

The choice of the epistemological approach depends on the nature of the research, as well as on the theories that support that research. Having said this, in this thesis, a positivist approach is followed, supported by qualitative and quantitative methods.

Ontological Considerations

Ontology refers to the way scientist sees the world around her/him. Thus, if the social entities that exist are considered as objective with realities external to the social actors, it is the realm of Objectivism (Bryman, 2012). Otherwise, if these entities are seen as social constructs and consequently subjective, created by the perceptions and actions of the social actors, it is Constructivism (Bryman, 2012; Saunders et al., 2016).

Therefore, according to Objectivists, reality exists, and the interpretations and experiences of social actors do not influence the existence of the social world, and social and physical phenomena have an independent existence (Saunders et al., 2016).

For followers of Constructivism, social phenomena and their meanings are constantly changing, being observed through social interaction, and the researcher can present a specific version of social reality, given that it is part of what is being observed (Bryman, 2012; Easterby-Smith et al., 2015).

5.2. Research Strategy

The research strategy is the plan that allows the researcher to achieve the research objectives and answer the research questions (Sekaran and Bougie, 2016). This choice concerns the way the researcher perceives reality - ontology – how s/he perceives knowledge - epistemology (Bryman, 2012), as well as the nature of the objectives and the research questions.

Traditionally there is the quantitative versus qualitative dichotomy. Thus, researchers who follow Interpretivism and Constructivism, and whose positioning of theory about research is Inductive, traditionally adopt a qualitative strategy (Bryman, 2012; Saunders et al., 2016). In these research approaches, the focus is on capturing the meaning that participants attribute to material objects and their relationships. Consequently, qualitative research is based on in-depth interviews, focus groups and participant observation (Hesse-Biber, Rodriguez, and Frost, 2015; Saunders et al., 2016).

Proponents of Positivism and Objectivism, follow a Deductive approach (using data to test/validate theory), using a quantitative strategy where data collection is reasonably structured (Bryman, 2012; Saunders et al., 2016). In this type of research, there is great care taken in respect of data validation and replication of results, so its collection is done through surveys (using questionnaires), structured interviews and observations, or experimental design (Hesse-Biber et al., 2015; Saunders et al., 2016).

The choice of one path instead of another is not without controversy. Therefore, a third research paradigm emerges – Mixed-Methods - which incorporates both quantitative and qualitative approaches, enhancing the advantages and mitigating the disadvantages of each approach (Bryman, 2008; Greene, Caracelli, and Graham, 1989; Johnson and Onwuegbuzie, 2004). This integration can be undertaken at different stages of the research process, either in the definition of questions, the data collection stage, or the data analysis stage (Bryman, 2006).

This paradigm has been accepted by the scientific community, and no longer represents the integration of two methods (Greene et al., 1989) positioning itself as a methodological orientation (Tashakkori and Teddlie, 1998).

Although mixed-method research is not an easy task because it raises issues of integration of results, it consumes more time and resources, the advantages it brings to the researcher exceed the effort expended (Bryman, 2006; Molina-Azorin, 2011).

Thus, mixed-methods not only outweigh the disadvantages of a purely quantitative (QUAN) or qualitative (QUAL) approach but also increase the scope of research, in that the use of QUAN and QUAL methods together produce a synergy equivalent to the equation 1 + 1 = 3 (Creswell and Clark, 2018; Fetters and Freshwater, 2015b). This methodology provides the researcher with a more comprehensive view on the topic at hand and can solve more complex issues than when addressed by only one strand (Creswell and Clark, 2018; Fetters and Freshwater, 2015b). This research strategy also allows the use of multiple paradigms/visions in the approach to a problem, giving the researcher a methodological eclecticism, i.e., s/he has greater freedom of choice of data collection and processing techniques to answer the research questions, while allowing the combination of deduction and induction, through abductive logic (Creswell and Clark, 2018; Morgan, 2007; Teddlie and Tashakkori, 2010).

In mixed-methods research, several techniques that equate the QUAN and QUAL relationship can be combined. The most common combination is questionnaires/structured interview (QUANT) and interview (semi-structured or unstructured) (QUAL), although there are cases where researchers use experimental/quasi-experimental designs (Bryman, 2006).

Thus, the sequential use of mixed-methods allows the use of QUAL methods to develop and refine the quantitative ones, namely, it allows the identification new variables and constructs to be explored in the quantitative study (Creswell and Clark, 2018; Greene et al., 1989).

Thus, regarding the motivations for the use of mixed methods in research, Greene et al., (1989, p. 259) synthesise them into five non-exclusive groups as follows:

- **Triangulation:** when seeking convergence, corroboration or matching between results of other methods;
- **Complementarity:** when seeking a better understanding of a phenomenon, comparing the results of different methods;
- **Development:** where there is a logical sequence, i.e. when it is intended to use or inform the results of one method in conjunction with another, especially in the case of sampling, implementation or development of measures;
- **Initiation:** when the goal is the discovery of new paradoxes, new frameworks and readjustment of questions or results of one or other method;
- **Expansion:** when the goal is to increase the scope of research using the various methods.

Among the most common reasons for using mixed-methods, there is triangulation and expansion (Bryman, 2006) and, more recently, researchers use it for complementarity (Small, 2011).

By choosing a mixed approach, the researcher has to make a series of decisions that will define the study (Creswell and Clark, 2018; Leech and Onwuegbuzie, 2009; Nastasi, Hitchcock, and Brown, 2010):

- **Emphasis on approach:** what the dominant methodology is, or whether QUAN and QUAL methodologies are represented equally;
- **Time orientation:** whether the study is sequential or simultaneous;

- **Priority:** what the weight of each methodology in the study is;
- **Level of interaction:** whether the QUAL and QUAN approaches are dependent or independent.

Thus, Leech and Onwuegbuzie (2009) define nine typologies of mixed-methods based on the priority, temporal orientation and emphasis on approach. However, Creswell and Clark (2018) summarise them in three basic typologies: the convergent, sequential explanatory and the sequential exploratory. For the purpose of this research, the focus will be on the last one.

The exploratory sequential design (or exploratory design) uses a sequential temporal logic and contrasts with the explanatory design since the first phase of this strategy is based on a QUAL collection (Creswell and Clark, 2018). This phase contributes to the development of scales, instruments and the discovery of new variables, among others, which are applied in a QUANT data collection and analysis and interpretation (Creswell and Clark, 2018).

Although mixed-methods are more advantageous than a single-method approach, their application is not exempt from recommendations, particularly regarding the difficulty in integrating QUAL and QUANT research, as well as the acceptance that research is reportedly using mixed-methods (Bryman, 2006, 2007). Moreover, a researcher who intends to use these methods has to be very clear in the way s/he intends to do it, as well as explaining the form and sequence of how to do it since this affects different stages of the research process (Creswell and Clark, 2018; Fetters and Freshwater, 2015a; Johnson, Onwuegbuzie, and Turner, 2007; Lopez-Fernandez and Molina-Azorin, 2011; Molina-Azorin, 2011).

Even though QUAN methods, such as surveys, are the most frequently cited in the consumer behaviour literature, especially in the digital era (Zhang and Benyoucef, 2016), mixed methodologies are gaining in importance, in particular in the development of measurement instruments for engagement in social networking sites (employing focus group and in-depth interviews to develop a scale) (Hollebeek, Glynn, and Brodie, 2014). Researchers also use them to study the consumer-brand relationship in social networks (through a survey and experimental design) (Labrecque, 2014). Another area where these methods have been growing is in social marketing and gamification, where Mulcahy et al. (2018) applied a focus group and an online survey to analyse the effects of game design on the relevant aspects (e.g., satisfaction and behavioural intent), and marketing (Harrison and Reilly, 2011).

For this study, the appropriate way to achieve its objectives, as well as answer the research questions was by using the mixed methodology, in the form of the exploratory sequential study. Thus, it was used a QUAL approach for the exploratory part, which allowed us to capture which variables were relevant for the experimental design.

With the first phase, it could be perceived the factors that compete in a dematerialised purchase decision, as well as the discovery of a new variable, such as the influence of third parties on the purchase decision. Also, the research questions could be refined, as well as the perception of possible bottlenecks that may occur in the second phase of the study.

The dominant methodology in this study was the quantitative, in the form of experimental design, according to the objectives and research questions.

Chapter 6: Ethical Considerations

6.1. Overall Ethical Considerations

Ethical principles in research are transversal to all stages of the research process: data collection and analysis and dissemination of results (Sekaran and Bougie, 2016).

Rosenthal and Rosnow (2008) based on the research code of the American Psychological Association, enumerate the following principles that must be adopted in research work:

- **Respect for people and their dignity:** it safeguards the privacy, confidentiality, self-determination and anonymity of the research subject, as well as her/his freedom to participate in the study, and that may s/he can leave it without consequences (Bryman, 2012; Rosenthal and Rosnow, 2008; Sekaran and Bougie, 2016).
- **Beneficence and not inflicting damage:** these ensure that the participant will not suffer any damage (physical or psychological), the 'management' of deception (only used to guarantee the quality of scientific research). It also relates to the type of research details that are given to the participant so as not to harm or affect the validity of the research, as well as ensure that participants are informed about the procedure at the appropriate time.
- **Justice:** it refers to the fact that the participants have access to the benefits of the research. Also, the researcher has the freedom to take the necessary precautions to mitigate potential biases.
- **Integrity:** this principle refers to the fact that the researcher establishes a relationship of trust with the research subjects, based on the assumption that they were informed of what would happen to them, and that their confidentiality was guaranteed.
- **Faithfulness and Scientific Integrity:** in this principle, the researcher has to assure his peers that the research was done according to the good practice that a scientific study requires (e.g., research design, the protocol followed, data collection, among others).

All of these principles can be safeguarded through informed consent secured from the research participants, where the researcher tells them the nature of the study and the implications of their participation. This consent is still essential to safeguard the researcher if participants or others raise any questions (Bryman, 2012; Cunningham and Wallraven, 2011).

6.2. Detailed Ethical Considerations

6.2.1. Ethics in Interview Research

Conducting interview research is a moral enterprise since both the interviewer and the interviewee are affected by the interaction generated by safeguarding the interview (Kvale, 1996). Therefore, there is a set of ethical aspects, which were taken into consideration throughout the project.

Given the inductive nature that a qualitative study involves and consequently the fact that relevant themes to the research may arise during the research, the researcher should ask the research subject to give her/his **informed consent** beforehand (Marzano, 2012). With this consent, the researcher informs the subject of the general objective of the study, relevant aspects of the design, as well as the risks and benefits arising from her/his participation in the study, and its voluntary nature, while minimizing the possible adverse social and personal outcomes (Kvale, 1996; Merriam and Tisdell, 2016; Mishler, 1991; Tracy, 2013).

Another issue that also has to be taken into account is **confidentiality**, which refers to "agreements with persons about what may be done with their data" (Sieber and Tolich, 2013, p. 155), i.e., the removal of any element identifying the participants, and **anonymity** of the data (Lune and Berg, 2017), and the participants' privacy, i.e., the “degree of control of the access of others to them” (Sieber and Tolich, 2013, p. 154). In practice, this issue translates into the non-publication of data that permits the identification of the subjects' identity, unless they explicitly authorise it (Kvale, 1996). This confidentiality works in the following ways (Kaiser, 2012; Sieber and Tolich, 2013):

- The anonymity of participants in interview transcripts (e.g., using letters instead of names);
- Modification of all data that may characterise people;
- Guarantee that only the person doing the transcription hears the recordings;

- Destruction of recordings and notes after approval of research publication;
- Guarantee of confidentiality of the interview, except for exceptions allowed by law (e.g., a threat to the well-being of someone or the existence of reports of abuse of vulnerable populations, such as children, elderly or non-self-sufficient adults);
- Avoid deception.

Another ethical guideline proposed by Kvale (1996) concerns the **consequences** of the study. Thus, it is argued that researchers should follow the principle of beneficence/principle of avoiding harm, i.e., the risk of inflicting harm on subjects should be as low as possible, and there should be some reciprocity between what subjects give and receive of the study (Hopf, 2004; Kvale, 1996; Sieber, 1982).

As in the points mentioned above, the question of ethics is a closely related factor with the **integrity of the researcher**, his familiarity with values, norms and ethical theories, that will help him adapt his knowledge to the research situation (Kvale, 1996).

6.2.2. Ethics in Experimental Design Research

Like other methodological approaches, experimental design research also follows strict ethical norms, mainly due to the management of deception, and to the fact that the experiments may be intrusive, because they subject individuals to experiences that despite do not cause harm, can be 'strange' to them (Babbie, 2007).

To overcome these 'constraints' regarding the protection of participants' interests, experimental designs research follows the guidelines of the Belmont Report which establishes the following principles (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research et al., 1979; Shadish, Cook, and Campbell, 2002; Vargas et al., 2017):

(1) **Respect for people**: treating individuals as autonomous subjects and protecting those with diminished autonomy;
(2) **Beneficence**: where people are treated according to ethical principles, minimising their risks and maximising their benefits;
(3) **Justice**: meaning fairness in the distribution of risks and benefits by participants and equal treatment.

These principles are guaranteed in the research through (Geuens and Pelsmacker, 2017; Marczyk, DeMatteo, and Festinger, 2005; Sekaran and Bougie, 2016):

(1) Informed consent: where the researchers explain the research and ask participants for their permission to participate in the research (not using coercion);
(2) Guarantee of privacy, confidentiality, and autonomy and absence of risks to participants;
(3) Debriefing: at the end of the experiment, the researcher explains the real nature of the study to the participants;
(4) The voluntary character of participation in research.

Thus, to accomplish this research, participants were asked for their informed consent (see Appendix 1 and Appendix 3).

6.3. Research Decisions

The population under study are young adults, aged between 18 and 25 years old, who voluntarily consented to participate.

They were given information on the type and purpose of the research, as well as how the data collection, processing and dissemination of the results would be carried out.

As researchers one is committed to following and respecting the norms and regulations established for the attainment of this type of research, thus protecting the participant from any harm and ensuring their privacy, disclosing the objectives, risks and benefits of the study. Therefore, rigorous, transparent and objective scientific research is carried out.

Chapter 7: Research Design

The research design is the guideline of a research project, which specifies the details of the procedures necessary to obtain information for the solution of marketing research problems (Malhotra et al., 2017).

As described in previous chapters, we followed a mixed-methods approach to achieve the proposed objectives and to respond to the research questions.

The first and exploratory phase is the application of qualitative methodology - interviews. With these we intended to:

(1) Find the factors that most influence the dematerialised purchase using mobile applications, namely:
   a. Factors related to the online/mobile platform (interface factors); and
   b. Factors related to the circumstances of the moment of purchase.

This phase allowed the identification of new variables to be included in the second stage of the study, like:

(1) To what extent does the social factor, i.e. the presence of third parties, influence this process. This social factor comprises:
   a. The physical presence of other people;
   b. An omnipresence in the consumer subconscious of reference groups such as family, friends and influencers; and
   c. Presence of online reviews and ratings.

The second phase of this study consisted of the development of experimental design, where, based on the experience of using a mobile application, it was intended to:

(1) Quantify (through a questionnaire) the impact of the app interface aspects;
(2) Quantify the influence of the social factor; and
(3) Find out if the consumer's body image plays any interference in the purchase decision.

7.1. Exploratory Qualitative Study: Interviews (phase I)

> "*For our purposes, an interview will refer to a face-to-face verbal exchange, in which one person, the interviewer, attempts to elicit information or expressions of opinion or belief from another person or persons*" (Maccoby and Maccoby, 1954, p. 449).

Interviews are the most common type of qualitative data collection in mixed-methods when the purpose of the study is to serve as means to develop and adjust the quantitative study (Bryman, 2006, 2012; Cooper and Schindler, 2013; Seidman, 2013). Thus, the contributions of these exploratory interviews are:

(1) Capture inputs relative to scales drawn from the literature;
(2) Test the usability of the mobile application in the context of research; and
(3) Capture and adjust the understanding of the concepts by the interviewees.

This research method is a seven stage~~s~~ process that involves (Kvale, 1996, p. 88):

1. **Thematizing**: Explanation of the purpose of the research and the topics to be explored;
2. **Designing**: Designing the study to achieve the objective of the research;
3. **Interviewing**: Conducting interviews;
4. **Transcribing**: Transcription of the interview from oral to written language;
5. **Analysing**: Analysis of the interviews in the light of the research objectives;
6. **Verifying**: Data reliability and validity check; and
7. **Reporting**: Dissemination of the findings.

A summary of the advantages and disadvantages of using interviews as a method of data collection is presented in Table 7. 1 (Brinkmann, 2013; Cooper and Schindler, 2013; Kvale, 2006, 2007; Lune and Berg, 2017; McDaniel Jr. and Gates, 2013; Merriam and Tisdell, 2016; Saunders et al., 2016; Seidman, 2013).

As far as research interviews are concerned, they are commonly used in marketing research, since they allow the researcher to capture the respondent's beliefs, perceptions, motivations, attitudes and feelings about a specific topic (Malhotra et al., 2017). These can also be used as pre-tests and refinement of research instruments, especially when interviewees are asked to share their opinion regarding a questionnaire (Riquelme, Román, and Iacobucci, 2016).

Table 7. 1 - Advantages and Disadvantages of Interviews

Advantages	Disadvantages
• The interviewee is the centre of the interview, thus eliminating the pressure of the group that exists in focus groups; • Questioning the interviewee about things s/he does not know, giving her/him the freedom to speak freely about experiences and choices; • Lower risk of obtaining socially accepted responses; • Allowing the researcher to capture what the interviewee thinks about the topic covered, namely her/his personal experiences (Sloan and Bowe (2014); Symeonides and Childs (2015)); • Granting access to the context of the interviewee, allowing us to understand their behaviour; • They are often used for exploratory purposes.	• The data generated by the interviews are not scientific, reflecting common sense; • They are not quantitative; • They are subjective; • Only an exploratory approach can be followed, not the hypothesis testing; • The results are biased; • It raises questions about the reliability of results; • The data are not intersubjective (as each reader finds different interpretations); • The validation of the data is debatable; • The generalisation is a sensitive issue. • Its implementation follows rigorous protocols, such as the preparation of the interview script, the formulation and sequence of the questions, the pre-test of the interview, the logistics involved in its making, the recording for later transcription, and the treatment of data; • The dilemma experienced by the researcher: s/he has to know the interviewee's vision while respecting her/his freedom of opinion and not abuse the asymmetry of power established in the interview. The interviewer cannot be invasive.

7.1.1. Types of Interviews

Often, interviews can assume one of three formats ranging from a continuum between structured/standardised interview, semi-structured/semi-standardised, to unstructured/unstandardized/informal (Brinkmann, 2018; Gillham, 2000; Lune and Berg, 2017; Merriam and Tisdell, 2016; Morse, 2012; Platt, 2012).

A **structured/standardised** interview follows a very restricted agenda, and the researcher already has a concrete idea of what s/he would like to discover with the interviews. So, both the questions and their order are predetermined, making them similar to oral questionnaires (Brinkmann, 2018; Lune and Berg, 2017; Merriam and Tisdell, 2016).

In these interviews the questions are asked as they are written, because they are simple, specific and closed, designed in a way to be clearly understood by the subjects, without clarifications, reformulations, or the addition of new questions (Gillham, 2000; Lune and Berg, 2017; Merriam and Tisdell, 2016).

Data collected in this type of interviews are treated as numerical data; they are "forced choice" questions, i.e., the respondents have to select an answer, resembling the questionnaires (Morse, 2012). Given their nature, it is recommended that the number of questions determines the sample and that elements are randomly selected from a given population (Morse, 2012, p. 195).

As regards examples of its application, there are ample research projects with multiple interviewers, such as censuses, market research, socio-demographic and stimulus-response questions (age, income, education, among others) (Gillham, 2000; Merriam and Tisdell, 2016; Tracy, 2013).

At the other extreme, there is the **unstructured interview**, where the interviewer does not have a sequence of questions planned (there is no script), and it starts with a "grand tour" question, from which the interviewee tells her/his story (Brinkmann, 2018; Gillham, 2000; Spradley, 1979). The interviewer is a listener, and occasionally may ask the interviewee for clarification, contrary to what happens with the structured interview (Kvale, 2006; Mishler, 1991).

This type of interview is more flexible, exploratory and organic in nature, it is characterised by open questions, and the interviewer has advanced training in probing techniques, to extract detailed answers that reflect the hidden meaning of the words (Douglas, 1985; Hair, Celsi, Ortinau, and Bush, 2017; Harwood and Garry, 2015; McDaniel Jr. and Gates, 2013; Merriam and Tisdell, 2016; Sekaran and Bougie, 2016).

The interviewer stimulates the interviewee's creativity through elicitation, adapting her/his speech to an ever-changing context, being able to read the verbal and nonverbal language of the interviewee and to improvise (Douglas, 1985; Hair et al., 2017; Harwood and Garry, 2015; McDaniel Jr. and Gates, 2013; Merriam and Tisdell, 2016; Sekaran and Bougie, 2016).

The researcher cannot assume that the same words have the same meaning for all people, i.e. s/he has to realise their meaning in the light of the interviewee's frame of reference

(Lune and Berg, 2017). Regarding the analysis of the data collected, this process is more time consuming than the analysis of the structured interviews due to the high volume of data, which makes the coding process (labelling and data systematisation) and subsequent analysis more demanding (Tracy, 2013).

These type of interviews is widely used in areas like Psychology or Anthropology, especially when using narrative and ethnography to access people's thoughts and experiences, since it is an excellent method for the study of dynamic and unpredictable situations (Brinkmann, 2013; Lune and Berg, 2017; Tracy, 2013).

In addition to the two types of interviews described above, there is the **semi-structured interview**. This interview is an intermediate form between unstructured and structured interviews, regarding script structure and time flexibility, being the most common interview format in qualitative research, and is used when the interviewer already has some knowledge about the topic of study (Brinkmann, 2013; Kvale, 1996; Morse, 2012).

In these interviews, the interviewer has a script/list of topics or critical questions that s/he intends to explore, as well as suggestions of issues, whereas s/he is free to choose whether to advance or not, and there is no predetermined order of the conversation (Bryman, 2012; Kvale, 2007; Merriam and Tisdell, 2016; Saunders et al., 2016). This technique is advantageous in relation to the unstructured interview, since it does not consume much time and allows the interviewer to concentrate on the topic in focus (Brinkmann, 2018; Bryman, 2012; Lune and Berg, 2017; Saunders et al., 2016). It is also advantageous in relation to the structured format since it permits the inclusion of themes that arise in the course of the conversation, which was not previously thought of, thus generating more knowledge than one anticipates (Brinkmann, 2018; Bryman, 2012; Lune and Berg, 2017; Saunders et al., 2016). Thus, these interviews are defined as “an interview with the purpose of obtaining descriptions of the life world of the interviewee in order to interpret the meaning of the described phenomena” (Brinkmann and Kvale, 2015, p. 6).

In this type of interview, the questions can be open or closed, more flexible, giving the researcher an opportunity to adapt them to the interviewee, as well as allowing her/him to compare the information generated with that of previous interviews, i.e., the interviewer uses probing and elicitation techniques (Gillham, 2000; Lune and Berg, 2017; Merriam and Tisdell, 2016).

Regarding data analysis, it is common to conduct a content analysis (especially for open questions), and cross-referencing it with more numerical data (from closed questions) (Morse, 2012). Given these characteristics, these are the predominant type of interviews used in mixed-methods research, when the objective of the study is to understand the opinions, perceptions, and sensitive themes (Bryman, 2006; Kallio, Pietilä, Johnson, and Kangasniemi, 2016). Typically, studies employing semi-structured interviews should have at least 30 participants with identified characteristics (Morse, 2012, p. 195).

7.1.2. Interview as a Research Tool

7.1.2.1. Interviewer Characteristics

When using interviews as a data collection method, the interviewer needs to gather several characteristics, since s/he is, *per se*, the research tool (Gillham, 2000; Kvale, 1996; McCracken, 1988). Kvale (1996, pp. 148–149) proposes the following characteristics:

(1) **Know** the topic of the interview;
(2) To create a logical **structure**;
(3) Be **clear** (i.e., to pose questions in a manner accessible to the interviewee);
(4) Be **kind, sensitive and empathetic** (practising active listening of verbal and non-verbal languages, intonation, and awareness of the respondent's emotions);
(5) Be **open** to the emergence of new topics introduced by the interviewee;
(6) Be **direct** and **critical** (i.e., knowing what is wanted and trying to get the knowledge by critically questioning the respondent, thus assessing the reliability and validity of the data);
(7) Having the ability to retain in **memory** what the respondent says (to be able to relate to information that has been or might be said); and
(8) Be able to **interpret** (which allows the researcher to clarify and expand throughout the interview what is being said to her/him).

To add to these characteristics, there is also **weighting** (i.e., the interviewer's ability to speak in the right way) and **ethical awareness** (by informing the interviewee of the purpose of the interview and ensuring its confidentiality) (Bryman, 2012). The interviewer must be able to create **rapport** ("*Rapport is a stance vis-à-vis the person* *being interviewed*”)**,** trust, and to be **neutral (“***Neutrality is a stance vis-à-vis the content of what that person says*”*)* (Patton, 2015, p. 457, emphasis in original). The interviewer should do so during the course of the first questions, to allow the interviewee to feel at ease, creating affinity with the subject, without letting the established relationship become equal (Brinkmann and Kvale, 2015; Tracy, 2013). Other authors state that the interviewer's age also influences the interview (the older the interviewer, the higher the level of cooperation), as well as the possession of some degree of experience (Singer, Frankel, and Glassman, 1983).

7.1.2.2. Quality of the Interview

The quality of the interview is paramount because it reflects on the quality of subsequent research steps, requiring the interviewer to have knowledge and craftsmanship not only of the interview topic but also of their practice (Kvale, 2007; McCracken, 1988). Thus, Kvale proposes six quality criteria that must be achieved (Kvale, 1996, p. 145):

- Respondents' responses should be rich, spontaneous, specific, and relevant to the topic of the interview;
- Questions asked by the interviewer should be short, while the interviewee's answers should be lengthy;
- The interviewer should follow and clarify the meaning of relevant parts of the interview;
- The interviewer should perform an exercise of interpretation throughout the interview;
- The interviewer should try, throughout the interview, to verify their interpretations of the answers obtained; and
- The interview should be self-reported, with no need for further explanation.

To these points, McCracken (1988, p. 50) adds that, for an interview to have quality, the data obtained in this should be:

- Exact, i.e., cannot contain inaccuracies, inconsistencies, or leave doubts;
- Economical, that is, being self-reported;

- To have mutual consistency, i.e., there should be no contradictions between the different parts;
- To have external consistency, allowing the data obtained in the interviews to be confirmed by independent sources;
- Having unity, i.e. the knowledge generated derives from a coherent and interrelated set of ideas;
- Powerful, i.e., the information must explain the maximum information of the data, without compromising its accuracy; and
- Fertile, insofar as one can project the conclusions drawn to different and/or broader contexts.

Thus, the quality of the interview is not limited to the quality and type of language used in the formulation of the questions, but also to the interviewer's craftmanship, both in interview techniques and in her/his expertise on non-verbal language (Kvale, 2007; Seidman, 2013).

7.1.3.Operationalisation of the Interview

7.1.3.1. Participants and Number of Interviews

The recruitment of participants is one of the crucial parts of interview preparation since the sample used should be representative of the study population (Lune and Berg, 2017).

When it comes to the sample size, there is no exact number of interviews that should be carried out, and it is frequent to find different points of view on the subject in the literature. There are authors in the field of Anthropology who argue that qualitative research should involve about six to seven sessions of 60-90 minutes for in-depth interviews and that a single research may take about 25-30 interactions (Seidman, 2013; Spradley, 1979). Researchers also point out that when dealing with younger subjects, the duration of interviews may be shorter (30-60 minutes) (Seidman, 2013; Spradley, 1979).

Other authors argue that eight interviews are sufficient for several research projects, provided that researchers make a careful selection of respondents to their agenda (McCracken, 1988). Glaser and Strauss argue that the number of interviews conducted depends on the quantity and quality of knowledge generated by an additional interview

(Glaser and Strauss, 1967). For Kvale, studies involve between 10 and 15 interviews, and the element that frequently signals the end of interviews is when the saturation point is reached as Glaser and Strauss also argue (Kvale, 1996).

Thus, the number of interviews to be conducted depends on the extra information that they bring. If the conduction of an extra interview does not bring any new data to the research, it is said that a theoretical saturation point of the topic is reached, from which the continuation of the data collection does not yield new insights (Ghaffari and Lagzian, 2018; Glaser and Strauss, 1967; Merriam and Tisdell, 2016).

Thus, in the case of this research, since it is used semi-structured interviews, a sample of approximately 10-30 participants is appropriated, that is, there are enough interviews to reach the saturation point of the topics (Glaser and Strauss, 1967; Kvale, 1996; Morse, 2012). In our study, a convenience sample of university students aged 18-25 years old was used.

The rationale for using this type of sample is that university students are an easy and fast access target audience (Bryman, 2012; Lune and Berg, 2017). Moreover, this age group presents characteristics relevant to the context of the study, namely (IBM, 2018; Priporas et al., 2017; Roth Capital Partners (ROTH), 2018):

- They are digital natives and cyber-savvy;
- They are increasingly dependent on new technologies, namely their smartphones;
- They increasingly use the digital channel in their purchasing process (whether for research or purchase).

7.1.3.2. The Interview

The interview process begins with the preparation of the interview, i.e., when the researcher deepens her/his knowledge about the topic under analysis, following the formulation of the preliminary interview script, which is refined, creating the basis for the script to be used in the collection (Kallio et al., 2016).

The script begins with simple response questions, to break the ice, set expectations, introduce informed consent, and begin to establish rapport (Lune and Berg, 2017; Tracy, 2013). The questions that follow are open ones of a more general nature linked to the subjects' experiences (Lune and Berg, 2017; Tracy, 2013). Then, there are the transition issues; the key questions/directives, and elicitation questions, where after each "sensitive" topic there are validation and clarification questions (Lune and Berg, 2017; Tracy, 2013). After this sequence, the researcher moves on to the next topic, concluding with the ending questions, and with the acknowledgement and reassurance of the participants' confidentiality and anonymity (Lune and Berg, 2017; Spradley, 1979; Tracy, 2013).

During the interview, follow-up questions and strategic probes are used, which allow the researcher to clarify meanings and doubts that arise during the interview (Brinkmann and Kvale, 2015). In the case of our study, since the target audience is young, we decided to put demographic issues at the end (Tracy, 2013).

The interview script is in Table 7. 2.

Table 7. 2 - Interview Script

Introductory Questions:

- Do you regularly check websites/online shopping apps? Which ones? For what purpose (s)?
- Have you ever shopped online? What products did you buy? What are the advantages and disadvantages?
- What aspects do you value in a shoe? Have you ever bought shoes online?

Central Questions:

- Do you know any website/app that lets you virtually experience the product that you want to buy?
- Here you have an app that lets you virtually experience shoes. How do you rate the experience? What are your thoughts about this experience?
- Do you think such an application would lead you to buy more shoes? What are your thoughts about purchasing using the app versus purchasing in a physical store?
- In your opinion, what brands can offer you an app like this? Why?
- How would you describe the typical user of this app?

Final Question:

- What aspects of the app are relevant for you to buy shoes using the app?

7.1.3.2.1. Analysis of the Interview

Once the interviews were concluded, the recordings were transcribed to ensure the confidentiality and anonymity of the participants and the content was subject to analysis (Brinkmann, 2013; Bryman, 2012; Kvale, 1996).

The techniques for the analysis of semi-structured interviews were selected based on the research objective, the questions and the methodological approach (Schmidt, 2004). Therefore, the most common method for analysing interview data is coding and content analysis (Bryman, 2012; Kvale, 2007; Schmidt, 2004). The fundamental unit used in this method is the code. Code is “a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data” (Saldaña, 2012, p. 3). Thus, coding is the process of assigning an abbreviated denomination to various aspects of the data collected, organising them so that they are easily retrieved and analysed (Merriam and Tisdell, 2016; Miles, Huberman, and Saldaña, 2014).

The content analysis reflects the systematic, objective and detailed method of analysis and interpretation of the data, leading to the identification of topics, categories, assumptions and meanings, allowing the quantification of the frequency of codes and making inferences from texts (Krippendorff, 2004; Neuendorf, 2002; Saldaña, 2011, 2012).

There is no single appropriate coding method, since “each qualitative study is unique, [so] the analytical approach used will be unique” (Patton, 2015, p. 522). Thus, the coding process involves two cycles: (1) the identification of critical points (first coding cycle), (2) their categorisation, creating exhaustive and exclusive categories (second coding cycle) (Gillham, 2000; Kvale, 2007; Saldaña, 2012).

The first cycle consists of an analysis of the data and the attribution of codes (words/phrases) that synthesises the essence of the discourse, according to a more descriptive perspective (Saldaña, 2012; Tracy, 2013). The second cycle is a more analytical process, involving tasks such as classification, prioritisation, integration, abstraction, conceptualisation and development of theory, where the researcher revisits the codes previously defined in the first cycle (Charmaz and Belgrave, 2012; Saldaña, 2012; Tracy, 2013).

One of the most sensitive questions regarding the application of content analysis in research is related to the validity and reliability of the data. Validity represents the degree of precision with which a measure evaluates the concept in the analysis (Carmines and Zeller, 1979). Thus, research should “speak as truthfully as possible to as many as possible" (Riffe, Lacy, and Fico, 2014, p. 137), i.e., it has to fulfil the following requirements (Krippendorff, 2004; Riffe et al., 2014):

- Face validity (be obvious);
- Social validity (the results contribute to the public discussion of social issues); and
- Empirical validity (making sense within the theoretical framework followed throughout the study).

As far as reliability is concerned, it relates to obtaining the same results of an analysis in successive attempts (Carmines and Zeller, 1979). In this type of analysis, one of the first steps to guarantee reliability is to have more than one coder to code the data (Hayes and Krippendorff, 2007; Krippendorff, 2004; Riffe et al., 2014). Thus, it can compare the results of one with the other through reliability coefficients, such as Alpha of Krippendorff, Scott's Pi, or Cohen's Kappa, and the higher the degree of agreement between coders, the greater the intercoder' reliability (Hayes and Krippendorff, 2007; Krippendorff, 2004; Riffe et al., 2014).

The coding was conducted solving potential discrepancies that might arise throughout the process (Krippendorff, 2004). The intercoder reliability for two coders for all 34 interviews was computed using Krippendorff's alpha reliability measure (Hayes and Krippendorff, 2007). The values ranged from 0.86 to 0.96. The mean value was 0.91, which was deemed acceptable.

7.2. Experimental Design (Phase II)

The experimental design is the method par excellence that allows to systematically analyse the effect of a deliberately manipulated variable (independent/explanatory/predictor variable [IV/X]) on the dependent/criterion variable (the variable that measures the effect caused by IV manipulation [DV/Y]) (i.e., allows us to measure the experimental effect of X on Y) (Hair et al., 2017; McDaniel Jr. and Gates, 2013; Sekaran and Bougie, 2016; Shadish et al., 2002). Some of its requirements include (Langston, 2010; Malhotra et al., 2017; Shadish et al., 2002):

(1) Variation in treatment (IV);
(2) Measurement of the effect (DV);
(3) Have at least one unit/subject in which the observation was made;

(4) Have a mechanism to control extraneous variables;
(5) Have a way to infer the result when there is no treatment (control group); and
(6) Random assignment of the participants/test units and how they are divided by homogeneous groups.

Cunningham and Wallraven (2011, p. 11) define experimental design as “a balancing act between *specificity* and *generality*” (p. 11, emphasis in original), where this method requires precision and control to validate the conclusions, and it is more challenging to extrapolate the results since it is only studied one particular situation/condition.

This method is based on the principle of causality and is used to establish cause-effect relationships (Abdi, Edelman, Valentin, and Dowling, 2009; Malhotra et al., 2017; Vargas et al., 2017). To establish causality, the following three conditions must be met (Hair et al., 2017; Malhotra et al., 2017):

(1) Concomitant variation: i.e., to what extent the cause (X) and effect (Y) occurs simultaneously, or vary together, according to predicted in the hypothesis under study, having a significant association between X and Y;
(2) The temporal order of occurrence of the variables: i.e., the cause (IV) precedes, or occurs simultaneously with the effect (DV), and cannot occur after this; and
(3) Elimination of other causal factors: meaning that the only explanation of the variation of Y is due to the manipulation of X.

The main advantages and disadvantages of adopting this method are summarised in Table 7.3 (Babbie, 2007; Cooper and Schindler, 2013; Easterby-Smith et al., 2015; Kardes, 1996; Malhotra et al., 2017; McDaniel Jr. and Gates, 2013; Vercruyssen and Hendrick, 2012).

The experimental design is a methodology that can be applied to the most diverse areas, from the Natural Sciences, such as Physics, Chemistry, Biology, Engineering, Computing, as well as disciplines such as Health Care, Psychology, Marketing and Design.

The use of experimental design in Marketing is relevant to gain information about specific market performance indicators or some marketing-mix variable, like sales forecasting, the anticipation of the reaction of consumers or competitors, acceptance of products, among others (Hair et al., 2017; Malhotra et al., 2017; McDaniel Jr. and Gates, 2013).

Moreover, as it can be seen in Table 1.1, sound research on the uses of AR in the field of Marketing uses experimental design as a research approach, hence its use on this research.

Table 7.3 - Advantages and Disadvantages of Experimental Design

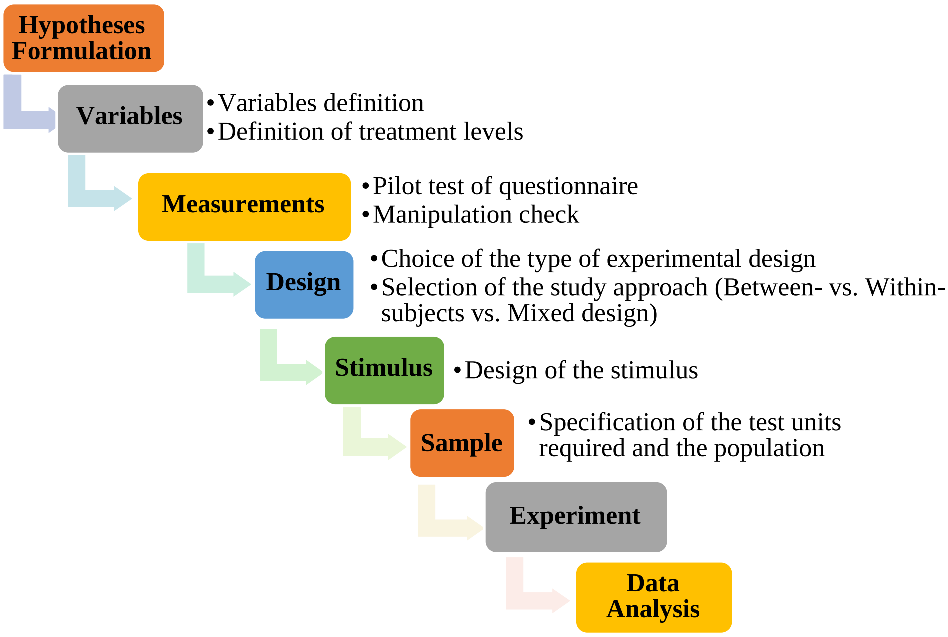
Advantages	Disadvantages
• To establish a cause-effect relationship between the variables of interest; • It is different from other methodologies because it allows the manipulation of the variables; • Greater control of extraneous variables, mainly when the research is conducted in a laboratory environment; • The researcher is trained; thus s/he can repeat the observation, as well as allow others to replicate; • The high cost and convenience of experimentation allows the researcher to schedule data collection, adjust the variables/conditions to unobservable extremes, and play with combinations of variables, anticipating them; • The experience is replicated in different groups of subjects, allowing the discovery of the average effect of IV with different people, contexts and times; and • It allows the researcher to transpose his research to the field experiment, reducing the bias created by her/his presence, allowing the replicability of the study.	• It is a time-consuming process; • Usually entails high costs; • Experiments can be challenging to implement and can raise safety issues, especially when they require the measurement of physiological data, or when they are field experiments; • Lack of realism, mainly if conducted in the laboratory (a threat to ecological validity); • It is susceptible to motivational differences since the motivation of the subjects in the laboratory is different from the real context. • The artificiality of this method, if one opts for a lab experiment, always carries a bias caused by the environment; • The generalisation is not exempt from questions (commonly the subjects of research are undergraduate students); • It is a method that can only be applied to issues of the present. Experimental studies of the past are not feasible and making predictions from them is difficult. • Since experimentation involves mostly people, there are limits to their application and ethical issues that have to be safeguarded.

Experimental design involves three main phases (see Fig. 7.1): planning, operationalisation and data analysis.

Fig. 7.1 - Overview of the Experimental Design Process

In the planning phase we define the variables and levels of treatment under study, the type of design to be used and the study approach, we design the stimulus, and we define the sample (involving the definition of control and experimental groups and random assignment of subjects) as summarised in Fig. 7.2 (Cooper and Schindler, 2013; Kirk, 2013).

Fig. 7.2 - Experimental Design Planning



The first step in planning is to formulate the statistical hypotheses of the study, i.e. we enunciate the testable formulations of the research hypotheses (Kirk, 2013). Then, the variables and the treatments' levels (experimental conditions) are defined (Kirk, 2013). We also operationalise the mediating and moderating variables through the response of questions from the questionnaire (Kirk, 2013).

The type and approach of the experimental design are chosen, followed by the design of the stimulus, and the delimitation of the study population, respective sampling, and random assignment to the study groups according to the type of design adopted.

Regarding the design of the questionnaire, Geuens and Pelsmacker (2017) suggest that questionnaires should follow, *lato sensu*, the following order: manipulation questions, measurement of the dependent variables (DVs), mediator and moderator variables, confounding variables, and ends with sociodemographic issues.

One of the crucial aspects of experimental design is the manipulation check. This is a set of questions that permits the gauging of whether subjects perceived and reacted adequately to a variation in the independent variable (IV) made by the researcher (Hoewe, 2017). These manipulations can be done at one of two moments: outside the main study (serving as a pre-test of manipulation), or in the main study, after exposure to the stimulus and the measurement of the DVs (Beck and Crié, 2018; Geuens and Pelsmacker, 2017; Hoewe, 2017; Perdue and Summers, 1986). Moreover, the questionnaire should be submitted to a pilot test (Malhotra et al., 2017).

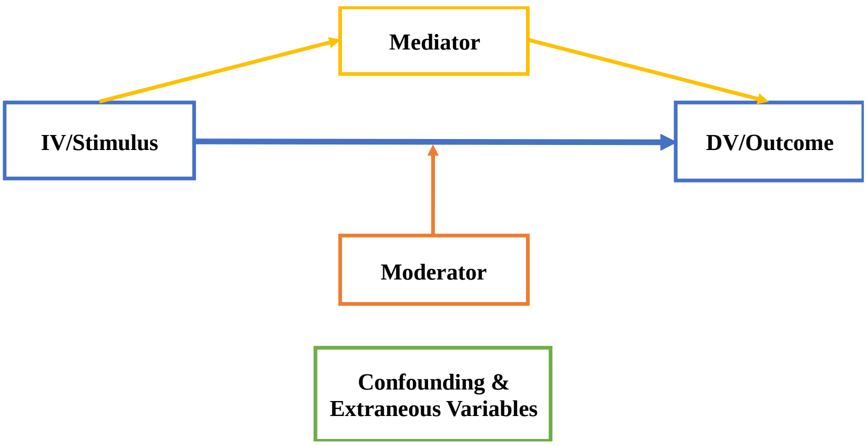
After all these phases, the experiment is conducted and finalised with the analysis of the corresponding data.

7.2.1.Experimental Design Variables

As previously mentioned, an experimental design involves the existence of at least one IV/treatment (X) that is manipulated and affects a DV(Y).

In addition to these two variables, there may still be moderating and mediating variables, which are related, as shown in Fig. 7.3 (Baron and Kenny, 1986; Hair et al., 2017; Saunders et al., 2016).

Fig. 7.3 - Relation between variables in experimental design



The **IV/stimulus/experimental factor** precedes the DV and can have several levels, corresponding to the experimental conditions/treatments that are manipulated, representing the presumed causes (Abdi et al., 2009; Edwards, 1968; Rosenthal and Rosnow, 2008).

The **DVs** are the materialisation of the manipulations of the IV, revealing the presumed effect, which is measurable (Abdi et al., 2009; Lee, 2007; Rosenthal and Rosnow, 2008).

Control variables are those that the researcher does not deliberately and systematically manipulate with IV, which means that they have to be kept constant, to avoid having an impact on the effect of IV in DV (Hair et al., 2017; Saunders et al., 2016).

Mediating variables are defined *a posteriori* as a result of IV action in DV, emerging as a function of IV that helps to explain the relationship between IV and DV, explaining how and why the effects occur (IV → ME → DV) (Baron and Kenny, 1986; Rosenthal and Rosnow, 2008; Saunders et al., 2016; Sekaran and Bougie, 2016; Spencer, Zanna, and Fong, 2005). Baron and Kenny (1986) consider that a variable is a mediator (ME) when:

- ME precedes DV;
- The variations of the IV correspond to variations of the ME;
- Variations in the ME correspond to variations in DV; and
- When the IV-ME and ME-DV relationships are controlled, the IV-DV relationship that was previously statistically significant, cease to be so.

Moderator variables are qualitative or quantitative variability factors that have a strong contingent effect on the causal relationship, affecting the intensity and/or direction of the relationship between IV and DV (Baron and Kenny, 1986; Rosenthal and Rosnow, 2008; Saunders et al., 2016; Sekaran and Bougie, 2016). Baron and Kenny (1986) consider that a variable is a moderator (MOD) when:

- MOD is not correlated with IV or DV;
- It always functions as an independent variable (being at the same level as DV in relation to IV); and
- The relationships established between the variables are as follows:
  - An IV impacts DV;
  - A MOD affects DV; and
- The interaction IV x MOD affects the DV, being this relation significant.

Extraneous variables, in turn, are the variables that may or may not interfere with the experience, affecting or not the response of the test unit, which may influence the measurement of the DV to the point of invalidating it; therefore, they must be controlled (Geuens and Pelsmacker, 2017; Malhotra et al., 2017; Vargas et al., 2017). In the case of experiences related to psychology, one can consider age, gender and level of education as extraneous variables. These variables are difficult to measure/observe and must be considered when discussing the results in order to avoid erroneous conclusions (Saunders et al., 2016). **Confounding variables** are variables like extraneous variables, i.e., other factors that interfere with the IV-DV relationship but influence the results because the researcher cannot control them, varying systematically with the variables and affecting the validity of the experiment, and they can be statistically analysed as covariates or as moderators, depending on the literature reviewed (Abdi et al., 2009; Malhotra et al., 2017; McDaniel Jr. and Gates, 2013).

7.2.1.1. Variables in the Study and their Relationship

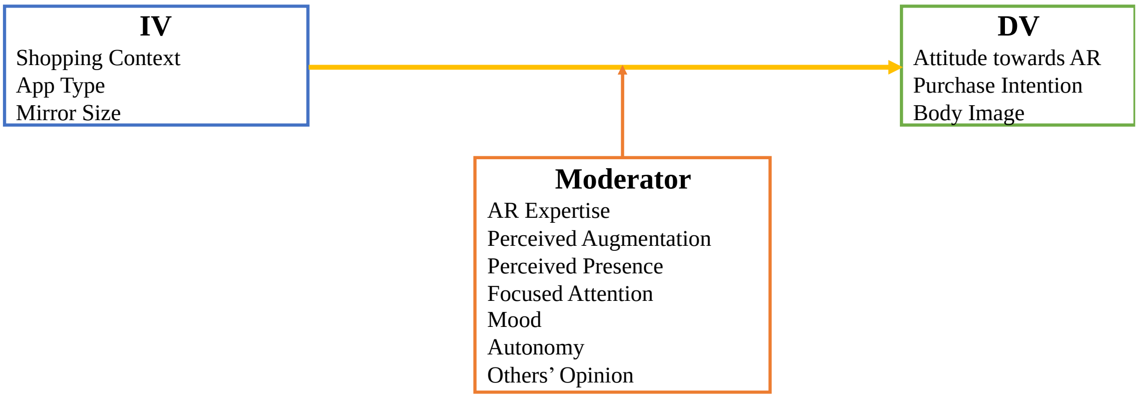
Our research aims to analyse the effect that the presence of third parties (whether physical, mental or virtual) has on consumer behaviour in a purchase context through a mobile app that incorporates AR technology. To this end, the theme was approached from a technology-oriented perspective, based on previous studies that explore the incorporation of AR into e-commerce solutions, mobile applications, and the respective acceptance of technology (both for AR and to the use of mobile apps). We also explored the concepts related to the <u>quality of digital media</u> (e.g., handheld displays) and the <u>inherent characteristics of AR</u>.

To study the impact of third-party presence, we reviewed the concepts from the area of Social Psychology, focusing on studies that address the physical and psychological presence of people at the time of purchase, as well as an online presence through reviews and interaction on social networks.

Taking into account the product category presented in the app (shoes) we studied the influence of the product involvement, as well as the role that the body image has in the intention to buy (this variable was introduced in this research through visualisation of a body part versus the whole body). Additionally, we measured the subjects' mood before and after the purchase process.

Traditionally, the decision-making process involves the following steps: recognition of need, search for information, evaluation of alternatives, purchasing decision, and post-purchase behaviour (Kotler and Armstrong, 2018). This study includes technology in the phases of the search for information and evaluation of alternatives, namely through the visualisation of the product in the consumer himself/herself (allowed by the use of the AR mobile app). Thus, taking into account the theoretical corpus of Consumer Psychology, and the type of variables described above, the variables and the relationship established between them was explored, as shown in Fig. 7.4.

Fig. 7.4 - Variables in study



The IVs manipulated directly by the researcher under study are:

- The shopping context (presence versus absence of another person when using the app);
- The mirror size needed to use the app (full-length versus small);
- The type of app (presence or absence of online reviews).

As moderators, there are AR Expertise, Perceived Augmentation, Perceived Presence, Focused Attention, Mood, Autonomy, Others' Opinion.

The DVs are related to consumer behaviours, such as purchase intention, consumer attitude toward AR technology embedded in a shopping app, and body image.

As control variables, there is the 'consumer profile', namely buying habits, use of apps, and demographic characteristics such as age, and gender.

7.2.2.Types of Experimental Design

There is a multitude of types of experimental design. Malhotra et al. (2017) and McDaniel Jr. and Gates (2013) organise them into four categories, as shown in Fig. 7.5:

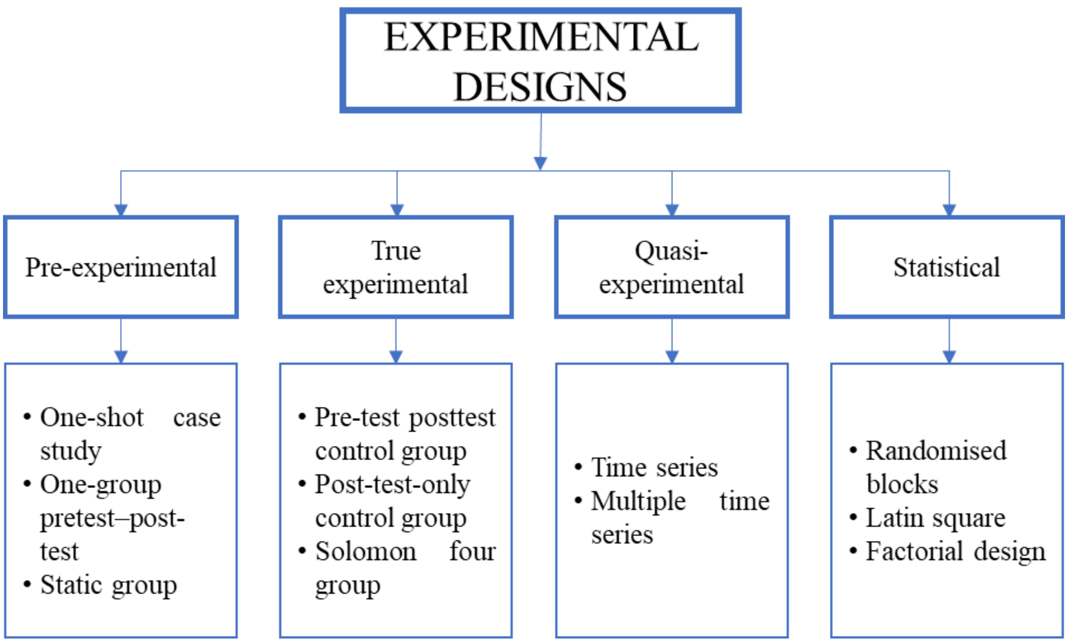
(1) **Pre-experimental Design**: those that offer low levels/lack of control over external factors, i.e., do not resort to randomisation. This category includes the one-shot case study, one-group pre-test-post-test and the static group;

(2) **True Experimental**: where the researcher randomly assigns the participants to the groups, as well as randomly assigning treatments to experimental groups. This group involves the pre-test-post-test control group, post-test-only control group, and the Solomon four-group;

(3) **Quasi-experiments**: characterised by the fact that the researcher does not have absolute control over the allocation of treatments or the allocation of participants to treatments. This is done in a non-random way. Examples of this design are time series and multiple time series;

(4) **Statistical**: this type of design applies the assumptions of true experiments, but there is no complete experimental control. Randomised blocks, Latin square and factorial design, are part of this set.

Fig. 7.5 - Types of Experimental Design. Source: Malhotra et al. (2017, p. 315)



True/Classical/Randomised experimental design

Overall, in these experiments, there is a random assignment of subjects to treatments, including a control group, and the variables are controlled by this random assignment and by comparison with the control condition so that cause-effect relationships can be established (Cash, Stanković, and Štorga, 2016).

One of the true experiment designs is the pre-test-post-test control group design where participants are randomly assigned to the experimental and control groups, the measurements are collected before, and after the stimulus, the effect of the treatment is found by the difference of the scores of each measurement, but the interaction effect is not controlled (Malhotra et al., 2017; Sekaran and Bougie, 2016).

In the post-test-only control group, the measurements are only collected once (any pre-test measurements are collected), which makes this design the most straightforward and most attractive of all (Cooper and Schindler, 2013). The difference between this design and the static group is that in this the participants are randomly assigned, overcoming the problem of DV variation before the presentation of the treatment (McDaniel Jr. and Gates, 2013).

The Solomon four-group is the complete design and the one that raises the least number of questions of internal validity, since it controls the interactive testing effects, besides the external variables (Campbell and Stanley, 1963; Sekaran and Bougie, 2016). This design involves four groups of subjects assigned randomly, with the advantage of mixing the pre-test-post-test control group and the post-test-only control group designs, and has as a disadvantage the time and resources that it requires (Malhotra et al., 2017).

7.2.2.1. Approaches to Experimental Design

One of the decisions that the researcher has to make, besides the choice of the type of experimental design, as described above, is the approach s/he intends to follow, i.e., if s/he chooses a between-subjects (Van Kerrebroeck, Brengman, and Willems, 2017), a within-subjects (Peterson, Wise, Ren, Wang, and Yao, 2017) or a mixed experimental design (Shao, Grace, and Ross, 2019).

Between-subjects design/Multiple group design/Nested design

In this type of approach, there are two groups: the experimental (where subjects are exposed only to one level of the factor/condition) and the control group, and the subjects are assigned to only one of the groups (Cunningham and Wallraven, 2011; Saunders et al., 2016).

This design allows the comparison of the effects of two or more groups in one or more DVs without any crossover effects between the conditions (Edmonds and Kennedy, 2017). By guaranteeing that each participant only sees one condition, it is ensured that there is no order of conditions and, consequently, there are no order effects (Cunningham and Wallraven, 2011).

Within-subjects design/Repeated measures design/crossed

In the within-subject design, there is only one group, and each participant is tested under all experimental conditions, either by exposure to multiple stimuli/different levels of treatment, or by answering several questions (Charness, Gneezy, and Kuhn, 2012). This design allows the collection of multiple data points over the study period, allowing the rate of change to be equated to a function of the treatment or time (Cunningham and Wallraven, 2011; Edmonds and Kennedy, 2017; MacKenzie, 2013).

In this design, the existence of a treatment effect can be tested by comparing different scores obtained within the same group of subjects (Maxwell and Delaney, 2018). Shao et al. (2019) used constructs such as the need for uniqueness or self-monitoring that were transformed into binary variables (high versus low) and subsequently used them as within-subject variables in their study.

This approach implies the existence of the impact of order effects, carryover effects (such as fatigue and familiarity), which can be overcome with a between-subject design, where there is another group that foresees all conditions, but in another order (Cunningham and Wallraven, 2011; Saunders et al., 2016).

The advantages of this approach are: to allow the use of smaller samples, to make more efficient use of the available sample, to remove variation of individual differences between subjects, to increase the power and accuracy of data and to gather more information (when compared with the between-subjects design) (Charness et al., 2012; Maxwell and Delaney, 2018).

The disadvantages of this approach are: threats to internal validity (issues of maturation, history, order/sequencing effects), exposure to learning effects, and fatigue effects

(Edmonds and Kennedy, 2017; MacKenzie, 2013; Maxwell and Delaney, 2018). However, order effects can be overcome through counterbalancing (creation of a group where the order of exposure of the stimulus changes) (Edmonds and Kennedy, 2017; MacKenzie, 2013; Maxwell and Delaney, 2018).

Mixed Experimental Design

The mixed experimental design combines the between- and within-subject experimental design.

In this, there is at least one between-subjects IV and one within-subjects IV, making two IV and three effects (Gamst, Meyers, and Guarino, 2008):

1) The main effects of between-subjects IV;
2) The main effects of within-subjects IV; and
3) The two-way interaction of the two previous effects.

7.2.3.Evaluation of the Experiment

> “The term "validity" denotes the scientific utility of a measuring instrument, broadly statable in terms of how well it measures what it purports to measure.” (Nunnally and Bernstein, 1994, p. 83)

The evaluation of the experience is related to a property of inferences – validity. It regards the quest for the approximate truth of inference to reality, which translates in the extent to which an experiment measures what the researcher wants to measure, i.e., whether or not the conclusions drawn by experience are accurate (Croucher and Cronn-Mills, 2015; Easterby-Smith et al., 2015; McDaniel Jr. and Gates, 2013; Shadish et al., 2002). Implicit in this concept is the need to eliminate/minimize the effects of external influences that may decrease the quality of results, i.e., reduce the systematic and random errors, since the goal is to increase the accuracy and usefulness of results, thus increasing quality and reliability of the study (Marczyk et al., 2005; McDaniel Jr. and Gates, 2013). Thus, validity concerns can be divided into: internal, external, ecological, statistical and construct validity (Campbell, 1957; Cook and Campbell, 1979; Marczyk et al., 2005).

7.2.3.1. Internal Validity

Internal validity refers to the extent to which the research design accurately identifies causal relationships, i.e. whether the effects observed in the subjects were caused by the treatment or if there was an influence of extraneous variables (Hair et al., 2017; Malhotra et al., 2017). Thus, the experimental design aims to maximise the validity of the control over extraneous variables (Easterby-Smith et al., 2015). The threats to the internal validity of the experiments are as follows (as per Campbell and Stanley, 1963; Malhotra et al., 2017; McDaniel Jr. and Gates, 2013; Sekaran and Bougie, 2016):

(1) **History:** relates to specific events that occur between the first and second measurements, or other events external to the experience that co-occur, and may cause changes in DV;

(2) **Maturation:** reflects the changes that occur in the test units due to the passage of time, which are not related to the experience *per se*, and can influence the response of the subjects to the treatment;

(3) **Testing effects:** these are caused by experimentation, before and after presenting the treatment. Thus, these may be main testing effects, when a previous observation affects a later observation, or interactive testing effects, when an earlier measurement affects the response of the test unit to treatment (these are not generalizable to the population. Consequently, they influence the validity experience);

(4) **Instrumentation:** related to changes in the measuring instrument, either in the observers or in the scores that can affect the measurements;

(5) **Statistical regression:** happens when test units with very extreme scores are approximated to the mean score during the experiment;

(6) **Selection bias:** this is due to the inadequate attribution of the participants to the treatments/conditions, reflecting systematic differences between the test and control groups;

(7) **Mortality:** refers to the loss of participants during the study, which may result in non-representativeness; and

(8) **Selection-maturation interaction:** occurs mainly in some multiple-group quasi-experimental designs, where the interaction with the effect of the experimental variable is confounded.

The extraneous variables pose a threat to the internal validity of the experiment. Therefore they should be controlled to study the effect of the IV on the DV (Malhotra et al., 2017; McDaniel Jr. and Gates, 2013; Sekaran and Bougie, 2016). There are four ways to control these variables (Malhotra et al., 2017; McDaniel Jr. and Gates, 2013):

(1) **Randomisation:** the random assignment of participants to treatments, which ensures their equitable representation by groups, allowing the cancellation of their effects;

(2) **Matching/physical control:** where the value of the extraneous variables is kept constant throughout the experiment by comparing a set of participants' key background variables before their assignment to the treatments;

(3) **Statistical control:** regards the measurement of variables and their respective adjustment through statistical analysis;

(4) **Design control:** consists of the use of an experimental design developed to control these types of variables.

7.2.3.2. External Validity

The external validity relates to the extent to which the causal relationships found in a study can be generalised beyond the focal objective of the same study, namely to other populations, contexts, times, IVs and DVs (Easterby-Smith et al., 2015; Hair et al., 2017; Malhotra et al., 2017; Shadish et al., 2002).

The sources of threats to this validity are related to the scenario/scope, history, or the fact that the specific set of experimental conditions do not take the interactions of other real-world variables into account (Hair et al., 2017; Malhotra et al., 2017).

Some of the factors that weaken external validity include (Campbell and Stanley, 1963; Cook and Campbell, 1979; Marczyk et al., 2005):

(1) **Reactive/Interaction effects of testing:** e.g., a pre-test that decreases the sensitivity and responsiveness of the subject to the experimental variable, i.e., the

fact of doing repeated measures can lead to the results becoming non-representative of the effect of the experimental variable;

(2) **Interaction effects of selection and treatment:** this risk is common when it is difficult to find subjects for the research, i.e., the risk of the subjects of the experimental and control groups being selected together;

(3) **Interaction setting and treatment:** when the data collected varies when we change the environment, i.e. when we cannot replicate a collection in another context;

(4) **Interaction history and treatment:** when the time at which the collection takes place influences the outcome;

(5) **Reactive effects of experimental arrangements:** refers to potential confounding variables that may influence participants as a result of knowing that they are participating in a research project. This may prevent the generalisation of the effects of the experimental variable on the individuals exposed in non-experimental environments;

(6) **Multiple treatment interference:** occurs when we apply multiple treatments to the same subjects, or when the same subject participates in more than one study since the effect of exposure to previous treatments cannot be eliminated;

(7) **Stimulus characteristics and settings:** the stimulus cannot be replicated even with another sample;

(8) **Novelty and disruption effects:** when the change in the test unit is originated by the singularity or novelty of the stimulus/situation and not by the IV.

Some ways to increase external validity include (Cook and Campbell, 1979):

(1) **Random sampling for representativeness model:** i.e., the use of significant and random samples of the population;

(2) **Model of deliberate sampling for heterogeneity:** where target classes of people, contexts and timings are defined, to guarantee that there is a variety of perspectives represented in the design;

(3) **Impressionistic modal instance model:** when the purpose is to explain the types of people, contexts or timing for which it is intended to generalise the results, and then select at least one case from each class that is impressionistically similar to the mode of the class.

7.2.3.3. Ecological Validity

The ecological validity of an experiment is related to the capability of the results obtained in a laboratory environment to be generalised for the real world (Marczyk et al., 2005). Thus, ecological validity is often confused with external validity, with many authors arguing that laboratory experiments lack external validity because one cannot replicate the lab results in the real world (Berkowitz and Donnerstein, 1982). Having said that, the fact that an experiment has external validity is a *sine qua non* condition of the existence of ecological validity. It means that the results obtained in an experiment can be the same if other subjects or contexts are used, guaranteeing the external validity, but these may vary if the experiment has been performed in the real world versus laboratory, not guaranteeing the ecological validity (Berkowitz and Donnerstein, 1982). Thus, the ecological validity differs from the external one insofar as the former specifies that the generalisation has to be from the results obtained in the laboratory to the real world.

7.2.3.4. Statistical Conclusion Validity

The statistical validity of the conclusion relates to the appropriate use of statistics that allows us to infer if the relationship between the IV and the DV would covariate, and how strong this covariation is (Cook and Campbell, 1979; Shadish et al., 2002).

Two types of error arise from inferences (Shadish et al., 2002):

(1) **Type I error:** where it is erroneously concluded that cause and effect would covary, while it does not happen; and

(2) **Type II error:** when it is erroneously concluded that this would not covary, although it actually does happen.

The threats to the statistical validity of the conclusion can be (Cook and Campbell, 1979; Maxwell and Delaney, 2018; Shadish et al., 2002):

(1) **Low statistical power:** refers to the possibility of incurring a Type II error when the sample is small and α is low, which may lead to the erroneous conclusion that the IV-DV relationship is not significant. This power can be increased by the use of matching, stratification or blocking; measuring and correcting for covariates,

or using the same sample size. The strength of the treatment can also be increased by improving the measurement, using a within-subject design, increasing the variability of the treatment. Groups of homogeneous participants can be selected to receive the treatment, decreasing the irrelevances of random configuration. Moreover, ensuring that robust statistical tests are used and that their assumptions are met are other ways to increase the strength of the treatment;

(2) **Violated assumptions of statistical tests:** violation of the assumptions of statistical tests may lead to an error in the estimation of the size and significance of the effect;

(3) **Fishing and the error rate problem:** The probability of incurring a Type I error increases with multiple comparisons, not recognising that there is a certain proportion of comparisons that is significantly different due to chance. So, the number of tests should be corrected;

(4) **Uncertainty of measures:** Measurement errors increase the standard errors of the estimates, which play a crucial role in inferring the differences between estimates. This unreliability can be controlled by the use of more extended tests or measures selected by their high intercorrelations, or by the use of more aggregated units (e.g., groups rather than individuals, because group averages are more stable than individual scores);

(5) **Restriction of range:** decreasing the amplitude of a variable weakens its relationship with another variable(s);

(6) **Unreliability of treatment implementation:** occurs when a treatment is designed to be applied in a certain way, and it is only partially applied to some participants. Alternatively, if different researchers apply it, it causes a lack of standardisation and, consequently an increase of variance errors while decreasing the chances of obtaining the actual difference

(7) **Extraneous variance in the experimental setting:** there are characteristics of the experimental environment that can alter the scores of the DV, increase the error of the variance, which makes it difficult to detect the effect;

(8) **Heterogeneity of units:** increased variability of DV under conditions increases the error of variance, which hinders the detection of the relationship, and involves additional procedures for its control;

(9) **Inaccurate effect size estimation:** some statistics systematically overestimate or underestimate the size of the effect.

7.2.3.5. Construct Validity

Construct validity is related to the basis of the causal relationship and to the congruence between the results of the study and the theoretical support that guides the research, involving inferences taken from a sample of individuals, for the higher-order constructs they represent (Marczyk et al., 2005; Shadish et al., 2002). The importance of construct validity relates to the theoretical concepts used in measurements and causal explanations since the purpose of constructs is to apply one or more measures whose results can be generalised to a broader class of measures having the same designation (Nunnally and Bernstein, 1994; Rosenthal and Rosnow, 2008; Vargas et al., 2017).

There are fourteen threats to this type of validity (Cook and Campbell, 1979; Shadish et al., 2002):

(1) **Inadequate explication of constructs:** the lack of a rigorous and clear explanation when an inadequate explanation of the construct makes the inferences made about the relation operationalisation-construct unfeasible;

(2) **Construct confounding:** the lack of completeness in the construct description leads to incomplete construct inferences. Thus, the researcher must control the construct to the maximum to be able to isolate the variable of interest from confounds;

(3) **Mono-operation bias:** the constructs must involve more than one operationalisation, to prevent the construct from being underrepresented or that it contains irrelevances that can affect the results. Thus, studies should be replicated to increase confidence in the construct;

(4) **Mono-method bias:** construct operationalisations should involve more than one method;

(5) **Confounding constructs with levels of constructs:** when the inferences about the constructs fail to represent all their levels, pre-test manipulations are advisable;

(6) **Treatment sensitive factorial structure:** the measurement structure can change as a result of the treatment, and the change can be hidden if the same score is always used;

(7) **Reactive self-report changes:** the self-report can be altered by the motivation of the subject participating in the experimental group, capable of being changed after the assignment is completed;

(8) **Reactivity to the experimental situation:** the subjects' responses are a function of the experimental context treatments, measurements and their perceptions;

(9) **Experimenter expectancies:** the researcher can also influence the response of subjects through poor management of expectations;

(10) **Novelty and disruption effects:** subjects do not all react in the same way to novelty and disruption, so these reactions must be included in the construct;

(11) **Compensatory equalisation:** when treatment entails desirable effects for those not receiving treatment;

(12) **Compensatory rivalry:** when subjects who are not exposed to the stimulus attempt to achieve the same benefits as those receiving the treatment;

(13) **Resentful demoralisation:** when subjects who do not receive treatment respond negatively to this fact;

(14) **Treatment diffusion:** when subjects are exposed to treatments other than those assigned, making it difficult to describe the construct and its conditions.

This validity can be improved through (Marczyk et al., 2005; Nunnally and Bernstein, 1994):

(1) An operational and concise definition of the concept/IV to be studied;

(2) Isolating constructs similar to those that the construct generated must be differentiated, determining to what extent observables measure the same thing, different things, or several different things, from empirical research and statistical analyses;

(3) Establish parameters or manipulations that mirror the construct of interest;

(4) Perform various manipulations of the IV to determine to what extent the construct measurements are consistent with the best guesses on the construct.

7.2.4. Control of the Experimental Environment

Experiments can be conducted in two types of environments: laboratory or field (Malhotra et al., 2017).

Laboratory experiments are conducted in an artificial environment, which entails its advantages and disadvantages (Hair et al., 2017), as shown in Table 7.4 (Bryman, 2012; Hair et al., 2017; Malhotra et al., 2017; McDaniel Jr. and Gates, 2013).

Table 7.4 - Advantages and Disadvantages of Lab Experiments

Advantages	Disadvantages
• Allows greater control of the variables (minimising the effects of history) and of the setting (allowing the replication of the conditions); • Eliminates other possible causal factors, allowing greater internal validity; • Reinforces the inference that a change in the experimental condition triggered a change in DV; • Uses a smaller sample for less time (making it less expensive).	• May cause the reactive error (i.e., the participants may react to the setting, not to the IV); • May cause artefacts (i.e., participants try to guess the purpose of the better and respond accordingly); • Raises issues of ecological validity, as it is difficult to generalise the results to the real environment.

In field experiments, the IV is manipulated to measure DV in the natural or real environment (Hair et al., 2017). The high level of realism achieved compromises the researcher's control over IV and extraneous variables since the researcher cannot control spurious factors that influence DV, compromising its internal validity, to the detriment of a higher ecological validity (Hair et al., 2017; McDaniel Jr. and Gates, 2013). Moreover, these experiments are more expensive in terms of resources and time (Hair et al., 2017).

It is noteworthy that external validity is only compromised depending on the generalised aspects, i.e., validity is only reduced if these aspects explicitly influence the manipulated variables (Malhotra et al., 2017).

7.2.5. Selection and Assignment of Participants

7.2.5.1. Population in Study

The population is the set of elements of interest to the researcher according to the research objectives, who have the information that the researcher intends to obtain, and on which the inferences will be made (Hair et al., 2017; Malhotra et al., 2017). In this research, the population under study is the Generation Z, also known as 'late millennial', 'post-millennials', 'centennials', 'digital natives' or Generation C (content), representing the group of young adults born from 1995-7 onwards (Dye, 2007; Smith, 2019; Southgate, 2017).

Generation Z is preceded by Generation X (born between 1965-1979) and Generation Y/Millennials (born between 1980-1994) (Van den Bergh and Behrer, 2016), the latter being the great propeller of the creation of platforms such as Facebook (created by millennial Mark Zuckerberg), Twitter, Instagram, Snapchat, Tinder, among other platforms widely used by Gen Z (Seemiller and Grace, 2019). For a summary of the key features of different generations, see Table 7.5.

Table 7.5 - Synthesis table of the different generational groups

	Baby Boomers	**Generation X**	**Generation Y/Millennials**	**Generation Z**
Birth Years	1946-1964	1965-1979	1980-1994	1995- onwards
Societal and Economical Context	Booming birth rate; Space Race; Vietnam War; ‘Sex, drugs & rock’n’roll’ age; Easy access to TV.	AIDS epidemic; Rise of violence; High divorce rate; Media ‘explosion’ (new TV technologies, VCR, videogames, fax, personal computer…).	The decline of the job market; High loan market; Raised by parents that micromanage their routine, Affordable technology; End of geographical barriers due to technology.	Large scale access to the internet; Always connected through smartphones; Gender and race diversity movements; The boom of Social Network Sites/and Streaming platforms
Main Characteristics	Individualistic; Strong work ethics; Competitive; Optimistic; Idealistic; Adaptive and Flexible.	Independent; Resourceful; Family-focused; Scepticism; Individualistic & Pessimistic.	Digitally connected; Focused on the self; Personal safety; Loyalty; Optimistic; Realistic; Critical and cynical; Appreciate diversity; Involved in family decisions.	Integrity; Openness; Creative; Spontaneous; Motivated; Driven.

Note: Adapted from Lancaster and Stillna (2002); Seemiller and Grace (2019); van den Bergh and Behrer (Van den Bergh and Behrer, 2016)

Generation Z is the first to be born with large-scale Internet access, cutting-edge technologies at affordable prices (smartphones, tablets, and laptops), social networks, streaming services (Spotify, Netflix, or HBO) (Bassiouni and Hackley, 2014). Thus, these are called cyber-savvy and multitaskers, because they are always connected to the world through their mobile devices (e.g. smartphones), not only for the purpose of communicating, interacting and creating content (as a way of self-expression), but also to buy, which creates the need for brands to generate different types of content to impact them (Dye, 2007; Smith, 2019; Southgate, 2017). Smartphones are Gen Zers' primary source of social action (through social networking), entertainment and information, shopping platform, and to interact with other consumers (Smith, 2019). These individuals are more likely to interpret visual representations, work better when connected, favour multi-tasking and work through parallel processes, and in real-time, demanding immediate information, action, and outcomes (Palfrey and Gasser, 2008; Prensky, 2001a; Smith, 2019).

Gen Z believes that diversity is a reflection of what they are, so they use digital customisation tools (like avatars, emojis, and gifs) as a way of communicating their identity that they manage online (Seemiller and Grace, 2019). Simultaneously, these individuals value financial stability, meaningful work, family and relationships, which are a source of motivation, whereas they are achievement-driven and passionate (Seemiller and Grace, 2019).

According to a biological point of view, this generation is also distinguished from previous ones when analysed in the light of the concepts of neuroplasticity (the capacity of the human brain to change throughout life, adapting to the different experiences) and malleability (the neuroplasticity process of adaptation) that require considerable amounts of time and focused attention. Thus, Prensky (2001b) argues that nowadays, given the high and constant exposure of young people from a young age to digital media, they develop and use different zones of the brain, while they think differently from previous generations (e.g., the response rate of young people to digital media stimuli is much faster than adults). These changes enable young people to focus on different aspects than previous generations, such as interactive and creative experiences (Prensky, 2001b).

In short, as Stacy Wood (2013) has identified, there are four significant trends for Gen Z as consumers:

(1) Innovation: they were born into a world with the Internet always accessible and experienced significant technological innovations. This young generation continually anticipates the arrival of technological gadgets;
(2) Convenience: Gen Z values the usefulness, ease of use and speed of goods/services;
(3) Security: due to the economic period they are going through, individuals born after 1995 tend to be more pragmatic and frugal, being more careful and more judgmental about their expenditures;
(4) Escapism: due to socioeconomic factors, and to the growing stress experienced by young people, they are more likely to try to escape from the reality that surrounds them, which is facilitated by new technologies such as VR and AR. These technologies are embedded in experiences and games accessible through smartphones and tablets, so this blend between real and virtual world allows them to enjoy experiences that are increasingly closer to their imaginary ideal.

The sophistication of this group leads to a readjustment of companies' marketing strategies, namely with the incorporation of smart technologies, not only in areas such as retail but also in awareness campaigns, so as to increase engagement (Priporas et al., 2017; Vallone et al., 2016). Moreover, Southgate (2017), in a study for Kantar Millward Brown that compares the Generations X, Y, and Z regarding the impact of advertising, argues that marketers should invest in the development marketing strategies focused on the media used by Gen Z, developing creative, co-creative, interactive and non-invasive experiences.

The youngest elements of generation Y and the older ones belonging to generation Z (ages 18-28) share a common technological trait, and they are digital-savvy. They also represent the current college population and are considered the individuals whose influence will soon be felt, not only because of their size but also because of their purchasing power (Fromm, 2018; IBM, 2018; Priporas et al., 2017; Smith, 2019).

Since the objectives of this research are related to the influence of the presence of third parties in the process of purchase of young adults, students of the University of Porto were selected as the target study population. Given the multiplicity of courses offered and the faculties involved therein (namely the Communication and Information Sciences courses involving the Faculties of Economics, Engineering and Fine Arts), we chose the Faculty of Arts (with approximately 3840 students enrolled[15]) as our sampling frame (i.e., the set of all sampling units eligible for the study).

7.2.5.2. Sample, Sample Size and Group Assignment

Given the size of the population and the investment in resources and time involved in analysing it in its entirety, it was decided to use a sample. The sample corresponds to a smaller group of members of the target population from which the researcher collects the data (Hair et al., 2017).

For reasons of appropriation for the type of study, convenience and costs, it was used a non-probabilistic sampling technique, where the probability of selecting each sampling unit is not known (Burns, Veeck, and Bush, 2017). Despite reasonable estimates of population characteristics can be obtained, the results obtained from this sampling technique are not statistically projectable onto the general population, although it is a more expeditious and more cost-effective technique (Burns et al., 2017; Malhotra et al., 2017). Additionally, this sampling technique depends on the knowledge and intuition of the researcher who decides which individuals to include in their research (Hair et al., 2017; Malhotra et al., 2017).

The most common non-probabilistic sampling techniques are the quota sampling, snowball/referral sampling, judgemental/purposive sampling, and the convenience sampling (Burns et al., 2017; Hair et al., 2017; Malhotra et al., 2017).

Taking into account the characteristics of the study, a **non-probabilistic convenience sample** was used. The convenience sample allows the researcher to select the sampling units included in the study according to convenience (Burns et al., 2017). This technique involves low costs of resources and time, allowing the recruitment of a large number of participants in a short period of time (Malhotra et al., 2017). However, this raises some questions like the difficulty of generalising the results for the defined population, as well

[15] Data related to the academic year of 2017/2018 (https://sigarra.up.pt/up/pt/conteudos_geral.ver?pct_grupo=887&pct_pag_id=122350&pct_parametros=p_pagina=122350). Accessed on May 4, 2019

as some bias derived from the way the subjects are included in the sample (Burns et al., 2017; Hair et al., 2017; Malhotra et al., 2017). Moreover, the representativeness of the sample cannot be obtained, given that one cannot compute the estimates of the sampling error (Hair et al., 2017; Malhotra et al., 2017).

In their overview of the experimental design methodology, Geuens and Pelsmacker (2017) argue that the sample should be large enough to ensure scientific relevance, but not large enough to compromise statistical relevance.

Kirk (2013) proposes several ways of estimating the size of the sample, varying in the quantity and simplicity of the information provided by the researcher, who can choose:

(1) Level of significance;

(2) The power (i.e., the probability of rejecting the false null hypothesis);

(3) The size of population variance; and

(4) The sum of the squares of the treatment effects of the population.

Some authors advance that fifteen is the minimum number of participants per predictor (Pituch and Stevens, 2016), whereas others state that in experimental designs in the behavioural area it is common to use 20 or 30 subjects per experimental condition (Geuens and Pelsmacker, 2017; Ogundimu, Altman, and Collins, 2016).

Another fundamental aspect to be considered in this chapter is the sample size, since it contributes to the power of the statistical test, together with the α determined by the researcher, and with the effect size, i.e., the extent to which the groups differ from the population in the dependent variable (DV) (Stevens, 2009).

In the case of this research project, a combination of factors was taken into account when determining the sample size, which had the net result of producing a mean value of 50 individuals per condition.

Thus, the sample consists of 304 students distributed in 5 experimental conditions ($n \approx 60$ subjects per condition) aged between 18 and 28 years old (Babbie, 2007; Geuens and Pelsmacker, 2017; Malhotra et al., 2017). One of the desirable characteristics of the research subjects is their group homogeneity, not only for the results to have higher predictive power, but also because it reduces the possibility of extracting false conclusions regarding the covariation between the variables (Calder, Phillips, and

Tybout, 1981). Since the sample translates into a homogeneous group, the next step was to randomly distribute the participants to the experimental groups - randomisation (Babbie, 2007).

7.2.6. Data Collection

7.2.6.1. Data Collection Instrument: Questionnaire

> "Although much progress has been made, designing questionnaires is still an art and not a science." (Iacobucci and Churchill, 2018, p. 342)

One of the instruments for collecting data in the experimental design methodology is the questionnaire, and its design must be carefully planned.

Geuens and Pelsmacker (2017, p. 88) advise a ten-step sequence in the design of this instrument in the context of experimental design which can be enumerated as follows:

(1) **Introduction/Briefing:** where the study or cover story, is introduced to the participants;
(2) **Manipulation:** exposure of participants to the stimuli;
(3) **Dependent Variables:** involves questions as to whether the constructs should be single or multiple items, what scale formats should be adopted, among others;
(4) **Quality Control:** development of mechanisms to ensure the quality of the data collected;
(5) **Mediating and Moderating Variables:** these must be controlled;
(6) **Potential Confounds - Filler Items:** must be controlled;
(7) **Manipulation Check**: verification of whether participants perceived the manipulation of the variables;
(8) **Sociodemographic**;
(9) **Suspicious Probes:** to check if participants believed in the cover story;
(10) **Debriefing:** the phase when the real objective of the research is explained and how the participants were manipulated.

One piece of advice given in the questionnaire design is the use (with due credit) of items from constructs already tested by other researchers, thus reducing the problems inherent to the formulation of questions and their pre-test, and allowing for the comparison of the data (when the target population is similar) (Bradburn, Sudman, and Wansink, 2004).

7.2.6.1.1. Quality of the Questionnaire: Pre-testing

One essential aspect of the design of a questionnaire is the assessment of its quality. The most common method for this assessment is the use of pre-tests (Saris and Gallhofer, 2014), and the need for its execution is vital, and it cannot be overemphasised (Iacobucci and Churchill, 2018; Warwick and Lininger, 1975) since the pre-test assesses the performance of the questionnaire under the same conditions as the data collection (Iacobucci and Churchill, 2018). Moreover, during the design of the questionnaire, the following aspects were taken into consideration to improve its response experience and rate (de Vaus, 2002; Fowler, 1995):

- The complexity of the questions: starting with more straightforward questions;
- Content of the questions;
- Type of responses, i.e., open versus closed; type of response scale;
- Formatting and clarity of instructions;
- The logical order of appearance of the issues: to reduce possible sources of error and bias.

The questionnaire consisted of the following elements: questions related to familiarity with mobile technologies and dematerialised purchase, the influence of third parties; AR experience, evaluation of the app, and the experience it provides; attitude towards AR, purchase intention using an AR app. It also included questions related to the assessment of the person's emotional state, physical store attachment, product involvement, and demographic questions.

Five and 7-points Likert scales were used (in the disagree-agree format) as well as 5-points semantic differential scales. The open questions related to information about the mobile applications that participants use and the AR applications the subjects already know.

PURPOSES OF PRE-TESTING

The pre-test is the final phase of the questionnaire design, prior to data collection, whose conduction allows the elimination of existing ambiguities, inconsistencies, concepts whose coverage is incomplete, revealing problems that the researcher did not foresee, and makes it possible to reformulate the questionnaire (Bradburn et al., 2004; Collins, 2003; Presser and Blair, 1994).

Pre-testing helps to guarantee the quality of the questionnaire at the individual level of questions (the way they are written - grammatical, semantic, lexical issues) and design (its sequence and structure). It is also relevant to the feasibility of its implementation, by allowing the researcher to grasp the difficulties that the person applying the questionnaire feels, and those felt by the person who responds it (Campanelli, 2008; Diamantopoulos, Reynolds, and Schlegelmilch, 1994; Iacobucci and Churchill, 2018; Presser and Blair, 1994).

At the level of the individual evaluation of the questions, the pre-test permits overcoming the following issues (Oksenberg, Cannell, and Kalton, 1991):

- the complexity of the sentences, their structure and formulation of the questions;
- clarify the respondents' understanding of the questions (in terms of vocabulary, semantics, lexical, phrasal structure and transmitted information);
- understanding of whether there is a shared comprehension and interpretation basis for different people.

The pre-test should also be performed and refined according to the insights collected during its administration under conditions equal to those in which the questionnaire will be performed (Bradburn et al., 2004).

PRE-TESTING METHODS

There are several types of pre-test, the most common of which are: (1) Conventional/Debriefing; (2) Behavioural/Interaction Coding, (3) Cognitive Methods/Interviews, and (4) Expert Panel/Reviews (Campanelli, 2008; Presser and Blair, 1994; Rothgeb, Willis, and Forsyth, 2007).

Conventional Pre-testing/Debriefing

Conventional Pre-testing/Debriefing is the most usual and straightforward way to perform the pre-test, which consists of conducting 15-40 interviews with potential questionnaire respondents, where they discuss their experiences (Czaja and Blair, 1996; Krosnick, 1999; Presser and Blair, 1994).

These sessions address the following issues (Czaja and Blair, 1996; Krosnick, 1999):

(1) Overview of the pre-test: where the respondents' sensitivity to specific topics and their resistance to participation is assessed;
(2) Question-by-question problem identification: where the interviewer questions the problems that the interviewees encountered in each item, from wording problems, issues that need to be better explained/clarified;
(3) Question-by-question suggestions for revision: where respondents give suggestions to overcome the problems mentioned above;
(4) Summary comments: it is a summary of the performance of the pre-test, highlighting the main themes that should be revised.

Another aspect that is also explored is the responses that respondents avoided/refused to answer (Krosnick, 1999).

Although the main advantage is to identify the problems raised with the interviewer, the main disadvantage is the feedback resulting from the interviewers' reports, that denotes a vision that is biased by their perspective and experience (Presser and Blair, 1994).

Behavioural/Interaction Coding

In these pre-tests, (real-time or recorded) interviews are conducted, where the interviewer/interviewee behaviour/interaction is coded in a systematic, objective and replicable way (Krosnick, 1999; Presser and Blair, 1994; Schwarz and Sudman, 1996).

Cognitive methods

Cognitive methods consist of applying the questionnaires through in-depth interviews, where particular attention is paid to the mental processes of the respondents during the answering of questions, attempting to perceive where their difficulties lie, especially at the level of the formulation, misinterpretation or lack of clarity (Campanelli, 2008; Willis, 2005).

Expert panel

The evaluation of the quality of the pre-test can consist of a review of the questionnaire by a panel of experts (Czaja and Blair, 1996). This method contributes to the improvement of the questionnaire as experts tend to be more sensitive in detecting problems with the instrument or to alert groups with a higher propensity for measurement errors, as well as stimulating the critical thinking of the person developing the questionnaire (Campanelli, 2008; Olson, 2010; Willis, 2005). It can stimulate the development of hypotheses to be tested with other methods.

The number of experts varies between two to eight (Czaja and Blair, 1996) or three to four (Campanelli, 2008). The great advantage of this method is that it is more efficient, cheaper, and more productive (Presser and Blair, 1994).

On balance, both behavioural/interaction coding and cognitive methods are resources-consuming methods that present low reliability (Krosnick, 1999; Presser and Blair, 1994). Moreover, more than one method for pre-testing the questionnaire should be used, representing a multi-method approach (Esposito and Rothgeb, 1997). In the case of this research, the following steps were taken to refine the research instrument (Campanelli, 2008, p. 197; Esposito and Rothgeb, 1997):

(1) Experts review: where the questionnaire was submitted to two experts from the scientific area related to the questionnaire topic; one expert in the elaboration of questionnaires and one expert who studies the target population of this study and;
(2) Debriefing carried out under the actual conditions in which the questionnaire will be applied, with 12 elements of the target population of the study between the ages of 20 and 21 years.

7.2.6.2. Pilot Test of the Experimental Design

After the qualitative pre-test of the questionnaire, the pilot test of the experimental design was carried out, which allowed the verification of the following aspects (Hauser, Ellsworth, and Gonzalez, 2018; Iarossi, 2006):

(1) Pre-test of the questionnaire in the actual situation in which it will be applied;

(2) Assessment of the duration of response times, the adequacy of the questionnaire, as well as the researcher applying it;
(3) Test of the experimental design, allowing for fine-tuning of certain aspects (like logistics or technological) for the final data collection;
(4) Verify if individuals with similar characteristics to the population in the study experienced the treatment effectively.

For this pilot test, a group of individuals similar to the potential participants of the study was used, namely in respect of demographic characteristics, familiarity with the theme, attitudes and behaviours (Burns et al., 2017).

This test involved 146 students from the University of Aveiro (67% female versus 33% male), aged M=18.83 (SD=2.018), who were invited to participate in the test. The participants were divided into groups or the isolation condition. Then, the students interacted freely with an AR mobile shopping app for 3-5 minutes, at the end of which they filled out a paper questionnaire. The total task time took a maximum of fifteen minutes.

About 39.7% of respondents said they had little experience with online shopping, with purchases made in the last year (25.3%). Individuals were very interested in using apps (28.8%), 43.8% used them for consultation in the last week, and 22.6% used apps in the last month to make purchases.

Another precautionary step taken with the pre-test of the questionnaire and that was decisive in the design of the final questionnaire was related to the validity of the instrument. To that end, the data collected were analysed using the IBM SPSS Statistics®, version 26. The Cronbach alpha (the most commonly used reliability measure) was calculated and items with values outside the range [0.65-0.90] were discarded because they raised questions regarding the internal consistency (DeVellis, 2016).

7.2.6.3. Final Questionnaire

After carrying out this pilot test, and since it is an experimental design, the questionnaire was adjusted to fit the experiment's typology. Then, the questionnaire was divided into two parts according to a logical order. For the final questionnaire, some elements were altered; namely, some issues related to the AR experience were eliminated, as well as those related to the assessment of the participants' emotional state, since these were found to be inoperative.

The number of questions was restricted to the essential to reduce the withdrawal rate of the study, as well as not to make the experience excessively time-consuming (Fowler, 2014)

Thus, the first part of the final questionnaire, distributed before treatment, consisted of seven groups of questions regarding the use of mobile apps, online shopping habits, familiarity with AR, product involvement, physical store attachment, and demographic issues. The second part (after interaction with the app) consisted of sixteen groups of questions that allowed the researchers to gauge the mental influence of others and their importance on buying decisions (family, friends, influencers, experts and online reviews). It also posited questions related to body image, the experience of the app (ease of use) and AR (related to the quality of the 'augmented' image, perceived augmentation, and perceived presence provoked by technology), attitude towards AR, purchase intention and mood assessment post-experience (see Appendix 1).

In the questionnaire design, five and 7-point Likert and semantic differential scales were used. The choice of the Likert scales (disagreement-agreement) is due to the fact that it is the most commonly used scale type, it is easy to develop, easy to understand, it is suitable for self-administered surveys; however it is time-consuming (since participants have to read the question and reflect upon them) (Hair et al., 2017; Malhotra et al., 2017). The use of a scale of 1-5 or 1-7 allows the existence of a midpoint/indifference, whose choice was accepted as valid.

The semantic differential scales used were five points (through a scale of 1 to 5), to which were associated with bipolar labels (adjectives) at the endpoints (Hair et al., 2017). The advantage of using these rating scales is their versatility, despite raising some questions regarding the type of data (Malhotra et al., 2017).

The type of questionnaire applied (pre- and post-treatment) followed the logic of the self-administered survey, which consisted of the participants reading the questions and completing them, without requiring the presence of an interviewer (human or computer) (Hair et al., 2017; McDaniel Jr. and Gates, 2013). The disadvantage of this method is that no one is present to clarify matters for participants (which may increase the risk of getting the wrong answers while believing they are responding correctly) (Cooper and Schindler, 2013; Malhotra et al., 2017; McDaniel Jr. and Gates, 2013). This can also be an advantage because it eliminates a source of bias, ensuring the privacy and anonymity of the subjects (Cooper and Schindler, 2013; Malhotra et al., 2017; McDaniel Jr. and Gates, 2013).

In the case of this experimental design, a distance between the researcher and the participants was ensured (so that the researcher did not enter the comfort zone of the participants), while allowing the subjects to clarify any doubts that might arise during the completion of the questionnaire. This method represents a reduction of costs (versus surveys via personal interviews), the respondent has control of the response (not being forced to leave his comfort zone), despite having limited topic coverage, since the researcher cannot delve too deeply into topics (a questionnaire should not take more than 10 minutes to complete) (Cooper and Schindler, 2013; Hair et al., 2017). There is also a risk of a high non-response rate (participants may not answer all questions, invalidating the questionnaire) (Cooper and Schindler, 2013; Hair et al., 2017).

One of the concerns in this type of questionnaire is the layout and design, which should be appealing, to increase the participant's engagement in responding, as well as the use of structured questions (usually dichotomous, scales or multiple choice) (Malhotra et al., 2017).

7.2.7. Experimental Procedure

7.2.7.1. Experimental Setting

The experimental sessions took place during April 2019 at the Faculty of Arts of the University of Porto. The sessions were conducted in a laboratory environment, equipped with 10-inch tablets, 1.50 m mirrors (which allowed full-body visualisation), 50 cm mirrors (which allowed only the person's foot visualisation) and fiducial markers. Potential sources of distraction, disturbance and noise were mitigated before the session, through the isolation of the participants during the interaction and the filling of the questions by separating them physically. The participants were divided into groups according to the treatments to be tested:

- **Mirror size:** full-length (1.50 m mirror) versus small (50 cm mirror);
- **Shopping Context:** unaccompanied versus accompanied, and
- **Type of app:** presence versus absence of online reviews.

Thus, there were five groups to test the mobile application:

1) 1.50 m mirror, unaccompanied, the app with reviews;
2) 1.50 m mirror, accompanied, the app with reviews;
3) 50 cm mirror, accompanied, the app with reviews;
4) 50 cm mirror, unaccompanied, the app with reviews; and
5) 1.50 m mirror, unaccompanied and the app had no reviews incorporated.

The precondition of having at least 30 observations per condition was fulfilled (Cohen, 1988; Hair et al., 2019). The test and questionnaire completion areas were isolated by a removable panel to avoid contagion effects.

The elements of the various treatments received upon arrival a brief explanation of the research and the steps involved in the experiment. They were given a document where they agreed to participate voluntarily in the research and filled out the first part of the questionnaire. After this stage, they were given instructions regarding the use of the app, and in the end, they filled out the rest of the questionnaire. Taking into account that this was a pre-test-post-test control group experiment, each participant was assigned an ID number which remained constant throughout the process.

The participants interacted with the app for 3-5 minutes, which is in line with the time used in other studies (Brito and Stoyanova, 2018), and the entire process took no more than approximately 15-20 minutes. After the questionnaires were delivered, the participants were debriefed, the real purpose of the research was explained to them, and they were thanked for their participation (Geuens and Pelsmacker, 2017). During this process, some field notes that served as a descriptive memory of the process were collected.

7.2.7.2. Procedure

To conduct this research, an application - Virtual Shoes (VS) – was developed to study the emotional and behavioural responses of consumers to social factors within an AR m-commerce experience.

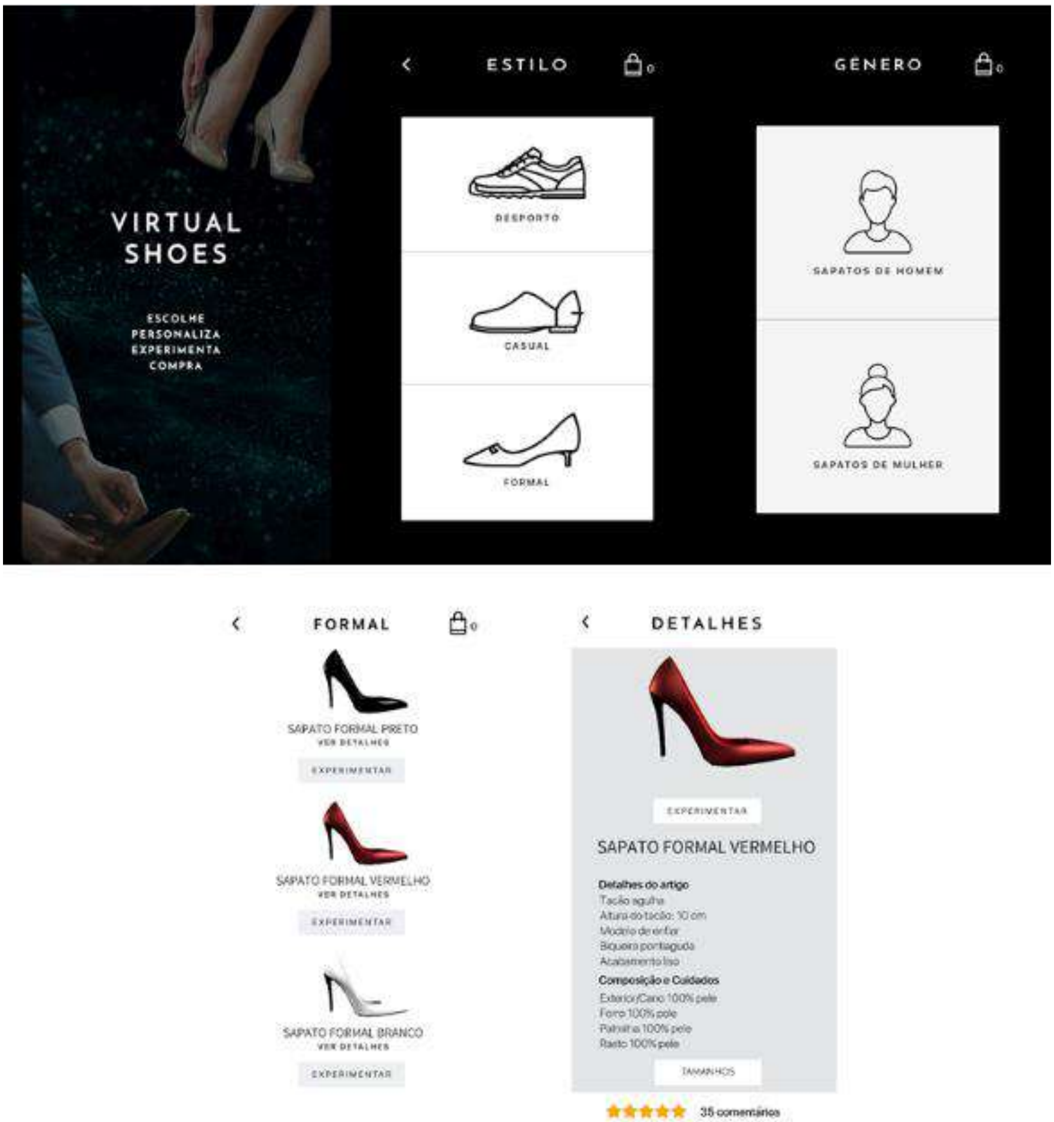
The tracking system of this app is marker-based, having been developed using the Vuforia Unity3D platform – the most used-platform to the development of games and XR experiences. Given the need for a marker, and since the purpose of the app is to allow the user to view the footwear on her/himself, a mirror was included in the experimental setup.

When designing the application, we paid careful consideration to the User Interface (UI), and User Experience (UX) questions so that the experiment would flow, without interruptions. So, after the activation of the app, the subjects selected the gender of the footwear that they intended to try on. Within each gender, they could choose three types of models, from which they could choose the colour they preferred.

When selecting the shoe, the subjects could see information about it, and they had the option to try on. All groups, except one, had access to reviews made by other users. Participants clicked on the TRY button and activated the app's AR mode, i.e. they activated the tablet's camera (Fig. 7. 6 presents the screenshots of the app). With the tablet’s camera pointed at the reflection of the fiducial marker in the mirror, the visualisation of the virtual shoe on the tablet was activated, and the image they saw on the tablet was their reflection in the mirror, with the shoe they chose superimposed on their foot.

In this AR mode, participants could adjust the size and position of the shoe with the designated buttons; they could change its colour, select the button with the text box to review and rate the shoe, or to select the photograph button to take a photo and send it by email to whomever they wished. Participants could also add the shoe to a shopping cart and from there, proceed to a simulation of the purchase.

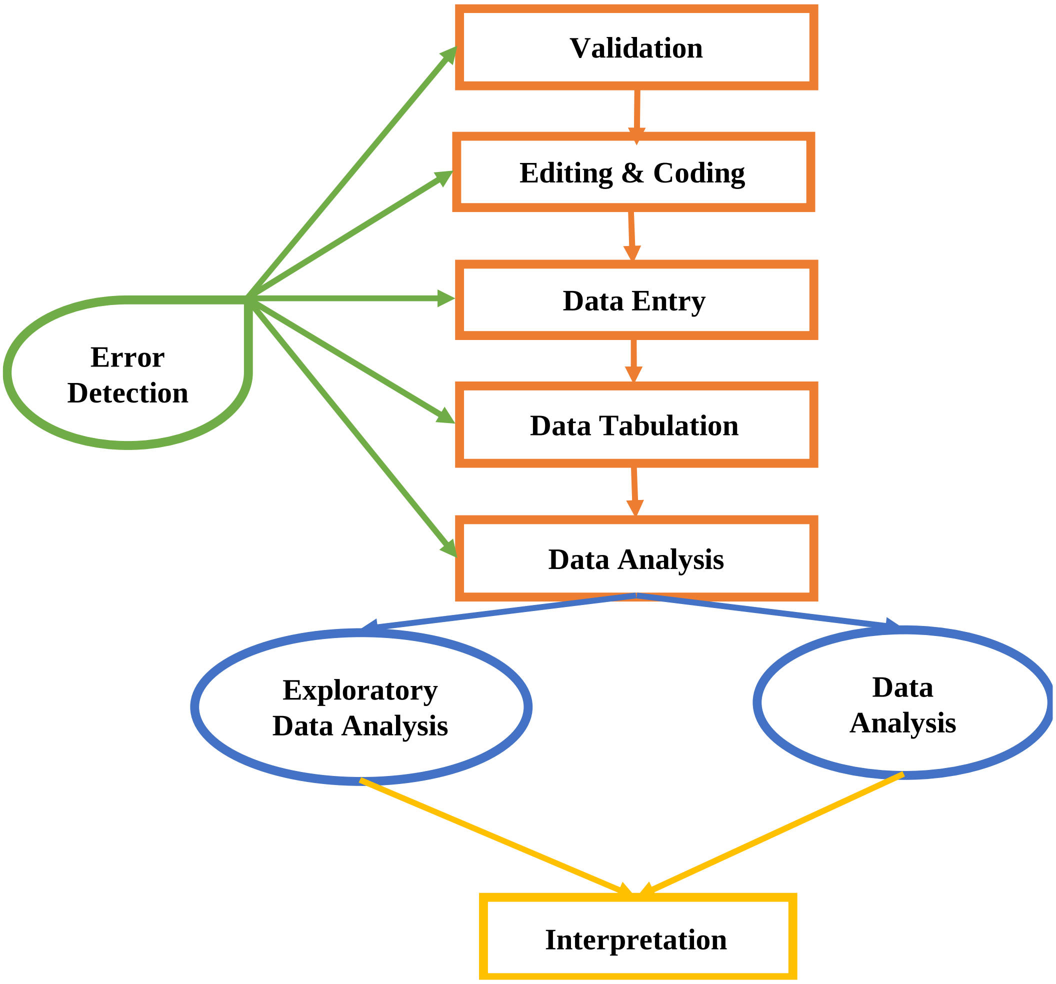
Fig. 7. 6 - Screenshots of the app



7.2.8. Data Analysis

After the data collection, the data was prepared, and the statistical analysis was conducted. The screening phase involved the validation, editing and coding the data, creation of the database and data tabulation. The statistical analysis regarded the exploratory data analysis and the data analysis in itself. A synthesis of this process is depicted in Fig. 7.7 (Malhotra et al., 2017, p. 248).

Fig. 7.7 - Summary of data preparation and analysis process



7.2.8.1. Data Preparation

Data preparation is the process that involves a series of steps that aim to guarantee the quality and integrity of the data (Hair et al., 2017; Malhotra et al., 2017; Marczyk et al., 2005).

Validation

The first step is validation, which aims to measure, as far as possible, if the data were collected correctly, without bias and fraud, and regards five aspects (Hair et al., 2017; McDaniel Jr. and Gates, 2013):

1) Prevent collected data from being fraudulent or falsified;
2) It involves a screening process, e.g. by including similar questions to gauge the consistency of responses;

3) Follows a pre-established collection procedure;
4) The data must be complete, i.e. the researcher should try to have the subjects give him the completed questionnaire in full; and
5) Ensure courtesy toward participants.

Editing and Coding

Editing or data screening is a process that consists of the revision of all the questionnaires, in order to verify if there is any error, omission, by the researcher or the participant, to increase data precision and completeness (Cooper and Schindler, 2013; Hair et al., 2017; Marczyk et al., 2005; McDaniel Jr. and Gates, 2013).

Some of the steps that comprise this phase include (Hair et al., 2017; McDaniel Jr. and Gates, 2013):

- Check that the questions are entirely answered, or if there are missing data;
- Verify that the researcher has correctly recorded all the answers, not letting any pass, or inserted, by mistake, in another place;
- Ensure correct screening, i.e., verify that questions have been asked and answered in the correct order;
- Ensure that open issues have been fully and accurately recorded.

Coding consists of assigning values (usually numerical, between 0-9) to the different answers of the questionnaire, and then inserting them into the statistical software used for data analysis (Hair et al., 2017; McDaniel Jr. and Gates, 2013). Regarding open questions, it is the assignment of a code, and its assignment to mutually exclusive categories, to which a numerical value is subsequently assigned (Cooper and Schindler, 2013; McDaniel Jr. and Gates, 2013).

Data Entry

The introduction of data occurs after the validation, editing and coding of questionnaires, and consists of the conversion of questionnaire information into an electronic format, i.e., construction of the database (Hair et al., 2017; McDaniel Jr. and Gates, 2013). In studies that use paper surveys, as in this case, the data is entered directly from the questionnaire, as well as the ID number of the questionnaire.

There are some precautions to be taken in this process, particularly regarding error detection, missing data and data organisation, usually performing data cleaning (checks of consistency and treatment of missing answers) (Hair et al., 2017; Malhotra et al., 2017). Thus, consistency checks are performed to identify data that exceeds the range, those that are logically inconsistent or that assume extreme values (Hair et al., 2017; Malhotra et al., 2017). These checks can be performed by software that performs error edit routines (Hair et al., 2017; Malhotra et al., 2017).

One of the crucial tasks at this stage is the treatment of missing data. These represent values of the variable that the respondent purposely or inadvertently did not respond to (Hair et al., 2017). There are four ways to overcome this situation (Hair et al., 2017; Malhotra et al., 2017):

(1) Substitution by a neutral value: when the midpoint of the scale is assigned. It does not interfere with the mean of the variable, and does not change the correlations significantly, among other statistics;
(2) Replacement by an imputed value: the following different logics can be followed in this case:
    a. Attribution of a value equal to that of another participant with the same type of response;
    b. Attribution of a value equal to that attributed in another question similar to that which was not answered;
    c. Assignment of a value resulting from the calculation of the mean of a sub-sample of individuals with similar characteristics.
(3) Casewise deletion: consists of the elimination of cases/individuals that present missing values of the analysis;
(4) Pairwise deletion: the researcher uses only the cases/participants with complete answers for each calculation. Thus, different calculations present samples with different dimensions. This procedure should only be used if we are dealing with large samples.

In this research, once it was ensured the condition of having at least n>50 per treatment, the casewise deletion strategy was followed, and seven individuals were removed from the initial sample of n=304 because they did not present the completed questionnaire.

It is also at this stage that the data to be analysed is processed. Thus, the following steps can be done (Malhotra et al., 2017; Marczyk et al., 2005):

- Re-specify variables, i.e., the data is transformed to create new variables or modify the pre-existing ones so that they are better suited to the research objectives;
- Reverse scale items;
- Data transformation: square root transformation, log transformation, and inverse transformation;
- Recode variables.

Data Tabulation

Frequency counting/tabulation allows researchers to gauge how many individuals answered each possible response scenario (McDaniel Jr. and Gates, 2013). Data tabulation can be one-way tabulation, where only one variable is analysed, or crosstabulation, where researchers compare the response with two or more variables simultaneously (Hair et al., 2017; Malhotra et al., 2017).

Although it is a descriptive statistic, the tabulation (when running in IBM SPSS Statistics) gives indications about missing data, determines valid percentages, and provides some summary statistics such as mean, mode, median, and standard deviation.

After this stage of data preparation, we started with a sample of 304 subjects and the final number of valid questionnaires to be used in the study was 264, as it can be seen on Table 7. 6.

Table 7. 6 – Number of subjects per experimental condition before and after data screening

Experimental Condition	$N_{initial}$	N_{final}
G1: Accompanied, full-length mirror, with ratings and reviews	63	56
G2: Unaccompanied, full-length mirror, with ratings and reviews	59	50
G3: Accompanied, small mirror, with ratings and reviews	60	53
G4: Unaccompanied, small mirror, with ratings and reviews	60	51
G5: Unaccompanied, full-length mirror, with **no** ratings and reviews	62	54
Total	304	264

7.2.8.2. Data Analysis Techniques

7.2.8.2.1. Exploratory Data Analysis

Descriptive statistics are techniques used to synthesise and describe data from a sample, analysing a variable (univariate analyses) in terms of (Hair et al., 2017; McDaniel Jr. and Gates, 2013; Vercruyssen and Hendrick, 2012):

(1) **Central Tendency Measures**, which include:

   a. Mean: the sum of the values of all the observations of a given variable, divided by the total number of observations;

   b. Median: value below which 50% of the observations fall, i.e., a measure that locates the centre of an ordered distribution of data;

   c. Mode: the value that occurs most frequently in a set of responses.

(2) **Measures of Variability**, such as:

   a. Range;

   b. Standard deviation;

   c. Variance.

(3) Measures of form, which are essential to understand the distribution of data, namely whether or not they follow a normal distribution (Cooper and Schindler, 2013; Field, 2018; Malhotra et al., 2017):

   a. Skewness: it allows the measurement of the deviation of the distribution concerning the symmetry, representing the propensity of the deviations to the average to be pronounced on one side or another;

   b. Kurtosis: is a measure of the relative flattening of the curve defined by the distribution.

Normal Distribution

It can be verified if a data set follows a normal distribution in two ways: a) the graphical representation and 2) numerically (Field, 2018):

   c. Graphic Representation

One can gauge whether a set of data follows the normal distribution, graphically by analysing histograms and Q-Q plots (Field, 2018; McDaniel Jr. and Gates, 2013;

Tabachnick and Fidell, 2014). In the case of Q-Q (quantile-quantile) plots, the deviation of the points of the diagonal line represents a deviation from normality (Field, 2018).

d. Numerical method

The numerical way of measuring the normality of a distribution can be through skewness and kurtosis (Field, 2018). The typical values of skewness and kurtosis that represent a normal distribution are zero, values of ± 1.0 are considered excellent for instruments, and values of ± 2.0 are also accepted (George and Mallery, 2019). Since the variables under study were constructed using Likert scales, we would exclude variables based on the value of skewness if no variance was recorded. If the values of kurtosis were outside the acceptable limits that could be a problem, although values of skewness and kurtosis between 2.0 and 3.0 would be flagged for later analyses.

Other tests that can be used to assess the normality of the distribution are the Kolmogorov-Smirnov and Shapiro-Wilk tests, which compare the scores of the sample with a set of scores that follows a normal distribution with the same mean and standard deviation and, whenever the test is not significant, it is indicative that the data probably follow a normal distribution (Field, 2018).

Notwithstanding the importance of having to follow a normal distribution, given that most statistical tests assume such a premise, especially in the social sciences, the fact that this does not happen does not necessarily present an issue (Pallant, 2016).

Checking for outliers

Checking for outliers is an essential pre-processing step since many statistical analyses are sensitive to these values (Pallant, 2016). Pallant (2016) identifies the following steps for the detection of these values:

- Histogram analysis;
- Boxplot analysis;
- Check if the scores are within the possible range of possible values for this variable;
- Analyse the descriptives' table to verify if the values are very different from the rest of the distribution;

In the end, to remove or not outliers, depends on the researcher's decision.

7.2.8.2.2. Data Analysis

Bivariate Statistics

The use of bivariate analysis allows researchers to determine the empirical relationship between two variables (Babbie, 2007; Vercruyssen and Hendrick, 2012).

The most frequent bivariate statistical tests are (as per Babbie, 2007; Hair et al., 2017):

(1) Crosstabulation/Contingency table: This is a statistical technique that describes the frequency of two or more variables, where the responses are tabulated, compared and their statistical significance is obtained through the chi-square test (Babbie, 2007; Burns et al., 2017; Hair et al., 2017; Malhotra et al., 2017). This test is easy to conduct and summarises the results in relation to subgroups and total. It is complemented by Chi-square Analysis because it allows understanding whether two or more measures are related (independence test) or whether the observed frequency distribution differs significantly from a hypothetical frequency distribution (goodness-of-fit test) (Burns et al., 2017; Field and Hole, 2003; Vercruyssen and Hendrick, 2012). This analysis is used or ordinal or nominal data (Marczyk et al., 2005; Vercruyssen and Hendrick, 2012).

(2) Bivariate Correlation Analysis: This measures the association between two variables, namely to what extent changes in one variable are associated with a change in another variable (Marczyk et al., 2005; McDaniel Jr. and Gates, 2013). The correlation is expressed by means of a value - correlation coefficient (r) - that varies between -1.0 to +1.0, with correlations in the order of |0.1-0.3| which would be considered weak; |0.3-0.7| are considered moderate; |0.7-0.9| are considered strong, and |>0.9| are very strong (Marczyk et al., 2005).

    a. According to the data type (interval/ratio versus ordinal), there are two types of correlation: Pearson's (for parametric data) and Spearman's rho (for nonparametric data) (Cooper and Schindler, 2013; Field and Hole, 2003).

(3) Comparison of means: used when comparing the means of two variables through, e.g., t-test (used when the sample has less than thirty elements, and the standard deviation is unknown).

Analysis of Variance (ANOVA)

ANOVA is the statistical test most frequently used in experimental designs, allowing the comparison of means in more than two groups or conditions, for the determination of the statistical difference between three or more means (Hair et al., 2017; Malhotra et al., 2017; Marczyk et al., 2005; Vercruyssen and Hendrick, 2012). For Gamst et al. (2008, p. 23) this analysis is “a statistical procedure that allows us to partition (divide) the total variance measured in the study into its sources or component parts.” Meanwhile, Kirk (2008, p. 394) defines ANOVA as “a procedure for determining how much of the total variability among scores to attribute to various sources of variation and for testing hypotheses concerning some of the sources.”

The null hypothesis (H0) for ANOVA is that the mean (average value of the dependent variable) is the same for all groups, and the alternative hypothesis (H1) is that there is at least one mean that differs from the others (Malhotra et al., 2017).

ANOVA analyses the variance of a given data set according to the logic that one calculates between-group variance, and we compare it to the within-group variance we can determine if the mean of the group is significantly different (Hair et al., 2017; Malhotra et al., 2017)[16].

In order to proceed to ANOVA, the DV should be metric, and the IV should be one or more categorical (non-metric) variable, also called factors or treatment (Malhotra et al., 2017). Additionally, three statistical assumptions should be met (Field, 2018; Gamst et al., 2008; Hair et al., 2019; Kirk, 2008; Malhotra et al., 2017) namely:

- Independence of the component errors/residual associated with IV and DV: achieved due to the random assignment of the subjects to only one experimental condition;
- Components errors should follow a normal distribution: the variables tend to present a normal distribution according to the Shapiro-Wilk test, the Normal Q-Q Plot, and within the analysis of the kurtosis values. It is noteworthy that ANOVA is not very sensitive to moderate deviations from normality, so some studies point that false positive rate is not overly affected by the violation of the

[16] The between-group variance measures how the means of the groups are different from the general mean, and the within-group variance measures how the groups vary from their own means.

assumption of normality (Glass, Peckham, and Sanders, 1972; Harwell, Rubinstein, Hayes, and Olds, 1992; Lix, Keselman, and Keselman, 1996; Refinetti, 1996); and

- Equality of variance between different levels/groups of IV, i.e. homogeneity of the variances or homoscedasticity: checked through the Levene's Test Homogeneity of Variances or the Brown–Forsythe/ Welch's adjusted F ratio.

Taking into consideration the relationship between the variables we can employ the following ANOVAs (Field and Hole, 2003; Hair et al., 2017; Malhotra et al., 2017; Marczyk et al., 2005):

(1) One-way ANOVA: When there is a single categorical factor/variable;
(2) Two-way ANOVA: This ANOVA is used when there are two IVs and different participants in all groups (each contributing only once to the data)
(3) MANOVA: A multifactor/multiple ANOVA is used when studying two or more IV/factors. The MANOVA allows the researcher to evaluate the main effects of each IV, plus the potential interaction between the combination of the IVs. This interaction effect occurs when multiple IVs act together, affecting the group means of DV. This type of analysis is frequently used in experimental designs with different stimulus levels.

After running a one-way ANOVA, we can run follow-up tests to conduct multiple comparisons or simultaneous measurement of confidence interval estimates of differences between means, comparing means two at a time (Hair et al., 2017).

Analysis of Covariance (ANCOVA)

ANCOVA is the statistical test that includes at least one categorical IV - factor - and an IV metric/interval - covariate (COV) (Malhotra et al., 2017). This test is used when it is necessary to take the influence of an IV (covariate/concomitant variable) that was not manipulated by the experimenter into account, but it can be observed together with the variation of the response variable (Montgomery, 2013; Rutherford, 2001). This analysis allows the inclusion of variables resulting from the individual/controlled differences of the subjects in the model in the study, which although not being the main objective of the research, can influence the results through interaction effects (Maxwell and Delaney, 2018).

This analysis is used for the following purposes (Tabachnick and Fidell, 2014):

- To enhance the sensitivity of the main effects and interactions tests, by decreasing the error term (it is adjusted for the relationship DV-COV). It increases the power of the F test, and it is used to assess the undesirable variance in the DV. It also reduces the within-group error variance by comparing the amount of variability of the data explained by the experiment against the variability it cannot explain;
- To adjust the means within the DV to the case where all respondents scored equally on the COV, thus eliminating confounds. This is mainly used when the researcher cannot randomly assign the participants to treatments.

The advantages of this analysis are that it reduces within-group error variance and the elimination of confounds/nuisance variables (Field, 2018).

ANCOVA uses the nuisance/variation created by extraneous variables, through the combination of regression-like and ANOVA procedures (Hair et al., 2019; Pituch and Stevens, 2016; Wildt and Ahtola, 1978). This way, ANCOVA removes the systematic error that the researcher does not manipulate, that can bias the results, and this accounts for differences in the responses due to inherent characteristics of the subjects, i.e., to reduce the within-group or error variance (Hair et al., 2019; Pituch and Stevens, 2016).

Given that "an effective covariate is one that is *highly correlated with the dependent variable(s) but not correlated with the independent variables*" (Hair et al., 2019, p. 398, emphasis in original), the correlation between the COV and the IV has to be minimal to ensure that the decrease of the explaining power of the reduction of the variance that could have been explained by the IV is less than the decrease of the unexplained variance attributable to the COV (Hair et al., 2019). Besides, it is desirable to use COVs which are correlated with the DV and which are not correlated with each other's (Tabachnick and Fidell, 2014).

To perform an ANCOVA, the following assumptions should be met in addition to those from ANOVA (Field, 2018; Pituch and Stevens, 2016):

- Linear relationships between the DV and COV
- Independence of covariate and the treatment effect: avoided by randomising the assignment of subjects to the experimental group;

- Homogeneity of regression slopes: the relationship between the DV and the COV is the same in each experimental group. This homogeneity is tested through the value of the test statistics of the interaction IV*COV, and if this value is significant, the assumption of the homogeneity of regression slopes is violated.

The null hypothesis underlying this test is that the adjusted population means are equal, and the alternative hypothesis is that there is at least one group whose mean is different (Pituch and Stevens, 2016).

Multivariate Analysis

The multivariate analysis consists of the simultaneous analysis of the relationships between more than two variables, representing an extension of the univariate and bivariate analyses (Babbie, 2007; Hair et al., 2019).

Factor Analysis (FA) and Principal Components Analysis (PCA)

Factor analysis (FA) is an interdependence technique that aims to reduce the size of the data into smaller factors or components and is used to analyse underlying patterns or relationships of a large number of variables, allowing for a better explanation of the data and its later application in other analyses (Conway and Huffcutt, 2003; Hair et al., 2019; Malhotra et al., 2017). In FA it is assumed that the observed variables are linear functions of latent variables, whereas in the Principal Component Analysis (PCA) the components are a function of observed variables, rather than latent variables (Denis, 2019).

As a result of the factorial analysis, depending on the extraction method selected in the statistical software, one can obtain the desired factors or components.

Principal Component Analysis (PCA) is another data reduction technique that does not require the data to follow a normal distribution and that the variables are related (Denis, 2019).

The difference between FA and PCA is that the objective of FA is to find which latent variables explain the relationship between the measured variables (Conway and Huffcutt, 2003), while PCA aims to reduce the number of variables through linear combinations that retain the maximum possible amount of the original variance of the measures (Conway and Huffcutt, 2003). Therefore, we use PCA in our study.

After the selection of principal components as the extraction method, PCA can be summarised in the following way: 1) to determine the number of components to retain; 2) to select the rotation method; 3) to interpret the rotated factor matrix; 4) to verify if there is a need to re-specify the factorial model; 5) validation of the factorial matrix; and 6) calculation of component scores (Hair et al., 2019).

To conduct a PCA, it is recommended to have at least five times more observations than the number of variables, and the sample should have more than 100 observations (Hair et al., 2019).

For the determination of the number of principal components (PC) to be retained, the following methods should be followed:

- Latent root (eigenvalue[17]) criterion: where components with an eigenvalue greater than one are retained (Hair et al., 2019).
- Scree plot[18] criterion: the elbow shape of the curve determines the number of components to retain (Cattell, 1966).
- Percentage of variance criterion: this criterion takes into account the percentage of variance extracted by successive components, ensuring that they explain a minimum value of variance, which in the case of Social Sciences is 60% (Hair et al., 2019).

After this step, the significance of the factor loadings[19] is ensured. For a sample with 250 elements, the minimum acceptable value is 0.35 (Hair et al., 2019). In addition to the loadings' number and size, we also examine the communalities[20] (Pituch and Stevens, 2016). If this value is between 0.40 and 0.70, there are good estimates for a sample of 200 individuals, and if the loadings are greater than or equal to 0.70, there are good estimates even for a sample of 100 individuals (Pituch and Stevens, 2016).

Two other values which are relevant when analysing the factorial solution are:

[17] Total variance explained by the component.
[18] It is the plot that relates the eigenvalues and the number of factors, in order of extraction.
[19] Correlation between variables and factors.
[20] The amount of variance on a variable accounted for by the set of factors

- Kaiser–Meyer–Olkin (KMO): this measurement shows the suitability of the data to the PCA by comparing the magnitude of the observed correlation coefficients with those of the partial correlation coefficients (Malhotra et al., 2017; Sharma, 1996). Thus, values below 0.50 are unacceptable, values between 0.50 and 0.70 are acceptable, and those greater than 0.80 are desirable (Kaiser, 1974; Sharma, 1996).
- Bartlett's test of sphericity: this statistical test is used in the identification and evaluation of the factorial solution, representing an objective assessment of the factorability of the correlation matrix (Bartlett, 1954; Hair et al., 2019). The hypothesis under study is that the variables are uncorrelated in the population, i.e., the correlation matrix of the population is an identity matrix where each variable perfectly correlates with its own but does not correlate with others (Hair et al., 2019; Malhotra et al., 2017). This test is used to examine the null hypothesis that all variables are uncorrelated in the population, and the higher the value of the test statistics, the greater the probability of rejecting the null hypothesis, indicating that correlations between pairs of variables can be explained by other variables (Hair et al., 2019; Thompson, 2004).

Reliability Analysis

"Reliability means that a measure […] should consistently reflect the construct that it is measuring" (Field, 2018). Therefore, **reliability analysis** allows us to assess the internal consistency between the multiple measurements of a variable, i.e. that the items of the scale measure the same construct and that they are highly intercorrelated (Churchill, 1979; Hair et al., 2019; Nunnally and Bernstein, 1994).

There are some considerations to be taken about the reliability analysis (Cronbach, 1951; Hair et al., 2019; Nunnally and Bernstein, 1994; Peter, 1979):

- That item-to-total correlation should exceed .50 and that the inter-item correlations should exceed .30; and
- Those related to Cronbach α (as explained below)

The most frequently used reliability measurement is Cronbach's coefficient alpha (α) because it lets us assess the quality of the developed instrument and construct validity (Churchill, 1979; Cronbach, 1951; Cronbach and Meehl, 1955). This measurement randomly splits the data into two; it computes the correlation coefficient for each split and averages it (Cronbach, 1951). Nunnaly and Bernstein (1994, p. 212, emphasis in original) define it as the "ratio of the sum of the covariances among the components of the linear combination (items), which estimates true variance, to the sum of *all* elements in the variance-covariance matrix of measures, which equals the observed variance".

Cronbach' coefficient alpha values range from 0 to 1. For samples with 300 or more observations, the accepted values are higher than 0.60 (Nunnally and Bernstein, 1994), notwithstanding, the most commonly accepted values for Cronbach's α are 0.70-0.80 (Field, 2018).

Clusters Analysis

Cluster analysis (CA) is a technique used to classify objects into groups with high internal homogeneity and external heterogeneity, i.e., similar to the elements of the same group and distinct from the elements of other groups, providing a reduction and summary of the data that facilitate its understanding (Hair et al., 2019; Malhotra et al., 2017).

In this research project, the non-hierarchical method K-means algorithm was used to dichotomize variables to characterise the sample and to run a logistic regression using the variables attitude towards AR and purchase intention as DV.

Logistic Regression

Logistic regression is a particular type of regression, similar to linear regression, used to predict and explain a binary categorical DV, and where the IVs can be both categorical and numerical (Hair et al., 2019; Hosmer Jr., Lemeshow, and Sturdivant, 2013). This type of regression has some advantages when compared with discriminant analysis, namely (Hair et al., 2019):

- It does not need to meet the assumptions of multivariate normality and the equality of the variance-covariance matrix;
- Its interpretation is similar to the linear regression one.

In the logistic regression model, the outcome/response variable of an individual (DV) can assume one out of two values, denoted by 0 and 1. As O'Connell (2006, p. 11) states, it "attempt[s] to model the odds of an event's occurrence and to estimate the effects of independent variables on these odds."

The model of this regression is $Logit\left(\hat{\pi}_j\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$, where β_0 is the intercept parameter and $\beta_1, \beta_2, \beta_k$ are the logit coefficients (Sharma, 1996; Tabachnick and Fidell, 2014).

To apply logistic regression, the following assumptions should be met (Field, 2018; Hair et al., 2019; Hosmer Jr. et al., 2013; Tabachnick and Fidell, 2014)

- The DV should be binary.
- The IV does not need to follow any specific distribution;
- Linearity: it does not require a linear relationship between IV-DV;
- Heteroscedasticity is not an issue;
- The logistic relationship addresses the nonlinear effects;
- Sample size: a minimum of 10 cases per IV;
- Outliers: extreme values should be removed from the database;
- Independence of error: this analysis assumes that the responses cases are unrelated/independent;
- Multicollinearity: logistic regression, like all regressions, is sensitive to multicollinearity (extremely high correlations among predictors).

To meet the first assumption, a cluster analysis, using the K-means algorithm, was conducted for the variables attitude toward AR and purchase intention after analysing their reliability. This step was included to allow the dichotomisation of such variables to be used as DVs on the logistic regression. This analysis segmented the sample among those who scored high/favourable (1) versus low/unfavourable (0) on both variables.

To estimate the binary logit model, and respective coefficients, the maximum likelihood method is used iteratively, “which selects coefficients that make the observed values most likely to have occurred”, thus maximising the likelihood of obtaining the observed frequencies/original data (Field, 2018; Hair et al., 2019; Malhotra et al., 2017; O’Connell, 2006; Tabachnick and Fidell, 2014).

The odds ratio [Exp(B)] represents the number of ‘success’ versus ‘failure’ when the IV increases one unit relative to the odds of ‘success’ versus ‘failure’ when the IV remains constant, indicating a change in odds as a result of the unit change in the predictor (Field, 2018; Menard, 2002). Whenever the odds ratio is greater than 1, it means that the odds of success increase with the increase of the IV, and the opposite happens when the odds ratio is lower than 1 (Field, 2018; Menard, 2002).

Assessment of model fit

The general statistical hypotheses to assess the overall fit of the model for the data are H0: The hypothesised model fits the data; H1: The hypothesised model does not fit the data (Sharma, 1996).

The most common measure of the model estimation fit is the log-likelihood (LL) which is multiplied by -2, creating the deviance statistic or the -2LL value that generates a quantity that can be used in hypothesis testing to compare to the R^2 of different models (Field, 2018; Hair et al., 2019; Hosmer Jr. et al., 2013). This value compares the differences between the null model (a baseline that only contains the intercept and from which the model fit improves) and the full/proposed/saturated model (which contains all the IVs included in the logistic regression model) (Hair et al., 2019). The model fit improves if the proposed model presents a lower -2LL value (Hair et al., 2019).

To test if the logistic regression model fits well the data, we analyse the Pearson X^2 or the likelihood-ratio (G^2) (Agresti, 2013). Another way to assess the model fit is through the Hosmer-Lemeshow test (X^2_{HL}) (Hosmer Jr. et al., 2013; Kleinbaum and Klein, 2010; Menard, 2002). According to Vittinghoff et al., (2012, p. 178) the rationale underlying this test is "forming groups of the ordered, estimated outcome probabilities […] and evaluating the concordance of the expected outcome frequencies in these groups with their empirical counterparts"; thus, an improved model fit corresponds to a smaller difference between the observed and the predicted classification (Hair et al., 2019). When the null hypothesis stated above is not rejected, it means that there is an agreement between the observed and the expected frequencies (O'Connell, 2006; Vittinghoff et al., 2012).

There are two other values of Pseudo R^2 that can be used to assess the model fit: Cox and Snell R^2 (R_{CS}^2) and the Nagelkerke R^2 (R_N^2) (Hair et al., 2019; Malhotra et al., 2017; Nagelkerke, 1991; Tabachnick and Fidell, 2014). If these values are over 0.50, it means that the model explains more than 50% of the variation between the levels of the DV (Hair et al., 2019).

Nagelkerke R^2 is sometimes preferred over the Cox and Snell R^2 because, by adjusting the Cox and Snell's value, it gets around the fact that the latter cannot equal 1.0, even when the model fit is perfect (Field, 2018; Malhotra et al., 2017; Nagelkerke, 1991; Tabachnick and Fidell, 2014).

Significance of the coefficients

The statistical significance of the coefficients is assessed through Wald's statistic (instead of the t-statistics of the linear model), and if the coefficient is statistically significant, it can be interpreted regarding its impact on the estimated probability (Field, 2018; Hair et al., 2019; Malhotra et al., 2017). However, this statistic should be used prudently because it tends to be underestimated, increasing type II error, especially when the b-value is large, the standard error tends to become inflated (Menard, 2002)

Still related to the coefficients is the directionality of the relationship. If the original coefficients were used (reflects changes in the log of the odds), their sign indicates the direction (a positive increases the predicted probability and a negative decreases the predicted probability) (Hair et al., 2019). Otherwise, if the analysed coefficients are the exponentiated ones [Exp(B)], they will reflect changes in the odds, where values above 1.0 represent a positive relationship, and values below 1.0 reflect a negative relationship (a value of 1.0 show no direction) (Hair et al., 2019).

The easiest way to assess the magnitude of change of metric IV is using the exponentiated logistic coefficients, where the percentage of change in odds equals: (Exponentiated coefficient - 1.0) × 100 (Hair et al., 2019). For nonmetric IVs, the equation is $Odds_{represented\ category}$ = Exponentiated coefficient × $Odds_{reference\ category}$ (Hair et al., 2019).

Two other values that are calculated when conducting a logistic regression are the measures of classification performance: specificity and sensitivity (Hosmer Jr. et al., 2013). These values are not used as measures of model fit because they rely heavily on the distribution of the estimated probabilities; however, they are used to compare the full versus the null model (Hosmer Jr. et al., 2013). Specificity regards the overall rate of correct classification given the values taken as 'failure' (e.g. low attitude towards AR or low purchase intention), while sensitivity pertains to the overall rate of correct classification given the values taken as 'success' (e.g. high attitude towards augmented reality or high purchase intention) (Hosmer Jr. et al., 2013).

7.2.9. Summary of Part II

In chapters 5, 6 and 7, we present all the steps that led and supported the methodological options and the ethical considerations involved.

In this research, we followed a mixed-methods approach, starting with a qualitative study (interviews) and then a pre-test-post-test experimental design (quantitative). This allowed us to fine-tune the strategy for data collection and hypothesis testing. In the case of our study, we used a between-subjects experimental design, where the IVs were the shopping context (presence versus absence of company), mirror size (full-length versus small), and app type (presence versus absence of reviews).

All methodological approaches used were duly justified, presenting their advantages and disadvantages, as well as decisions regarding sampling (methods and procedures). Particular attention was paid to the random assignment of the participants, to avoid introducing bias into the study and the generalisation of its results. We also implemented all the necessary precautions needed to increase internal and external validity.

Notwithstanding all these precautions, and despite having a representative sample of the population, it is advisable to carry out replication studies, not only to confirm the obtained results but also to demonstrate the minimisation of threats to external validity.

Part III

Data Analysis

Chapter 8 Data Analysis Results

In this chapter, we present the results of the data analysis. Firstly, we introduce the results of the qualitative study – interviews –, and from which the necessary conclusions were drawn in respect of the development of the quantitative study – experimental design.

The conduction of the interviews was crucial because they not only gave insights into how the experimental design should be operationalised, but also contributed to the discovery of new perspectives and new constructs that were not yet described in the literature, and which are relevant when devising an AR m-commerce experience.

Regarding the quantitative study, it begins with the exploratory data analysis (EDA), which includes the computation of the descriptive statistics and the identification of outliers. Then, we present more sophisticated data analysis techniques.

8.1. Qualitative results: Interviews

8.1.1. Sample and Procedure

The interviews were conducted at the School of Economics and Management of the University of Porto in February and March 2018. As such, 34 students were interviewed (16 females, 18 males), aged between 19 and 22 years old (M=19.5, SD=1.97). The participants' profile is described in Appendix 2.

This sample size was deemed appropriate, and it did not compromise the validity and reliability of the study, because the most frequent number of interviews per research ranges from 10 to 30 subjects, but also according to the criterion of saturation of topics (where conducting an additional interview yields neither additional nor novel knowledge to the study) (Glaser and Strauss, 1967; Kvale, 1996; Morse, 2012).

The average duration of the interviews was 40 minutes until the saturation point of the topics was reached (Glaser and Strauss, 1967), and because a shorter period of interview time is appropriate for younger interviewees (Seidman, 2013).

According to the guidelines for conducting semi-structured interviews as described in the literature, after the validation of a preliminary script, the interview script was developed to guarantee the data quality (Kvale, 1996). The protocol defined that the interview should begin with the interviewee giving informed consent to the investigator, to allow conduction and to audio-record the interview (Lune and Berg, 2017; Tracy, 2013). Then, the script that was followed consisted of five central questions. During the interviews, the standard practices of this research method were followed, and the interviews were conducted as follows (as per Brinkmann and Kvale, 2015; Lune and Berg, 2017; Spradley, 1979; Tracy, 2013):

(1) Introductory questions used to break the ice and to begin establishing rapport;

(2) Key issues, and after each of these we used probing, follow-up, and elicitation questions to validate and clarify more complex aspects (this process was repeated for each question), and

(3) Acknowledgement and reaffirmation of the confidentiality and anonymity of the participants.

After the initial questions, the participants were asked to interact with an AR app (the Virtual Shoes) which was developed for this research. This app allows the user to try different pairs of shoes, take a picture, share it (as in Fig. 8. 1), add to a cart, and eventually make a (fictitious) purchase. The user only needs to have a mirror, a fiducial marker (in this case, the sheet of paper shown in Fig. 8. 1), and a tablet with the application installed. The Augmented Reality (AR) experience begins when the user points the tablet camera towards the reflection of the marker in the mirror, and the environment is augmented with digital shoes (Kourouthanassis, Boletsis, and Lekakos, 2015).

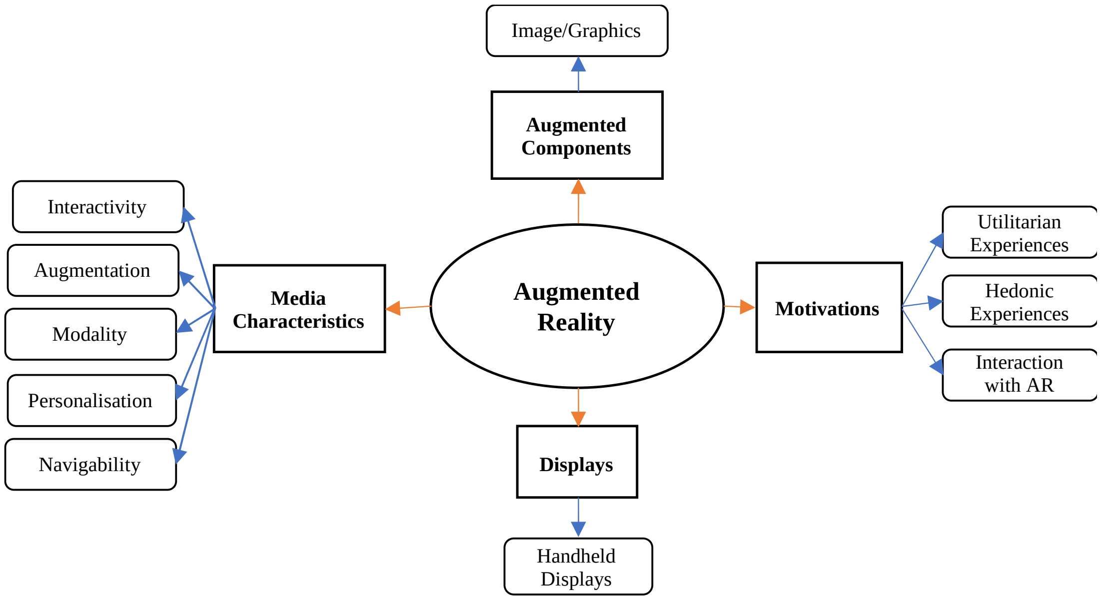
Fig. 8. 1 - The virtual shoe[21]

[21] This image shows what the participant could see when experiencing the AR app.

8.1.2.Results

Based on the results obtained by Roxo and Brito (2018), and given that the focus of the interview was a consumption experience, we developed the following mind-map, addressing the topics that were expected to be mentioned by the respondents (see Fig. 8. 2).

Fig. 8. 2 - Mind-map of expected topics



Media Characteristics

Since 2012, academics have focused their efforts on the study of interactivity and augmentation as the most salient media characteristics (MC) (Javornik, 2016b; Roxo and Brito, 2018). However, we found that navigability (i.e., how the user moves in a mediated environment, mainly if it is guided (Sundar et al., 2012)) is an MC whose influence is felt by consumers, namely those who regard intuitiveness highly.

> *"It could have some sort of text that appears on the screen to guide us. For instance, when pointing the camera to the mirror; what should appear is some instructions telling me to move forward or backwards..." (male, 20 years old).*

> *"Despite the fact I understood how the app worked, if it could 'augment' the instructions to guide us throughout the try-out process, it would be great!" (male, 19 years old).*

"Although the app was intuitive, I would feel lost if there were no previous explanation regarding how it worked… It should incorporate some guidance…" (male, 22 years old).

Augmented Components

Excellent image resolution was an emphasised topic because it is the most frequently augmented element. Image recognition was also mentioned because it is related to the authenticity of the experience, which image resolution enhances. Respondents further mentioned the affordance of automatic fitting as an aspect they value most.

<u>Image Resolution:</u> *"The image is neat; it has a high-definition… the shoe is a high-resolution image (...) [which] improves the experience." (male, 20 years old).*

"If the resolution of the shoe could be improved, it would help a lot the realism of the experience." (female, 21 years old).

"Something that could be improved is the resolution of the image… the higher, the better" (female, 19 years old).

<u>Recognition and Fitting:</u> *"If would be amazing if we could put our foot on the floor, we point the camera to the mirror, and then the shoe fitted our foot, and when we add it to the cart, the size would already be filled, meaning that the app recognised our real size by the reflection." (female, 20 years old,).*

"Regarding sizes and details, it would be great to point the camera, and we could see the shoe immediately adjusted to our foot and have the information about the size of the shoe we see on the app and its corresponding in real life." (male, 19 years old).

"An aspect that could be improved in the app is the foot recognition and immediate adjustment of the 'augmented' image with my shoe size, meaning if the app recognised my foot and overlapped an image and it was my shoe size, this would be life-changing…" (male, 20 years old).

Motivation

The analysis of the interviews showed that participants feel that new emerging technologies should fulfil the pre-requisite of convenience. Thus, AR must be employed by companies and brands to facilitate consumers decision-making process, avoid spending unnecessary time, to enable the creation of a personalised experience, thus accomplishing a utilitarian value (Roxo and Brito, 2018). Moreover, participants mentioned two other elements they value, related to the utilitarian feature of an app, that should be considered when developing technological solutions: intuitiveness and realism.

> Convenience: *"It contributes to the purchase decision because it is a confirmation of what we are buying." (male, 20 years old).*
>
> *"[The app] saves times in every aspect of it." (female, 21 years old).*
>
> *"This app not only is cool, but it also saves times, is easy to use, there is no big deal in using it, and it can be done anywhere and at any time. It is suitable for our busy daily life" (female, 20 years old).*
>
> Intuitiveness: *"It is intuitive; you can change colours and sizes easily. It's objective and only has the features that are needed, nothing more, and nothing less." (male, 20 years old).*
>
> *"It is very intuitive how you should use the app. We have fewer than half a dozen commands, and we can try the shoe." (male, 20 years old).*
>
> *"The app is highly intuitive. I could easily use it with no explanations" (female, 19 years old).*
>
> Realism: *"The shoe is a high-resolution image… that makes the experience more real." (male, 20 years old).*
>
> *"About the experience, it looks authentic. I can see myself with the shoe on." (female, 19 years old).*
>
> *"A better image leads to a more real and more authentic the experience, which improves the purchase likelihood" (male, 20 years old).*

Display

The display should be mobile, which is in line with the most closely studied AR displays. These displays allow consumers to be constantly accompanied by them (using a smartphone or a tablet), despite their inherent limitations (Chatzopoulos et al., 2017).

> *"We don't need many types of equipment, just a tablet, being in front of a mirror, and the marker." (female, 19 years old).*

> *"A great advantage of trying-out shoes this way is that it is portable so that we can do it anywhere." (male, 20 years old).*

> *"Trying out shoes using this app is awesome because anyone has a smartphone, so everyone easily reaches this technology." (male, 22 years old).*

EMERGING THEMES:

Tracking System

Turning attention to the tech-related category, the ideal AR experience would be a markerless (ML) one. ML AR is more interactive than marker-based (MB) AR, and the need for a fiducial marker interrupts the flow of the experience (Carmigniani et al., 2011). The ML preference is further confirmed by interviewees that attribute great importance to automatic recognition of the foot/marker. Moreover, interviewees agreed that this recognition should involve a sophisticated mechanism that allows the device to match the size of the image captured through the camera with the actual foot size.

> *"I was hoping that the app recognised my foot immediately…" (female, 20 years old).*

> *"As a user, I don't think that the need to have a marker is useful…Wouldn't it be better if I pointed the camera and the shoe appeared?" (male, 20 years old).*

> *"It is a bit awkward to try out a shoe on a black and white floor… it doesn't have the same effect as if it was a wooden one." (male, 19 years old).*

<u>Product-related attributes</u>

Product category was one theme that emerged from the analysis that was also linked to the product price. On the one hand, there are some categories whose purchase intention is more easily affected than others, for instance, shoes are seen as being more standardised products than clothes, which makes people more willing to buy them. Moreover, the price of the product category influences this decision to purchase certain product categories perceived as less expensive (like clothes and fashion accessories from fast-fashion brands) are more prone to be bought.

> *<u>Category:</u> "Buying shoes is not that complicated; it easier than buying clothes because the shoe size is more consistent." (male, 20 years old).*
>
> *"Shoes are a type of products whose size is more standardised and vary less across brands" (female, 19 years old).*
>
> *<u>Price:</u> "For me, shoes are a more expensive product [than clothes], so I'd need to try them on physically… it would be easier for me to buy cheaper products such as clothes, or makeup using an app such as this" (female, 20 years old).*
>
> *"I only buy cheap online products, and that happens with clothes… I've never found a good bargain for a pair of shoes" (female, 21 years old).*
>
> *"It all depends on the price, for instance, from the products that I buy online, shoes are more expensive than clothes. I would only buy a shoe if was sure the product would fit me" (male, 20 years old).*

<u>Brand-related attributes</u>

The theme of the brand has some connection with the product topic. As it was noted, well-known, and well-established brands were a decisive factor for a successful outcome of an AR experience. Companies with high brand awareness, with whom customers have past experiences, are perceived as more trustworthy and less risky than others. With the implementation of AR, brands will be able to foster consumer-brand relationships, leveraging customer engagement (Scholz and Duffy, 2018; Scholz and Smith, 2016).

> *<u>Previous Experience, Trust and Risk:</u> "With well-known brands consumers already have **some experience** with their models, their sizes … some are even*

*loyal customers, so that **trust** comes to the surface. Therefore, there are fewer **risks** associated with the purchase." (male, 19 years old).*

*"Obviously that if I **know** the brand, it is easier to purchase… I'm aware of its quality, I **trust** it… there are barely any **risks** of having a bad experience" (female, 19 years old).*

*"In this case, the fact that there is **a well-known brand endorsing** the app would be helpful, in the same way, it is for any e-commerce: it provides and endorsement to which we associate **trust** and **risk** reduction" (female, 22 years old).*

<u>Profile characteristics</u>

Drawing attention to the issue of the profile characteristics, we found, to a certain extent, a match between interviewees perceptions on Mobile AR (MAR) apps users and providers. Both AR users and providers are seen as innovators, future-oriented, practical, and e-commerce experienced. Whereas the average target of the apps is mostly made up of young adults who are tech-lovers, busy, practical and open-minded, companies that provide these apps have a strong market position, and high brand awareness, like Nike and Adidas.

<u>Users:</u> "There are two types of people who could use this app. One is those who are either lazy or busy, so they buy online. Other is the type of person that use virtual platforms because usually, in physical stores, there are fewer sizes than online and because when we order clothes and shoes online, we know that they weren't displayed in the store and that the odds of someone trying them are close to none." (female, 19 years old).

"The typical user would be someone who is used to online shopping, either because he/she prefers buying from the comfort of their home (to avoid crowds), or ubiquitously, either because online has more stock, shoes' sizes, the product arrive in better conditions…" (female, 22 years old).

"The average user would be someone practical, that is a skilled time manager, with shopping habits more or less established, and probably more girls." (male, 20 years old).

Providers: *"I think of brands that are more internationalised could have an app like this." (male, 22 years old).*

"I think Nike could provide this app; they are innovative enough for that; they have the innovation on themselves" (male, 19 years old).

"Perhaps companies that are already established in the market, with relatively high brand awareness." (female, 20 years old).

Social component

A MAR app can also fulfil a social-related need. If, on the one hand, the presence of rating and reviews influence customers' perceptions (von Helversen, Abramczuk, Kopeć, and Nielek, 2018), young consumers still face the need for validation, not only by their parents but also by their close friends. Respondents also mentioned the influence exerted by family and peers, who are perceived as key-elements in the purchase decision-making process, thus providing normative and informational influence (Deutsch and Gerard, 1955; Huang et al., 2012; Mascarenhas and Higby, 1993)

Validation: *"In a real-life scenario, I'd like to be able to share this picture with my mother to seek her advice." (female, 19 years old).*

"It would be fantastic if there were some wish list, where I could add the shoes I like, the size, colour, etc., and then could share it with my parents and they could 'authorise and pay' for the purchase or not" (male, 20 years old)

"It would be nice to able to share this photo. I'm not saying on Social Networks, but sending an SMS or a WhatsApp to my mother or my friend would help me to decide whether or not to buy" (female, 19 years old)

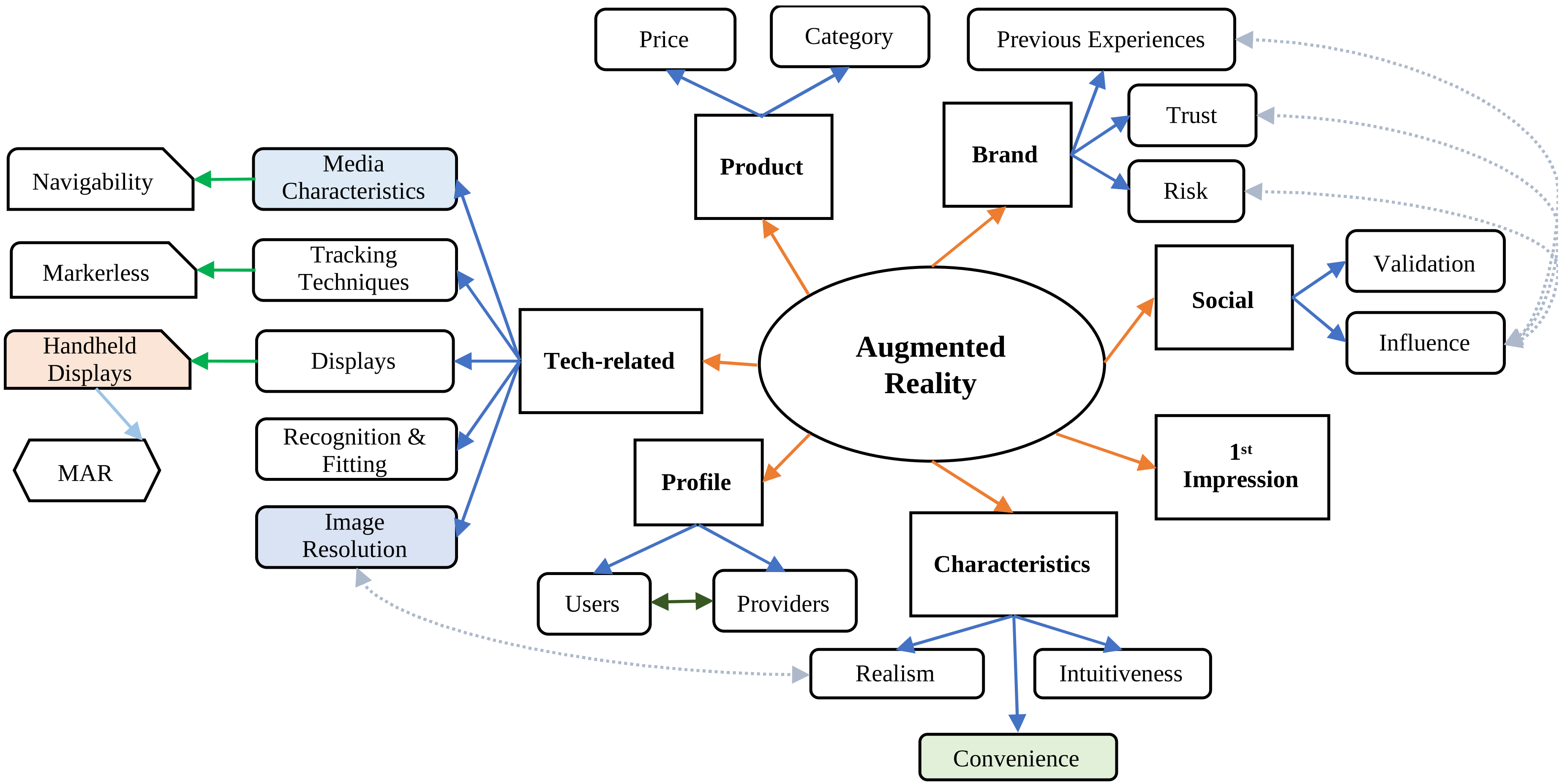
Influence: *"One thing that I value a lot is having [in the shopping platform] the feedback of other people that have bought the product, what did they think of the experience, how did it fit…?" (female, 20 years old)*

"Besides reviews, we could have the rating of the products, as Amazon does." (male, 20 years old)

"The incorporation of other's customers' reviews is essential when I am evaluating the shoes" (male, 22 years old)

Summing up, the results of the interviews are visually depicted in **Erro! Autorreferência de marcador inválida.**.

Fig. 8. 3 - Mind-map of the elements valued in an AR Experience



8.2. Preliminary Data Analysis

8.2.1. Exploratory Data Analysis (EDA)

The data were inserted in IBM SPSS v. 26® software to be treated statistically. Thus, in order to detect missing values, errors of respondents and individuals who had always responded the same way to all questions, a preliminary data analysis was conducted.

All the entries that had missing values due to non-completeness of the questionnaire or severe outliers were removed from the sample. Thus, about 13.16% of the questionnaires were deleted from the database ($N_{initial}$= 304; N_{final}=264).

After this stage, the descriptive statistics related to the measures of central tendency, dispersion and association were calculated (see Appendix 4). This analysis allowed the assessment of the applicability of parametric statistics in the subsequent analyses.

In relation to kurtosis, values near 0 indicate a normal distribution. Moreover, only kurtosis and skewness values between |2| and |3| were subjected to a later graphical analysis (Normal Q-Q Plot) (see Appendix 24). This analysis showed that the distribution tends to be normal (for more information about skewness and kurtosis values see Kline (2016)).

With regards to the association measures, the linearity of the variables to be used as the dependent (DV) and covariates (COV) in the covariance analysis was firstly assessed through scatter plots (see Appendix 5). Pearson's correlation coefficient was then computed (see Table 8. 1). Given the results obtained, it was decided to exclude the variable Digital Perceived Presence from further analysis.

Table 8. 1 - Pearson Correlations and respective significance[22]

	AR Expertise	Perceived Augmentation	Perceived Simulation	Real Perceived Presence	Digital Perceived Presence	Focused Attention
Attitude toward AR	.130**	.563***	.326***	.588***	-.049	.326***
	Mood	Autonomy	Others' Opinion			
Purchase Intention	-.370***	-.108*	.212***			

*** Correlation is significant at the 0.01 level (2-tailed); ** Correlation is significant at the 0.05 level (2-tailed); * Correlation is significant at the 0.1 level (2-tailed).

[22] Magnitude values: <0.10 => independent; [0.10-0.30[=> low magnitude; [0.30-0.50[=> medium magnitude, and >0.5 => high magnitude.

8.2.2.Sample Characterisation

After analysing the reliability of the variables, a cluster analysis using the K-means algorithm was conducted on the following variables: Product Involvement and Physical Attachment. This step allowed us to segment the sample among those who scored higher versus lower on both variables. After that, we conducted a crosstab's analysis, contrasting them with the gender of the participants, to further characterise the sample.

Therefore, this study involved 264 students from the University of Porto (55.7% female versus 44.3% male), aged M=20.49 (SD=2.269), who were invited to participate in the research. The use of students sample to grasp their relationship toward new technology is frequent because from a psychological perspective they tend to be early adopters of new technologies, and statistically because their homogeneity increases internal validity (Ono, Nakamura, Okuno, and Sumikawa, 2012).

From the 147 females surveyed, 72.8% were found to be attached to physical stores (versus 27.2%), and 60.7% of the males surveyed followed the same trend (versus 39.3% who scored low)[23]. In the context of product involvement, 58.8% of the female population was highly involved with the product sold in the app (versus 41.5%), whereas 44.4% of the male population was highly involved with shoes (versus 55.6%)[24].

Subjects were randomly assigned to 5 homogeneous groups in terms of gender and age:

- G1: N_{final}=56; Mean Age= 20.71; Std. deviation= 1.997; %female= 57.1%.
- G2: N_{final}=50; Mean Age= 20.62; Std. deviation= 2.663; %female= 54.0%.
- G3: N_{final}=53; Mean Age= 20.17; Std. deviation= 1.661; %female= 58.5%.
- G4: N_{final}=51; Mean Age= 20.24; Std. deviation= 2.178; %female= 52.9%.
- G5: N_{final}=54; Mean Age= 20.70; Std. deviation= 2.745; %female= 55.6%.

8.3. Quantitative Results: Experimental Design

8.3.1. Principal Component Analysis

Principal Component Analysis (PCA) is a dimension reduction technique, where each new variable is the result of a linear combination of the original variables (Sharma, 1996).

[23] $\chi^2(1, N= 264) = 4.347, p=0.037<0.05$

[24] $\chi^2(1, N= 264) = 5.161, p=0.023<0.05$

Thus, this statistical technique was used for the set of questions that emerged from the interviews, related to the mental and virtual presence of third parties, as well as for the set of questions related to the AR experience.

Mental and Virtual Presence

The theme of mental and virtual presence emerged from the interviews conducted in the qualitative study; thus, they were subjected to the PCA.

From the PCA with Varimax rotation applied to the 45 questions underlying this subject, ten principal components (PC) were extracted. All the items were in a 7-point Likert's scale.

The components obtained showed eigenvalue greater than one and explained approximately 71% of the extracted variance. The communalities obtained had values greater than 0.40, and the factor loadings were higher than 0.40, exceeding the minimum acceptable value, considering the sample size. Regarding the appropriateness of the data to the PCA through the Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO) a value of 0.844 was obtained, which is considered very good (Kaiser, 1974). Bartlett's sphericity test was also significant ($p<0.001$).

In this way, the first PC corresponds to family's opinion, PC2 relates to influencer's opinion, PC3 is online reviews influence, PC4 regards friends/peers' opinion, PC5 depicts sellers & experts opinion, PC6 is others' opinion, PC7 is autonomy, PC8 relates to esteemed one's opinion, PC9 is group acceptance (it only had one item; therefore, its reliability was not computed), and PC10 corresponds to negative reviews' influence.

AR Experience concepts

The concepts of AR experience that were subjected to a PCA were those related to the adapted scales of Augmentation (Javornik, 2016b) and Presence (Klein, 2003; Verhagen et al., 2014).

With regards to the **augmentation** one, a PCA with Varimax rotation to a set of 8 items elaborated in a 7-point Likert's scale was applied, and we obtained two PC with eigenvalues greater than one which explained about 60% of the extracted variance. The communalities showed values higher than 0.35 and factor loadings greater than 0.40, exceeding the acceptable minimum. The KMO Measure of Sampling Adequacy was

0.818, and Bartlett's test of sphericity was significative ($p<0.001$). so, we retained 2 PC. PC1 corresponded to Perceived Augmentation, and PC2 was the Perceived Simulation

As for **presence**, a PCA with Varimax rotation to a set of 6 items elaborated in a 7-point Likert scale was applied, and it was extracted two PC with eigenvalues greater than one that explained about 74% of the extracted variance. Communalities showed values greater than 0.50, and factor loadings were higher than 0.70 exceeding the acceptable minimum. The Bartlett's test of sphericity was significative ($p<0.001$), and the KMO Measure of Sampling Adequacy was 0.666. Therefore, two PCs were retained, where PC1 corresponded to the **real perceived presence**, and PC2 was the **digital perceived presence**. After this analysis, the novel concepts are defined as the position of the self within mixed realities, whereas **real perceived presence** is related to a position closer to the real world, the **digital perceived presence** is when the self feels closer to the virtual one.

Mood concept (Djamasbi et al., 2010; Lorr and Wunderlich, 1988; Mehrabian and Russell, 1974) consisted of seven items in a 5-point semantic differential scale, and this was also subjected to this analysis resulting in only one component was retained.

After we conducted the PCA, we created the new variables by computing the mean of the items.

The reliability of all the new variables will be computed in the following section.

8.3.2. Reliability Analysis

The dimensions used in subsequent analyses presented acceptable Cronbach α values higher than 0.70 (to see the values and the items that belong to each dimension see Table 8. 2 and Appendix 6).

Nonetheless, given the low-reliability value of the PC Negative Reviews Influence (0.179), this dimension was excluded from subsequent analyses. Moreover, in PC Family's Opinion, the item related to question 19.3 was also excluded because it increased the Cronbach α value from 0.789 to 0.897.

Table 8. 2 - Dimensions and respective Cronbach α

Dimension	Cronbach α
AR Expertise	0.924
Product Involvement adapted from Chandrashekaran (2004)	0.763
Physical Attachment adapted from Brocato et al. (2015)	0.802
Focused Attention adapted from Lin et al. (A. Lin et al., 2008) and Novak et al. (T. P. Novak et al., 2000)	0.948
Body Image adapted from Yim and Park (2019)	0.739
Family's Opinion	0.897
Influencers' Opinion	0.922
Online Review Influence	0.915
Peers/Friends' Opinion	0.911
Sellers & Experts Opinion	0.864
Others' Opinion	0.836
Autonomy	0.826
Esteemed Ones' Opinion	0.745
Negative Reviews Influence	0.179
Projection adapted from Laroche et al. (2005)	0.833
Perceived Augmentation adapted from Javornik (2016b)	0.778
Perceived Simulation adapted from Javornik (2016b)	0.800
Real Perceived Presence adapted from Klein (2003) and Verhagen et al. (Verhagen et al., 2014)	0.831
Digital Perceived Presence adapted from Klein (2003) and Verhagen et al. (Verhagen et al., 2014)	0.858
Attitude toward AR adapted from Yim et al. (Yim et al., 2017)	0.926
Purchase Intention adapted from Yim et al. (Yim et al., 2017)	0.888
Mood adapted from Djamasbi et al. (2010), Lorr and Wunderlich (1988), and Mehrabian and Russel (1974)	0.824

8.3.3. Experimental Design results

8.3.3.1. Manipulation Check

Manipulation checks, as mentioned previously, serve to verify whether the IV had the intended effect on participants; however, their use raises some controversial issues (Hauser et al., 2018). To this end, the three manipulated IV were checked:

1) Did you have someone at your side to share the experience of viewing the AR shoe with you? (unaccompanied versus accompanied)
2) How large was the mirror you used to try the app? (small versus full-length)
3) Did you find any product review in the app? (review versus no review)

Given that the answers were categorical, the analysis performed was Crosstabulation - Chi-Square Test.

All three manipulations were successful, and participants understood the circumstances under which the study was taking place. For the question of shopping context (unaccompanied versus accompanied) and Mirror size (small versus full length), we obtained a χ^2 (1, N= 264) = 264.00, p<.001. For the question relating to Online Reviews (review versus no review), we obtained a χ^2 (1, N= 95) = 95.00, p<.001. Thus, there is a 100% match between the imposed condition and the subjects' perception.

8.3.3.2. ANOVA and ANCOVA

This section presents the results of the effects of the manipulations performed on the subjects. Two statistical data analysis techniques were used to measure the analysis of variance (ANOVA) and the analysis of covariance (ANCOVA).

ANOVA

The analysis of variance is used to check whether there are statistically significant differences in the means of two or more independent (unrelated) groups (dependent variables - DV) caused by the effect of the independent variable (IV)/stimulus controlled by the researcher (Malhotra et al., 2017).

In this case, a one-way ANOVA was used since there was only one categorical variable/single factor which was used to test whether there were statistically significant differences between the following groups:

- Presence versus absence of peers (shopping context)
- Presence versus absence of reviews in the app
- Full-length mirror versus small mirror (mirror size)

ANCOVA

ANCOVA is a development of the ANOVA where one considers the effect of another IV (metric-scaled) which was not manipulated by the researcher but was measured – i.e., the covariate (COV) – adjusting the scores of the DV associated with the covariates (Malhotra et al., 2017; Tabachnick and Fidell, 2014).

Assumptions

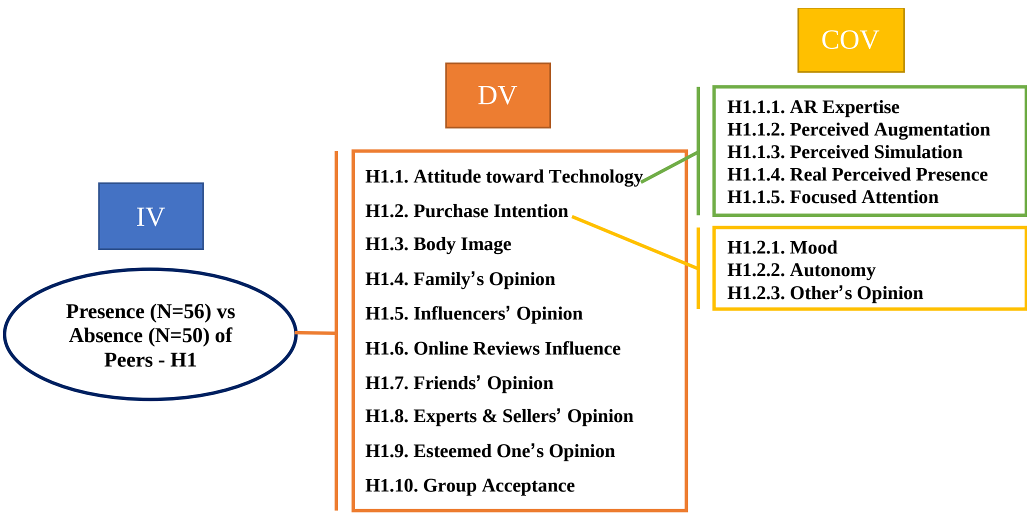
After analysing the linearity and the correlations of the relationships between DV-COV (see Table 8. 1), the normality of the distribution of the variables (through the numerical and graphical analysis, and Shapiro-Wilk test), we verified:

- Covariate homogeneity across factor levels (using ANOVA) (see Appendix 11), which was met;
- Variances homogeneity (assessed through Levene's test): almost all variables met this principle, and those two which did not the respective value was close to the significance 0.05 (Lix et al., 1996; Sharma, 1996); and
- Homogeneity of regression slopes (by analysing the interaction between IV*COV) (see Appendix 12).

8.3.3.3. Experimental Condition: Presence versus Absence of Peers

Now examining the issue of the experimental condition presence versus absence of peers, we applied an **ANOVA** to test the hypotheses related to the effect of the variation of the shopping context in how it affects the attitude toward the app (H.1.1), purchase intention (H.1.2) and body image (H.1.3) (see Fig. 8. 4).

Fig. 8. 4 - Relationship between variables for the experimental condition: Presence versus Absence of Peers



This statistical technique was also used to gauge whether the physical presence of peers interferes with the preconceptions/effects of the mental presence of others (H1.4-H1.10). Thus, hypotheses from 1.1 to 1.3. and 1.4 to 1.10 were tested, segmenting them according to the mirror size, i.e., the experimental condition is the variation of the shopping context (unaccompanied versus accompanied) when the subjects are facing a full-length mirror versus small mirror.

Regarding the normality of the distribution of the variables, they tended to follow a normal distribution according to the Shapiro-Wilk test, the Normal Q-Q Plot, and the analysis of kurtosis value. Therefore, when using a full-length mirror, the descriptive statistics for each group of **H1.1, H1.2 e H1.3** and the descriptive statistics of these hypotheses when facing a small mirror are presented in Appendix 13 and Appendix 14 respectively.

To the extent of how the assumptions of the ANOVA affected the analysis, not only was it verified the normality of the data distribution, but also the homogeneity of the variances through the Levene's test. In this test, only the purchase intention variable using the small mirror did not meet the principle of homogeneity of variances, because p>0.05 (see Appendix 15).

For the variables whose assumptions were met, an ANOVA test was then conducted, and the following results were obtained (see Table 8. 3):

Table 8. 3 - ANOVA results H1.1-H1.3

Variable	ANOVA	
	Full-length Mirror	**Small Mirror**
H1.1. Attitude toward AR	F (1,104) = 0.613; p = 0.435 > 0.05	F (1,102) = 0.350; p = 0.555 > 0.05
H1.2. Purchase Intention	F (1,104) = 0.754; p = 0. 387 > 0.05	F (1,102) = 0.103; p = 0.749 > 0.05[25]
H1.3. Body Image	F (1,104) = 0.584; p = 0. 447 > 0.05	F (1,102) = 0.051; p = 0.822 > 0.05

Since the assumption of homogeneity of variance was not met for purchase intention when using a small mirror, the Welch's adjusted F ratio F (1,95.736) = 0.104; p = 0.748>0.05 was used. This value was not significant, thus demonstrating that the means for the purchase intention were not significantly different comparing being alone versus accompanied when exposed to a small mirror.

At this point, there was no statistically significant difference between groups as a one-way ANOVA revealed. Hence, it was not rejected the statistical H0 that all means are equal. So, H1.1, H1.2, and H1.3 for both mirror sizes were rejected.

In the hypotheses **H1.4** to **H1.10,** it was tested whether the physical presence of peers interfered with the preconceptions/the effect of the mental presence of others. Thus, the

[25] The analysis here used was the Welch's Robust Test of Equality of Means, whose interpretation was given for F (1,95.736) = 0.104; p = 0.748>0.05 [H1.2., small mirror].

descriptive statistics for the full-length mirror can be found in Appendix 16, and those for the small mirror are in Appendix 17.

The principle of homogeneity of variances was verified through the Levene's test of Homogeneity of Variances (see Appendix 18).

For the variables whose assumptions were met, an ANOVA test was then conducted, and the following results were obtained (see Table 8. 4):

Table 8. 4 - ANOVA results H1.4-H1.10

Variable	ANOVA	
	Full-length Mirror	**Small Mirror**
H1.4. Family's Opinion	F (1,102) = 0.248; p = 0.619 > 0.05	F (1,102) = 0.312; p = 0.578 > 0.05
H1.5. Influencers' Opinion	F (1,102) = 0.860; p = 0. 356 > 0.05	F (1,102) = 1.759; p = 0.188 > 0.05
H1.6. Online Reviews Influence	F (1,102) = 0.027; p = 0. 869 > 0.05[26]	F (1,102) = 0.031; p = 0.861 > 0.05
H1.7. Friends/Peers' Opinion	F (1,102) = 0.607; p = 0. 438 > 0.05	F (1,102) = 0.126; p = 0. 723 > 0.05
H1.8. Experts & Sellers's Opinion	F (1,102) = 0.994; p = 0. 321 > 0.05	F (1,102) = 0.096; p = 0. 757 > 0.05
H1.9. Esteemed One's Opinion	F (1,102) = 0.220; p = 0. 640 > 0.05	F (1,104) =0.340; p = 0. 561> 0.05
H1.10. Group Acceptance	F (1,102) = 1.448; p = 0. 232 > 0.05[27]	F (1,104) = 0.041; p = 0. 840 > 0.05

Since the assumption of homogeneity of variance was not met for online reviews influence and for group acceptance when using the full-length mirror, it was used the Welch's adjusted F ratio [online reviews influence] F(1, 89.583) = 0.104; p = 0.871>0.05 and [group acceptance] F(1, 99.483) = 0.104; p = 0.327>0.05. This value was not significant for both variables, thus demonstrating that the means for the online reviews influence and group acceptance were not significantly different unaccompanied versus accompanied.

At this point, there were no statistically significant differences between groups as determined by a one-way ANOVA. Hence it was not rejected H0 that all means are equal. So, it was not found support for H1.4 - H1.10 for both mirror sizes.

[26] The analysis here used was the Welch's Robust Test of Equality of Means, whose interpretation was given for F (1, 89.583) = 0.104; p = 0.871>0.05 [H1.6., full-length mirror].
[27] The analysis here used was the Welch's Robust Test of Equality of Means, whose interpretation was given for F (1, 99.483) = 0.104; p = 0.327>0.05 [H1.10., small mirror]

In relation to the experimental condition of presence versus absence of peers, the results of **ANCOVA** are presented in Table 8. 5, and it was found that AR Expertise was significantly related to Attitude toward AR when the significance level (α) was 0.1 (for both mirror sizes). Nevertheless, Perceived Augmentation, Perceived Simulation, and Real Perceived Presence were significantly related to Attitude toward AR when α was 0.001 (for both mirror sizes).

However, no statistical evidence was found to attest to a significant effect of the shopping context (unaccompanied versus accompanied) on subjects' attitude towards AR controlling for their AR Expertise, Perceived Augmentation, Perceived Simulation, Real Perceived Presence, and Focused Attention (for both mirror sizes).

Concerning the relation between the COV and Purchase Intention, it was found that Mood was significantly related to it (for both mirror sizes) (α=0.001), whereas Autonomy and Others' Opinion were significantly related when using the full-length and the small mirror, respectively.

Once again, no statistical evidence was found to the effect of the shopping context (unaccompanied versus accompanied) on subjects' purchase intention controlling for Mood, Autonomy, and Others' Opinion (for both mirror sizes).

Table 8. 5 - ANCOVA results

Hypotheses		**Experimental condition: Shopping Context**					
		Full-length Mirror			**Small Mirror**		
		Result	**Partial η^2**	**Observed Power**	**Result**	**Partial η^2**	**Observed Power**
H1.1.1. AR Expertise	COV	F (1,102) = 3.872; p = 0.052*	0.036	0,496	F (1,101) = 3.344; p = 0.070*	0.032	0.441
	IV	F (1,102) = 10.538; p = 0.465 >0.05	0.005	0.112	F (1,101) = 0.099; p = 0.753 >0.05	0.001	0.061
H1.1.2. Perceived Augmentation	COV	F (1,102) = 78.806; p = 0.000***	0.433	1.000	F (1,101) = 45.761; p = 0.000***	0.312	1.000
	IV	F (1,102) = 0.067; p = 0.796 >0.05	0.001	0.058	F (1,101) = 0.07 p = 0.940 >0.05	0.000	0.051
H1.1.3. Perceived Simulation	COV	F (1,102) = 20.471; p= 0.000***	0.166	0,994	F (1,101) = 18.244; p = 0.000***	0.153	0.988
	IV	F (1,102) = 0.306; p = 0.581 >0.05	0.003	0.085	F (1,101) = 1.569; p = 0.213 >0.05	0.015	0.237

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level.

Table 8. 6 - ANCOVA results (continued)

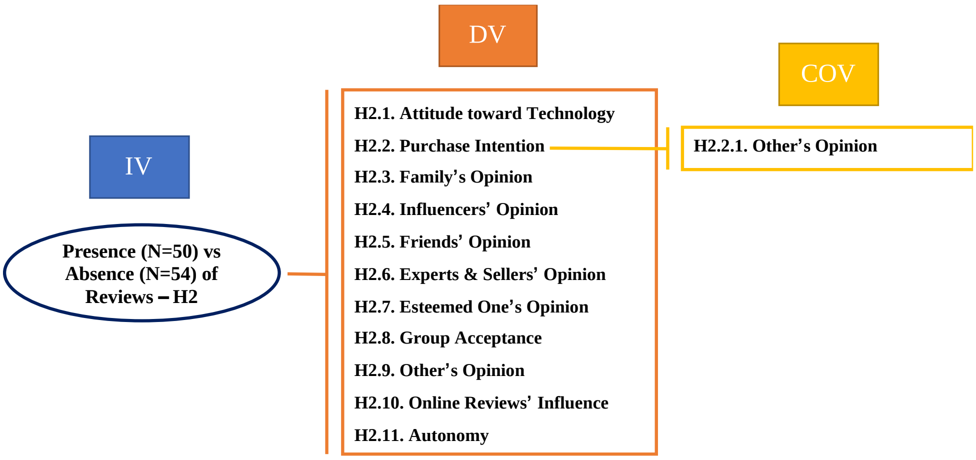
Hypotheses		Experimental condition: Shopping Context					
		Full-length Mirror			Small Mirror		
		Result	Partial η^2	Observed Power	Result	Partial η^2	Observed Power
H1.1.4. Real Perceived Presence	COV	F (1,102) = 65.008 p = 0.000***	0.387	1.000	F (1,101) = 54.784; p = 0.000***	0.352	1.000
	IV	F (1,102) = 0.293; p = 0.590>0.05	0.003	0.083	F (1,101) = 0.178; p = 0.674 >0.05	0.002	0.070
H1.1.5. Focused Attention	COV	F (1,102) = 6.509 p = 0.012**	0.059	0.715	F (1,101) = 54.784; p = 0.000***	0.352	1.000
	IV	F (1,102) = 0.287; p = 0.593>0.05	0.003	0.083	F (1,101) = 0.178; p = 0.674 >0.05	0.002	0.070
H1.2.1. Mood	COV	F (1,102) = 17.362; p = 0.000***	0.144	0.985	F (1,101) = 13.989; p = 0.000***	0.122	0.959
	IV	F (1,102) = 0.744; p = 0.390 >0.05	0.007	0.137	F (1,101) = 0.205; p = 0.652 >0.05	0.002	0.073
H1.2.2. Autonomy	COV	F (1,102) = 0.426; p = 0.515 >0.05	0.004	0.099	F (1,101) = 5.886; p = 0.017**	0.055	0.671
	IV	F (1,102) = 0.790; p = 0.376 >0.05	0.008	0.142	F (1,101) = 0.145; p = 0.704>0.05	0.001	0.066
H1.2.3. Others' Opinion	COV	F (1,102) = 7.178; p = 0.009**	0.065	0.756	F (1,101) = 2.081; p = 0.152	0.020	0.298
	IV	F (1,102) = 1.644; p = 0.203 >0.05	0.016	0246	F (1,101) = 0.074; p = 0.786 >0.05	0.001	0.058

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level.

8.3.3.4. Experimental Condition: Presence versus Absence of Reviews in the App

Hypotheses **H2.1** and **H2.2** tested whether the presence (versus absence) of reviews interfered with Attitude toward AR and Purchase Intention. The hypotheses **H2.3** to **H2.11** tested whether the presence (versus absence) of reviews interfered with the preconceptions/effect of the mental presence of others (see Fig. 8. 5). As such, the descriptive statistics can be found in Appendix 19.

Fig. 8. 5 - Relationship between variables for the experimental condition: Presence versus Absence of Reviews in the App



The assessment of the principle of homogeneity of variance was achieved by using the Levene's test of Homogeneity of Variances (see Appendix 20).

For the variables whose assumptions were met, an ANOVA test was then conducted, and the following results were obtained (see Table 8. 7):

Table 8. 7 - ANOVA results H2.3-H2.8

Variable	ANOVA
H2.1. Attitude toward AR	F (1,102) = 4.968; p = 0.028 **< 0.05***
H2.2. Purchase Intention	F (1,102) = 2.350; p = 0.128 > 0.05
H2.3. Family's Opinion	F (1,102) = 0.069; p = 0.793 > 0.05
H2.4. Influencers' Opinion	F (1,102) = 0.002; p = 0. 964 > 0.05
H2.5. Friends/Peers' Opinion	F (1,102) = 0.008; p = 0. 931 > 0.05
H2.6. Experts & Sellers's Opinion	F (1,102) = 0.050; p = 0. 824 > 0.05
H2.7. Esteemed One's Opinion	F (1,102) = 0.007; p = 0. 934 > 0.05
H2.8. Group Acceptance	F (1,102) = 3.934; p = 0. 050 = 0.05[28]
H2.9. Other's Opinions	F (1,102) = 0.119; p = 0. 731 > 0.05
H2.10. Influence of Online Reviews	F (1,102) = 0.442; p = 0. 508 > 0.05
H2.11. Autonomy	F (1,102) = 0.095; p = 0. 759 > 0.05

Since the null hypothesis (H0) of the ANOVA is that all means are equal, and H0 was not rejected, there is no statistically significant support to the contention that there is an experimental group whose mean is different from the remaining. Thus, it was found support for the hypotheses **H2.3-2.7** and **2.9** that the presence (versus absence) of reviews

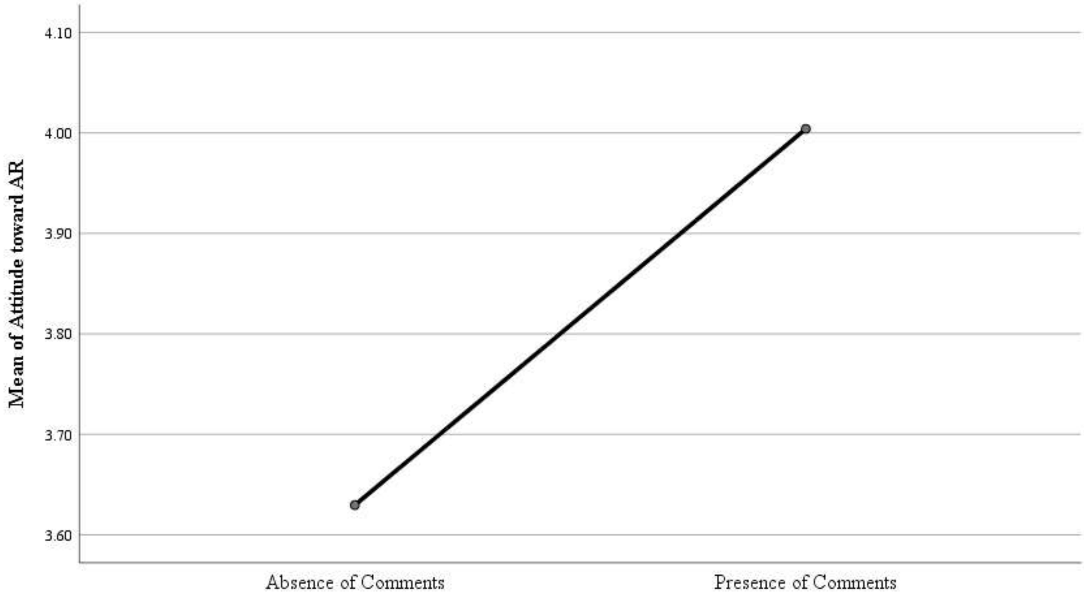
[28] The analysis here used was the Welch's Robust Test of Equality of Means, whose interpretation was given for F (1, 80.212) = 4.117; p = 0.046<0.05 [H2.8.].

does not make the mental influence of others vary when exposed to an app with or without reviews.

Since the assumption of homogeneity of variance was not met for group acceptance (**H2.8**), Welch's adjusted F ratio was used: F (1, 80.212) = 4.117; **p = 0.046<0.05**. This value was statistically significant; therefore, it was found that the means for group acceptance were different across conditions (presence versus absence of reviews). This means that the fact that the mean for group acceptance is higher in the absence (versus presence) of reviews in the app is statistically significant.

Regarding the **H2.1**, ANOVA's H0 was rejected. Thus, there is statistically significant evidence that the groups are significantly different from one another. So, in the presence (versus absence) of reviews, the subjects' attitude towards AR is more favourable (see Fig. 8. 6).

Fig. 8. 6 - Means plot for Attitude toward AR



Examining the issue of **H2.2**, ANOVA's H0 was not rejected. Thus, no significant statistical evidence was found to support the view that the presence (absence) of reviews in the app led to more (versus less) favourable purchase intention.

Concerning **H.2.10** and **2.11**, ANOVA's H0 was not rejected; thus, it was not found statistically significant evidence that the presence (absence) of reviews in the app leads to more (versus less) positive influence of online reviews, neither that it led to more (versus less) negative values of autonomy.

Regarding the experimental condition of presence versus absence of reviews in the app, the results of **ANCOVA** can be found in Table 8. 8. The relationship between Others' Opinion and Purchase Intention in the presence versus absence of reviews in the app was significant at a α=0.001. Nonetheless, there was no significant effect of the type of app (with versus without reviews) on the person's purchase intention, controlling for the effect of Others' Opinion.

Table 8. 8 - ANCOVA results

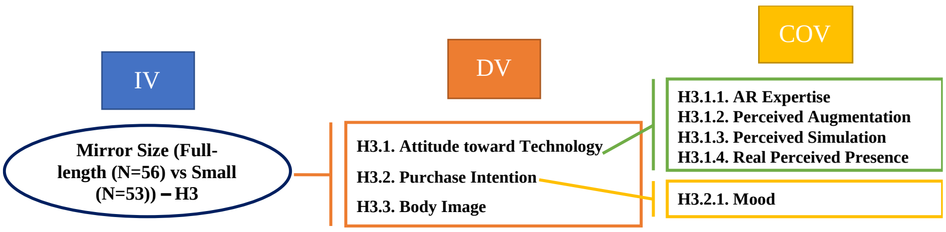
Hypotheses		**Experimental condition: App with and without reviews**		
		Result	**Partial η^2**	**Observed Power**
H2.2.1. Others' Opinion	COV	F (1,101) = 11.418; p = 0.001***	0.102	0.917
	IV	F (1,101) = 2.229; p = 0.139 >0.05	0.022	0.316

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level.

8.3.3.5. Experimental Condition: Full-length versus Small Mirror

To study the experimental condition full-length versus small mirror, we used an ANOVA to test the hypotheses related to the effect of the variation of the mirror size in the attitude toward the app (H.3.1), purchase intention (H.3.2) and body image (H.3.3) (see Fig. 8. 7).

Fig. 8. 7 - Relationship between variables for the experimental condition: Full-length versus Small Mirror



In this context, hypotheses 3.1 to 3.3. were tested, segmenting them according to the shopping context, i.e., the experimental condition is the variation of the mirror size (full-length versus small) when subjects are unaccompanied or accompanied.

Descriptive statistics were obtained for each group of **H3.1, H3.2 e H1.3** when individuals were accompanied and unaccompanied (see Appendix 21 and Appendix 22, respectively).

When analysing the ANOVA's assumptions, not only was the distribution of the data verified, as well as the homogeneity of the variances, through the Levene's test (see Appendix 23).

An ANOVA test was conducted using the variables whose assumptions were met, and this exercise generated the following results (see Table 8. 9):

Table 8. 9 - ANOVA results H3.1-H3.3

Variable	ANOVA	
	Accompanied	**Unaccompanied**
H3.1. Attitude toward AR	F (1,104) = 0.613; p = 0.435 > 0.05	F (1,102) = 0.350; p = 0.555 > 0.05
H3.2. Purchase Intention	F (1,104) = 0.754; p = 0. 387 > 0.05	F (1,102) = 0.103; p = 0.749 > 0.05[29]
H3.3. Body Image	F (1,104) = 0.584; p = 0. 447 > 0.05[30]	F (1,102) = 0.051; p = 0.822 > 0.05

Since the assumption of homogeneity of variance was not met for body image when using the small mirror and for purchase intention when using the full-length mirror, Welch's adjusted F ratio was used. The following results were obtained:

- Body image: F (1,97.528) = 1.159; p = 0.284>0.05;
- Purchase intention: F (1,93.589) = 0.197; p = 0.658>0.05.

These values were not significant, thus demonstrating that the means for body image and purchase intention were not significantly different when using the small mirror versus full-length mirror.

At this point, there was no statistically significant difference between groups as determined by a one-way ANOVA. Hence H0 that all means are equal was not rejected. So, we did not find support for H3.1, H3.2, and H3.3 for shopping contexts.

From the perspective of the experimental condition of mirror size, the **ANCOVA** results obtained therefrom can be found in Table 8. 10.

In that context, it was found that AR Expertise was not significantly related to Attitude toward AR when unaccompanied) and that it was significant (α=0.05) when accompanied. Perceived Augmentation, Perceived Simulation, and Real Perceived

[29] The analysis here used was the Welch's Robust Test of Equality of Means, whose interpretation was given for F (1,97.528) = 1.159; p = 0.284>0.05 [H3.2., unaccompanied]
[30] The analysis here used was the Welch's Robust Test of Equality of Means, whose interpretation was given for F (1,93.589) = 0.197; p = 0.658>0.05 [H3.3., accompanied]

Presence were both significant at α=0.001 (both unaccompanied and accompanied), as well as Perceived Simulation when accompanied.

Once again, it was not found statistical evidence that there was a significant effect of the mirror size (small versus full-length) on participants' attitude towards AR controlling for their AR Expertise, Perceived Augmentation, Perceived Simulation, and Real Perceived Presence (when unaccompanied and accompanied).

When considering the variable Mood, it was found it was significantly related to Purchase Intention at α=0.001 when accompanied. It was also significant when unaccompanied, but at α=0.05.

It is noteworthy that although the covariates did not vary significantly among groups (IV), they influence the values of the DV with whom they are highly correlated, with high values for the estimated size (partial eta^2)[31] and observed power[32].

Moreover, when unaccompanied, there was a significant effect of the experimental condition Mirror Size after controlling for the covariate Perceived Simulation (α=0.1). Thus, the planned contrast revealed that trying shoes accompanied in a small mirror, p=0.078, 95% CI [-0.03,0.048], significantly increased the participant's attitude toward AR, with partial η^2= 0.292. It was also found that the increased mean of the full-length mirror versus the small one (M=0.229) is statistically significant and that for that situation the condition mirror size largely supports the research hypothesis (see Fig. 8. 8).

Table 8. 10 - ANCOVA results

Hypotheses		**Experimental condition: Mirror Size**					
		Accompanied			**Unaccompanied**		
		Result	**Partial η^2**	**Observed Power**	**Result**	**Partial η^2**	**Observed Power**
H3.1.1. AR Expertise	COV	F (1,106) = 5.921; p = 0.017**	0.053	0.674	F (1,99) = 1.682; p = 0.198>0.05	0.017	0.250
	IV	F (1,106) = 0.186; p = 0.667 >0.05	0.002	0.071	F (1,99) = 2.076; p = 0.153 >0.05	0.021	0.297

[31] Partial Eta^2 (η^2) it regards the "at the proportion of variance that a variable explains that *is not explained by other variables in the analysis*." (Field, 2018). It varies from 0 to 1, and [0.01-0.06[- small effect size; [0.06-0.14[- medium effect size; >0.14 – large effect size (Cohen, 1988, p. 283).

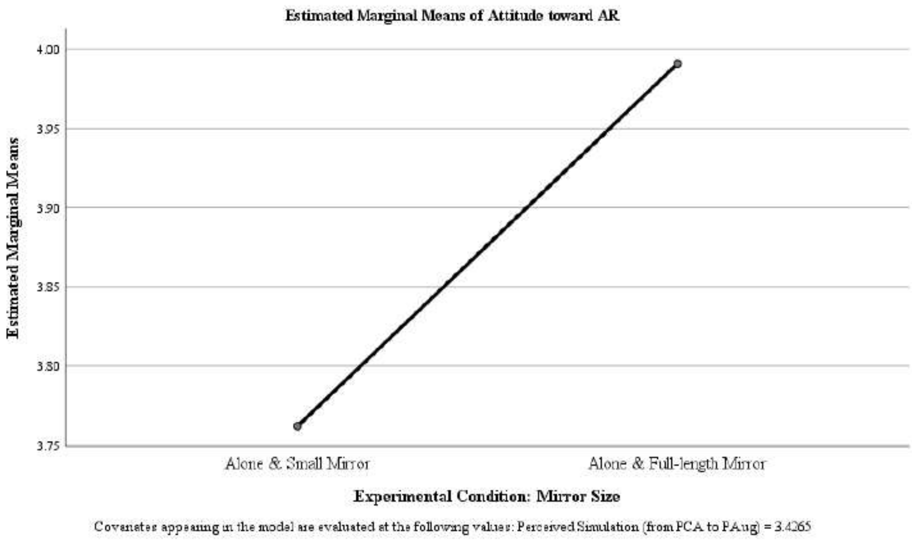
[32] Observed Power: "provides an estimate of the probability that the statistical test could detect the difference between the observed group means." (Field, 2018). Cohen (1988) argues that values around 0.2 convey a small effect size, around =0.5, a medium one, and ≥ 0.80, a large effect size.

Table 8. 11 - ANCOVA results (continued)

Hypotheses		Experimental condition: Mirror Size					
		Accompanied			Unaccompanied		
		Result	Partial η^2	Observed Power	Result	Partial η^2	Observed Power
H3.1.1. AR Expertise	COV	F (1,106) = 5.921; p = 0.017**	0.053	0.674	F (1,99) = 1.682; p = 0.198>0.05	0.017	0.250
	IV	F (1,106) = 0.186; p = 0.667 >0.05	0.002	0.071	F (1,99) = 2.076; p = 0.153 >0.05	0.021	0.297
H3.1.2. Perceived Augmentation	COV	F (1,106) = 77.923; p = 0.000**	0.424	1.000	F (1,99) = 47.329; p = 0.000**	0.323	1.000
	IV	F (1,106) = 0.038; p = 0.847 >0.05	0.000	0.054	F (1,99) = 0.000; p = 0.986 >0.05	0.000	0.050
H3.1.3. Perceived Simulation	COV	F (1,106) = 87.736; p = 0.000**	0.143	0.986	F (1,99) = 23.672; p = 0.000***	0.193	0.998
	IV	F (1,102) = 0.071; p = 0.790 >0.05	0.000	0.052	F (1,99) = 3.164; p = 0.078*	0.031	0.421
H3.1.4. Real Perceived Presence	COV	F (1,106) = 77.923; p = 0.000**	0.453	1.000	F (1,99) = 40.818; p = 0.000**	0.292	1.000
	IV	F (1,106) = 0.038; p = 0.847 >0.05	0.001	0.058	F (1,99) = 11.349; p = 0.594 >0.05	0.003	0.083
H3.2.1. Mood	COV	F (1,106) = 22.351; p = 0.000**	0.011	0.195	F (1,99) = 47.329; p = 0.0041**	0.103	0.916
	IV	F (1,106) = 0.011; p = 0.916 >0.05	0.004	0.098	F (1,99) = 0.010; p = 0.919 >0.05	0.000	0.051

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level.

Fig. 8. 8 - Variation in the mean due to the control of Perceived Simulation



8.3.4. Variables Influencing Attitude toward AR and Purchase Intention

To analyse hypotheses **H4** and **H5**, logistic regression was applied, to grasp what experimental conditions contributed more to the explanation of the variables attitude toward AR (H4) and purchase intention (H5).

The rationale that was applied to the logistic regression was to test the hypotheses that attitude toward AR (**H4**) and purchase intention (**H5**) are influenced by the experimental condition applied to the participants. Therefore, two logistic regressions were conducted, where the respective DVs were the attitude toward AR (**H4**) and purchase intention (**H5**). The reference condition that enhances the effect/has the highest impact of the IV on the DVs was the group of subjects who were accompanied, using the full-length mirror, and that the app had ratings and reviews.

To test **H4**, the selected categorical IVs were the experimental condition and gender (set as contrasts - indicator), and the metric IVs were Ease of Use, Projection, Imagery, Perceived Augmentation, Perceived Simulation, Real Perceived Presence, Digital Perceived Presence, Family's Opinion, Influencers' Opinion, Online Reviews' Influence, Friends' Opinion, Seller & Experts' Opinion, Others' Opinion, Esteemed Ones' Opinion, Autonomy, Negative Reviews' Influence, Group Acceptance, Mood, AR Expertise, Product Involvement, and Physical Attachment to the physical store. To assess the significance of the previous variables over the probability of having a favourable attitude toward AR, logistic regression using the Enter method was conducted.

The full/saturated model containing all predictors was statistically significant, X^2 (27) = 185.625, p<.001, i.e., the model was able to distinguish between the respondents who showed a favourable (high) and a less favourable (low) attitude toward AR. Overall, the model explained between 50.8% (Cox and Snell R^2=.508) and 70.5% (Nagelkerke R^2=.705) of variance in attitude toward AR, and correctly classified 87.4% of the cases. As shown in Table 8. 12 (which sums up the model's coefficients and respective significance), the following variables presented a statistically significant effect over the Logit of the probability of having a favourable attitude toward AR:

- **Experimental Group (3)** (unaccompanied, small mirror, with ratings and reviews) (b_{group3}=1.331; $X^2_{Wald}(4) = 3.239$; p=.072);
- Ease of Use (b_{EoU}=.662; $X^2_{Wald}(1) = 6.981$, p=.008);

- Projection (b_{Proj}=.755; $X^2_{Wald}(1) = 7.247$, p=.007);
- Perceived Augmentation (b_{PAug}=.954; $X^2_{Wald}(1) = 4.904$, p=.027);
- Friends' Opinion (b_{FOp}=.492; $X^2_{Wald}(1) = 4.683$, p=.030);
- Esteemed Ones' Opinion ($b_{Esteemed}$=-.443; $X^2_{Wald}(1) = 5.372$, p=.020);
- Autonomy ($b_{Autonomy}$=-.295; $X^2_{Wald}(1) = 3.072$; p=.080);
- Negative Reviews' Influence (b_{NegRev}=.371; $X^2_{Wald}(1) = 2.908$; p=.020);
- Mood (b_{Mood}=-1.820; $X^2_{Wald}(1) = 15.564$; p=.000);
- Product Involvement (b_{PInv}=.269; $X^2_{Wald}(1) = 2.752$; p=.097);
- Physical Attachment ($b_{PhysAtt}$=-.507; $X^2_{Wald}(1) = 8.816$; p=.003).

For attitude toward AR, variables such as Gender, Imagery, Perceived Simulation, Real Perceived Presence, Digital Perceived Presence, Family's Opinion, Influencers' Opinion, Online Reviews' Influence, Seller & Experts' Opinion, Others' Opinion, Group Acceptance, and AR Expertise did not show statistically significant effects over the Logit of the probability of having a favourable attitude toward AR. The model also presents high values of sensibility, i.e., it correctly rates 92.6% of the subjects with a favourable (high) attitude towards AR, and sensitivity, i.e., it correctly rates 77.0% of the subjects with an unfavourable (low) attitude towards AR.

In the case of attitude toward AR, those who tried the app using the small mirror, unaccompanied and the app with reviews (i.e. they had a virtual presence influence and no physical presence, and they did not see their full-body reflected) were 3.8 times (Exp (B) = 3.783) more likely to have a favourable attitude toward AR than those who experimented with a physical and virtual presence influence. Therefore, we did not find sufficient support for H4.

Moreover, the fact that AR is perceived as a technology that is easy to use (<u>ease of use</u>), its ability to materialise the product (<u>projection</u>), the feature that AR has to enrich the real world (<u>perceived augmentation</u>), and the influence exerted by <u>negative reviews</u> are positively linked to a favourable purchase intention. Also, friends mental influence and product involvement are positively linked to a favourable attitude toward AR. On the other hand, the connection to the influence that <u>esteemed ones</u> have over subjects, the feeling of <u>autonomy</u> experienced by the subjects (in the sense that they believe that others do not influence them), physical attachment, and <u>mood</u> are negatively linked to a favourable attitude toward AR.

Table 8. 12 - Logistic regression model results for attitude toward AR

Parameter	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP(B)
Experimental Group			3.505	4	.477		
Experimental Group (1)	.999	.798	1.568	1	.211	2.714	].569; 12.957[
Experimental Group (2)	.630	.705	.797	1	.372	1.878	].471; 7.482[
Experimental Group (3)	1.331	.739	3.239	1	.072*	3.783	].888; 16.113[
Experimental Group (4)	.737	.738	.997	1	.318	2.089	].492; 8.877[
Gender (1)	-.518	.516	1.004	1	.316	.596	].217; 1.640[
Ease of Use	.622	.235	6.981	1	.008**	1.862	]1.174; 2.954[
Projection	.755	.281	7.247	1	.007**	2.128	]1.228; 3.688[
Imagery	.060	.246	.059	1	.808	1.062	].655; 1.721[
Perceived Augmentation	.954	.431	4.904	1	.027**	2.595	]1.116; 6.035[
Perceived Simulation	.085	.165	.262	1	.609	1.088	].787; 1.505[
Real Perceived Presence	.412	.322	1.629	1	.202	1.509	].802; 2.839[
Digital Perceived Presence	-.022	.146	.022	1	.883	.979	].735; 1.304[
Family's Opinion	-.255	.205	1.556	1	.212	.775	].519; 1.157[
Influencers' Opinion	-.011	.283	.002	1	.969	.989	].568; 1.722[
Online Reviews' Influence	.198	.225	.773	1	.379	1.218	].784; 1.893[
Friends' Opinion	.492	.227	4.683	1	.030**	1.635	]1.047; 2.552[
Sellers&Experts' Opinion	.272	.247	1.216	1	.270	1.313	].809; 2.129[
Others' Opinion	-.297	.210	1.990	1	.158	.743	].492; 1.123[
Esteemed Ones' Opinion	-.443	.191	5.372	1	.020**	.642	].442; .934[
Autonomy	-.295	.169	3.072	1	.080*	.744	].535; 1.036[
Negative reviews’ Influence	.371	.218	2.908	1	.088*	1.450	].946; 2.222[
Group Acceptance	-.143	.211	.463	1	.496	.867	].573; 1.309[
Mood	-1.820	.461	15.564	1	.000***	.162	].066; .400[
AR Expertise	-.156	.169	.846	1	.358	.856	].614; 1.193[
Product Involvement	.269	.162	2.752	1	.097*	1.308	].952; 1.798[
Physical Attachment	-.507	.171	8.816	1	.003**	.603	].431; .842[
Constant	-3.638	2.297	2.509	1	.113	.026	

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level.

To test **H5** the categorical IVs were the experimental condition and gender (set as contrasts - indicator), and the metric IVs were Ease of Use, Projection, Imagery, Perceived Augmentation, Perceived Simulation, Real Perceived Presence, Digital Perceived Digital Presence, Family’s Opinion, Influencers’ Opinion, Online Reviews’ Influence, Friends’ Opinion, Seller & Experts’ Opinion, Others’ Opinion, Esteemed Ones’ Opinion, Autonomy, Negative Reviews’ Influence, Group Acceptance, Mood, AR Expertise, Product Involvement, Physical Attachment to the physical store, and Body Image. The significance of the previous variables over the probability of having a favourable purchase intention as assessed through logistic regression, using the method Enter.

The full/saturated model containing all predictors was statistically significant, X^2 (28) = 185.243, p<.001, i.e., the model was able to distinguish between the respondents who showed a favourable (high) and a less favourable (low) purchase intention. Overall, the model explained between 50.7% (Cox and Snell R^2=.507) and 68.8% (Nagelkerke R^2=.688) of variance in purchase intention and correctly classified 83.6% of the cases.

As shown in Table 8. 13 (that sums up the model's coefficients and respective significance), the following variables presented a statistically significant effect over the Logit of the probability of having a favourable purchase intention:

- **Experimental Group 4** (unaccompanied, full-length mirror, without ratings and reviews) (b_{group4}=1.331; $X^2_{Wald}(4) = 3.239$, p=.072);
- Gender (b_{Gender}=1.967; $X^2_{Wald}(1) = 13.015$, p=.000);
- Projection (b_{Proj}=.730; $X^2_{Wald}(1) = 7.521$, p=.006);
- Real Perceived Presence (b_{RealPP}=1.157; $X^2_{Wald}(1) = 14.448$, p=.000);
- Influencers' Opinion ($b_{Influencer}$=.523; $X^2_{Wald}(1) = 3.523$, p=.061);
- Online Reviews' Influence ($b_{OnRevInf}$=-.486; $X^2_{Wald}(1) = 4.701$, p=.030);
- Seller & Experts' Opinion ($b_{SellExp}$=.556; $X^2_{Wald}(1) = 5.504$, p=.019);
- Physical Attachment (b_{PA}=-.927; $X^2_{Wald}(1) = 26.351$, p=.000);
- Body Image (b_{BI}=-.254; $X^2_{Wald}(1) = 3.063$, p=.043).

In this case, variables such like Ease of Use, Imagery, Perceived Augmentation, Perceived Simulation, Digital Perceived Presence, Family's Opinion, Friends' Opinion, Others' Opinion, Esteemed Ones' Opinion, Autonomy, Negative Reviews' Influence, Group Acceptance, Mood, AR Expertise, and Product Involvement did not present statistically significant effects over the Logit of the probability of having a favourable purchase intention. The model also presents high values of sensibility, i.e., it correctly rates 87.6% of the subjects with favourable (high) purchase intention, and sensitivity, i.e., it correctly rates 77.2% of the subjects with unfavourable (low) purchase intention.

For purchase intention, individuals who tried the app without reviews and comments, unaccompanied (i.e. without the physical and virtual influence of others) using a full-length mirror were 4.3 times (Exp (B) = 4.303) more likely to show a favourable purchase intention using an AR m-commerce app than those who experienced a virtual or a physical presence influence. Therefore, it can be reported that insufficient evidence was found to support H5.

Moreover, males were 7.1 times (Exp (B) = 7.147) more likely to exhibit favourable purchase intention than females. Besides, an increasing projection, the ability of the self feeling closer to the real world (versus the virtual one) (real perceived presence), and the influence exerted by influencers and sellers & experts are positively linked to a favourable purchase intention. On the other hand, the connection to the physical store, the influence exerted by the presence of online reviews and body image are negatively linked to a favourable purchase intention.

Table 8. 13 - Logistic regression model results for purchase intention

Parameter	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP(B)
Experimental Group			4.583	4	.333		
Experimental Group (1)	.789	.743	1.127	1	.288	2.200	].513; 9.439[
Experimental Group (2)	.259	.628	.170	1	.680	1.296	].378; 4.441[
Experimental Group (3)	.727	.638	1.300	1	.254	2.069	].593; 7.221[
Experimental Group (4)	1.459	.716	4.159	1	.041**	4.303	]1.058; 17.498[
Gender (1)	1.967	.545	13.015	1	.000***	7.147	]2.455; 20.804[
Ease of Use	.221	.236	.878	1	.349	1.248	].785; 1.983[
Projection	.730	.266	7.521	1	.006**	2.076	]1.232; 3.498[
Imagery	.176	.244	.522	1	.470	1.193	].740; 1.923[
Perceived Augmentation	.174	.382	.208	1	.648	1.191	].563; 2.520[
Perceived Simulation	-.162	.152	1.135	1	.287	.850	].631; 1.146[
Real Perceived Presence	1.157	.304	14.448	1	.000***	3.181	]1.752; 5.777[
Digital Perceived Presence	.218	.136	2.576	1	.108	1.243	].953; 1.622[
Family's Opinion	.087	.203	.182	1	.669	1.091	].733; 1.623[
Influencers' Opinion	.523	.278	3.523	1	.061*	1.686	].977; 2.910[
Online Reviews' Influence	-.486	.224	4.701	1	.030**	.615	].396; .954[
Friends' Opinion	.240	.215	1.245	1	.264	1.271	].834; 1.936[
Sellers & Experts' Opinion	.556	.237	5.504	1	.019**	1.743	]1.096; 2.772[
Others' Opinion	.007	.211	.001	1	.972	1.008	].666; 1.524[
Esteemed Ones' Opinion	-.209	.181	1.335	1	.248	.812	].570; 1.156[
Autonomy	.094	.159	.353	1	.552	1.099	].805; 1.500[
Negative reviews' Influence	.283	.209	1.824	1	.177	1.327	].880; 2.000[
Group Acceptance	-.262	.223	1.383	1	.240	.769	].497; 1.191[
Mood	-.578	.400	2.086	1	.149	.561	].256; 1.229[
AR Expertise	-.016	.153	.011	1	.915	.984	].729; 1.328[
Product Involvement	.200	.169	1.400	1	.237	1.221	].877; 1.701[
Physical Attachment	-.927	.181	26.351	1	.000***	.396	].278; .564[
Body Image	-.254	.145	3.063	1	.080*	.776	].584; 1.031[
Constant	-5.651	2.787	4.113	1	.043**	.004	

*** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level.

8.4. Summary

In this chapter, we present the results of the qualitative study, that clarified not only previous ideas but also provided new insights, regarding the role that the social presence of others (real, imaginary or virtual) may play within an AR shopping context.

Then, we introduce the results of the analysis of the questionnaire used in the experimental design. We explained all processes for data treatment (EDA), we show the results of the manipulation check, and then we proceed to the data analysis (PCA, reliability, ANOVA and ANCOVA). These analyses had the purpose of determining whether there were statistically significant differences among the experimental conditions. We finally present a summary of the results obtained for the hypotheses **H1**, **H2** and **H3**, that showed weak support for the hypothesis related to the physical presence of others and mirror size effect, and some support for the hypothesis related to the virtual presence (here reflected in the presence versus absence of reviews in the app) (see tables 8.12, 8.13, and 8. 14). Moreover, **H4** and **H5** were not supported (see Table 8.15).

Table 8. 12 - Table of results of the experimental condition shopping context

Varied Factor	Hypotheses	Fixed Factor	Partial Result	Result
Unaccompanied versus accompanied	**H1.1** Attitude toward AR	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.1.1 AR Expertise moderating Attitude toward AR	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.1.2 Perceived Simulation moderating Attitude toward AR	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.1.3 Real Perceived Presence moderating Attitude toward AR	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.1.4 Digital Perceived Presence moderating Attitude toward AR	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.1.5 Focused Attention moderating Attitude toward AR	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.2 Purchase Intention	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.2.1 Mood moderating Purchase Intention	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.2.2 Autonomy moderating Purchase Intention	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.2.3 Others' Opinion moderating Purchase Intention	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.3 Body Image	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.4 Family's Opinion	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.5 Influencers' Opinion	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.6 Online Reviews Influence	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.7 Friends/Peers' Opinion	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	

Table 8. 13 - Table of results of the experimental condition shopping context (continued)

Varied Factor	Hypotheses	Fixed Factor	Partial Result	Result
Unaccompanied versus accompanied	**H1.8** Experts & Sellers's Opinion	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.9 Esteemed One's Opinion	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	
	H1.10 Group Acceptance	Full-length mirror	Not supported	Not supported
		Small mirror	Not supported	

Table 8. 14 - Table of results of the experimental condition presence versus absence of reviews

Varied Factor	Hypotheses	Result
Presence versus Absence of Reviews	**H2.1** Attitude toward AR	Supported
	H2.2 Purchase Intention	Not supported
	H2.2.1 Others' Opinion moderating Purchase Intention	Not supported
	H2.3 Family's Opinion	Supported
	H2.4 Influencers' Opinion	Supported
	H2.5 Friends/Peers' Opinion	Supported
	H2.6 Experts & Sellers's Opinion	Supported
	H2.7 Esteemed One's Opinion	Supported
	H2.8 Group Acceptance	Not supported
	H2.9 Other's Opinions	Supported
	H2.10 Influence of Online Reviews	Not supported
	H2.11 Autonomy	Not supported

Table 8. 15 - Table of results of the experimental condition Mirror Size

Varied Factor	Hypotheses	Fixed Factor	Partial Result	Result
Full-length versus Small mirror	**H3.1** Attitude toward AR	Accompanied	Not supported	Not supported
		Unaccompanied	Not supported	
	H3.1.1 AR Expertise moderating Attitude toward AR	Accompanied	Not supported	Not supported
		Unaccompanied	Not supported	
	H3.1.2 Perceived Augmentation moderating Attitude toward AR	Accompanied	Not supported	Not supported
		Unaccompanied	Not supported	
	H3.1.3 Perceived Simulation moderating Attitude toward AR	Accompanied	Not supported	Not supported
		Unaccompanied	Not supported	
	H3.1.4 Real Perceived Presence moderating Attitude toward AR	Accompanied	Not supported	Partially supported
		Unaccompanied	Supported (α=0.1)	
	H3.2 Purchase Intention	Accompanied	Not supported	Not supported
		Unaccompanied	Not supported	
	H3.2.1 Mood moderating Purchase Intention	Accompanied	Not supported	Not supported
		Unaccompanied	Not supported	
	H3.3 Body Image	Accompanied	Not supported	Not supported
		Unaccompanied	Not supported	

Table 8. 16 - Table of results of the variables Influencing Attitude toward AR and Purchase Intention

Hypotheses	Result
H4: The three elements manipulated in the experimental condition, the combination accompanied, full-length mirror, with ratings and reviews is that which enhances the maximum effect (i.e. this condition is the one that has the most significant impact), influencing the attitude toward AR positively; thus the other experimental conditions will negatively influence attitude toward AR.	Not supported
H5: The three elements manipulated in the experimental condition, the combination accompanied, full-length mirror, with ratings and reviews that which enhances the maximum effect (i.e. this condition is the one that has the most significant impact), influencing positively purchase intention; thus the other experimental conditions will negatively influence purchase intention.	Not supported

Part IV

Discussion and Conclusion

Chapter 9 Discussion

9.1. Introduction

This chapter follows the results of the empirical study (presented in chapter 8) which is going to be examined from the perspective of the research vis-à-vis the research hypotheses (presented in chapter 4), and the existing literature (introduced in chapters 2 and 3).

The reasoning of this study is to assess *what the sociological, psychological and technological factors relevant to the efficacy of a mobile shopping experience using AR technology are*. Thus, the main goal of our research is to study the efficacy of the influence of social (physical, virtual and mental presence of others) and technological factors (perceived augmentation, simulation, and perceived presence) on consumers' attitude toward the use of an AR m-commerce app, and their purchase intention. More precisely, this chapter aims to answer the following research questions:

> RQ1: What is the role of social influence (induced by the presence of peers and reviews & ratings) in the attitude toward AR and purchase intention in an AR m-commerce context?
>
> RQ2: What impact do the mental presence of others and mood have as moderators of consumers purchase intention?
>
> RQ3: What impact do the technological aspects inherent to augmented reality have as moderators of the consumers' attitude of toward AR?
>
> RQ4: What is the role of body image (introduced through the visualisation of the reflection of the whole body or only part of it) on consumer's attitude towards technology and purchase intention in an AR m-commerce context?

The results from the qualitative study are discussed, followed by the results of the experimental design, which are now briefly introduced.

From the perspective of the interviews conducted (n=34), these were useful not only to test the app but also primarily to assess which elements are crucial and consequently should be incorporated in an AR m-commerce app. Therefore, it was found that consumers value aspects of a more technical nature, such as being a markerless AR solution, that makes the automatic matching of the shoe to the foot, while it recognises the equivalent size. Interviewees revealed favourable attitudes and purchase intention while using this app when it provides them with high levels of realism and authenticity.

From the analysis of Table 8. 3 and Table 8. 4 in the previous chapter, it appears that in the shopping context condition (presence versus absence of peers), the research hypotheses were not supported either for those related to attitude toward AR (H1.1), purchase intention (H1.2), body image (H1.3), nor the mental presence of others (H1.4-10).

When analysing the virtual presence represented by the type of app (presence versus absence of comments), the hypotheses related to attitude toward AR (H2.1) and part of the hypotheses related to the mental presence of others (H2.3-7 and H2.9) were supported. For the remaining hypotheses (H2.2, H.2.8 and H2.10-11), no statistically significant evidence was found to support them.

The condition mirror size yielded similar results to the shopping context. This means that it was not found support for the hypotheses related to attitude toward AR (H3.1), the intention to purchase (H3.2), and body image (H3.3). However, the hypotheses that studied the effect of mirror size in the attitude toward AR, when controlling for real perceived presence, were partially supported by the evidence obtained (H3.1.4).

Of the 40 hypotheses under analysis, seven were confirmed, and one was partially supported (H.3.1.4).

Moreover, no evidence was found to support the hypotheses provided for under H4 and H5.

9.2. Qualitative Study

The conduction of the interviews was essential for the assessment of what users' value in an AR m-commerce app when compared with their other shopping experiences (AR m-commerce versus e-commerce versus physical store). To reach that goal, the interviewees were exposed to the AR app Virtual Shoes, and they were given some time to explore it. Only a few respondents were aware of what AR was, although they have reported having tried Instagram and Snapchat filters, which rely on AR technology. Others mistook AR for Virtual Reality. It was found that although AR has existed for several years (Azuma, 1997; Milgram et al., 1994), there is no awareness of it and its potential, from the consumers' standpoint.

The findings of this qualitative study show that navigability is the most salient media characteristic (MC) of AR, given that this MC is associated with the app's intuitiveness and its convenience. Additionally, convenience was a valued topic, similar to the study of Grewal et al. (2020) and as a feature of m-commerce platforms (Wang, Malthouse, and Krishnamurthi, 2015). Moreover, markerless tracking systems are preferred to marker-based ones, outperforming them (Brito and Stoyanova, 2018). Another finding was the preference for the use of handheld devices to create an AR experience. This finding is supported by the past research conducted using such displays (McLean and Wilson, 2019; Poushneh, 2018; Roxo and Brito, 2018), and its ease of use (Grewal et al., 2020). Two other features of AR that are relevant for the development of AR m-commerce solutions are the resolution of the image, the recognition and automatic fitting of the shoe to the user's foot. This research was also crucial to the study of the importance of the social factor, namely the need for approval/validation that users' have, and the influence that others exert on subjects when interacting with AR m-commerce apps. This stream of research is now starting to be studied with the rise of social AR (Grewal et al., 2020; Hilken et al., 2020).

On balance, the qualitative study provided useful insights for the development of AR m-commerce apps, especially the incorporation of reviews and its convenience and usefulness. Consequently, AR technology was perceived as novel and essential in the decision-making process, which was felt could foster the relationship between brands and young consumers. It also contributed to the identification of new themes to explore, to fine-tune the quantitative methodology and in the development of new measures and the accuracy of previous ones.

9.3. Experimental Design

In this section, the results yielded for the three experimental conditions studied will be discussed: the physical presence of peers (shopping context), the virtual presence of others (the type of app with or without reviews), and the full-body effect (using a small as opposed to a full-length mirror).

The first three sub-sections present the discussion of the results of the bivariate analyses (using ANOVA and ANCOVA). The fourth sub-section shows the discussion of the findings of the multivariate data analyses (using Logistic Regression).

9.3.1.Shopping Context: the Presence versus Absence of Peers

This experimental condition aimed to study whether the physical presence of peers yielded any effect on subjects' attitude toward AR (H1.1), purchase intention (H1.2), body image (H1.3), and in the variables related to the mental presence of others (H1.4-10.). To study such effects, the existence of differences between the groups: presence versus absence of peers, was assessed through ANOVAs. Moreover, the moderating effects that the variables related to AR had on attitude toward this technology (H.1.1.1-5), and the role of mood (H.1.2.1), autonomy (H.1.2.2), and other's opinion (H.1.2.3) played on the purchase intention was tested. For that analysis, the ANCOVA technique was used.

The results indicate that the physical presence of peers (versus absence) when trying an AR m-commerce app had no impact on subjects' attitude toward AR (**H1.1**), purchase intention (**H1.2**), and body image (**H1.3**). These findings may be explained, in part, because young consumers are less susceptible to peer influence (through normative influence), similar to past research in retail contexts and eWOM intentions (Mangleburg et al., 2004; Mishra, Maheswarappa, Maity, and Samu, 2018). Another factor that may explain these results is the high value registered for focused attention (M= 5.218, Std.=1.671, see Appendix 4), i.e., participants' attention was so centred on the task at hand that they override the effect that being with a friend may have on them. This effect may be anticipated because focused attention is an antecedent of flow, which is an element of consumer experience on computer-mediated environments (Csikszentmihalyi, 1975; Lin et al., 2008; Novak et al., 2000). In the case of body image, the reason why no differences were found between the experimental groups may be explained by the fact that participants scored relatively high on this variable (M= 4.362, Std.=1.450, see Appendix 4), and also their mood state (M= 2.324, Std.=.667, see Appendix 4) which is in line with the findings from earlier studies that linked body image and positive emotional states (Castonguay, Gilchrist, Mack, and Sabiston, 2013). Our findings also prove that body image satisfaction of young adults is not impacted by friends, family, colleagues or significant others (Rieke et al., 2016).

The data highlights the fact that mobile purchasing in the physical presence of friends does not differ from purchasing in their physical absence regarding the mental presence of others. This means that the opinion one anticipates from family (**H1.4**), influencers (**H1.5**), online reviews (**H1.6**), friends (**H1.7**), experts & sellers (**H1.8**), esteemed ones (a person inner circle of relationships) (**H1.9**), and the need to belong to a group (group acceptance, which is somehow a measure of the subjects' propensity to friends normative influence) (**H1.10**) is not influenced by the physical presence of others. Again, such findings are related to the fact that as an adolescent becomes a young adult s/he tends to rely less on the normative influence of others, which is in line with Mangleburg, Mishra et al. findings in respect of young people (Mangleburg et al., 2004; Mishra et al., 2018). However, our data contradict the findings of Wenzel and Benkenstein (2018), who found that teenagers are at ease with a shared shopping experience context and the related researches for adults in a retail store context (Borges et al., 2010). The results of the bivariate analysis are in contravention to those that state when in public, one may expect that individuals feel pressured by the possibility of being watched by others (Wood, 2000). For the particular case of the effect of influencer's opinion the findings of our study contradict authors who argue that Instagram influencers significantly impact subjects intention to follow their recommendations (Casaló et al., 2020).

Moreover, the data suggest that even when controlling for the effects of other variables, there were no significant differences, in respect of attitude toward AR, between those who tried the app accompanied versus those who tried it unaccompanied. These findings are accurate when AR Expertise (**H1.1.1**) is controlled for. This means that the fact of having a shared experience with a peer does not affect attitude toward AR regardless of the level of knowledge and experience related to AR, which might demonstrate that expertise might not play an essential role within the field of AR. This apparent lack of importance is also supported by studies that focus on inspiration and the impact of AR expertise (Hinsch et al., 2020).

Moreover, there is no impact of the shopping context on the attitude toward AR when we control for:

- Perceived augmentation: the ability that AR exerts to enrich the environment (**H1.1.2**). This is in line with the findings that did not find support for the effects that perceived augmentation has on attitude-related variables (when mediated by flow) (Javornik, 2016b). Furthermore, the fact that participants were accompanied may contribute to this situation that the enrichment of the reality through AR does not affect attitude toward it.

- Perceived simulation: the ability of AR that its users can simulate their interaction with a product (**H1.1.3**). These findings may be explained by the lower levels of perceived simulation experienced by participants (M= 3.231, Std.=1.639, see Appendix 4) because as AR is anchored in the visualisation of 3D objects superimposed to the real world and participants could not experience any haptic feedback of the product (which is useful in the case of shoes); therefore subjects' mental representation of the product is not fully reached (Heller et al., 2019b). Being accompanied did not yield significant differences as opposed to when unaccompanied, in part due to the previously mentioned lack of haptic affordances of the AR stimulus and other elements that 'mimic' a real-store experience.
- Real perceived presence: the fact that AR creates an experience closer to the real world (**H1.1.4**). This is explained by the findings of the qualitative study, where consumers value a realistic representation of the augmented products. In the quantitative one, participants reported low levels of reality in the AR experience (M= 3.128, Std.=1.335, see Appendix 4). If consumers reported higher levels of realism of the AR visualisation, one might observe some significative differences because higher levels of interactivity and vividness (which increase the realism of the experience) leads to higher levels of presence, which in turn decreases product risk due to low levels of realism (Vonkeman, Verhagen, and van Dolen, 2017). The fact that one is accompanied was insufficient to create a realistic experience.

When controlling for participants' focused attention (**H1.1.5**), there are no differences registered between those who have a shared experience (versus unaccompanied). This result somehow contradicts past research where flow (from which focused attention is a dimension) is positively associated with consumers' attitude toward the use of mobile shopping. Although, it presents a contribution since our study produces results relating to the role of social influence (physical presence) in attitudes toward AR when controlling one of the dimensions of flow (Chen, Hsu, and Lu, 2018).

The analysis of the effect of the shopping context on the purchase intention when controlling for mood, autonomy and other's opinion, showed that there was no effect of the presence (versus absence) of peers on purchase intention.

For the case of mood (**H1.2.1**), it was found that when subjects are in a positive one, they tend to favour hedonic shopping experiences which are associated with more purchase experiences and longer shopping duration (Yim, Yoo, Sauer, and Seo, 2014). Additionally, when shopping accompanied (versus unaccompanied), shoppers tend to be more prone to marketing stimuli, having a great desire to purchase and spending more time in-store (Yim et al., 2014). Therefore, the findings contradict the rationale posited, because once controlling for mood, it does not yield any difference in purchase intention.

In relation to autonomy (**H1.2.2**) (i.e., consumers belief that others do not influence them), data suggest that this covariate does not influence the relationship between the shopping context and purchase intention, which contradicts past research which found that the presence of peers is a drive to consumption, whereas shopping with family plays a regulatory role (Luo, 2005; Mangleburg et al., 2004)

Turning attention to other's opinion (**H1.2.3**) the same arguments for autonomy are valid, in addition to the fact that social influence helps to increase a sense of security, although it was not found evidence that it leads to the adoption of positive attitudes towards technology adoption and possibly to purchase using such technology (Park et al., 2019). Therefore, H1.1-10, H1.1.1-5 and H1.2.1-3 were rejected.

9.3.2. App Type: With versus Without Reviews

With the manipulation of the type of app presented to the participants of this study, the intention was to examine if the virtual presence of others (induced by the reviews embedded in the app) impacted subjects differently to those who tried the app without reviews. Therefore, the impact of the app type on subjects' attitude toward AR (H2.1), purchase intention (H2.2), and in the variables related to the mental presence of others (H2.3-11) was analysed. To assess the presence of differences between the groups regarding the presence versus absence of reviews, the ANOVA technique was used. The moderating effects that the variable other's opinion played in the purchase intention (H3.2.1) was also tested using the ANCOVA technique.

These findings point that trying an m-commerce app with embedded reviews generates more positive consumer' attitudes toward AR (**H2.1**). This can be explained by the fact that knowing the opinion of those who tried and had previous experience with the platforms may create a sense of trust in the app and influence attitudes toward the product (Floyd, Freling, Alhoqail, Cho, and Freling, 2014; von Helversen et al., 2018).

Conversely, when assessing the differences of the type of app regarding purchasing intention (**H2.2**), no evidence was found that supported that there was an effect created by the presence (versus absence of reviews), which contradicts sound research on the topic that links several aspects of reviews (valence, credibility, among others) to an increased purchase intention (Jiménez and Mendoza, 2013). Nonetheless, this 'null effect' of reviews may be explained by the perceptions subjects had of the type of comments, namely whether or not they were overly positive or negative because when that happens, consumers are not too willing to trust them (Prendergast, Paliwal, and Chan, 2018).

In relation to the variables connected to the mental presence of others, no difference was found on the impact of the presence (versus absence) of reviews on family, influencers, friends, experts and esteemed one, and others' opinion (**H2.3-7. and H2.9.**), as expected. These findings are similar to previous one relating to the lack of influence of the mental presence of others, when in the physical presence of peers. Therefore, since the physical presence (versus absence) of peers did not influence subjects, neither does the virtual presence (versus absence) of reviews influence them, showing some consistency regarding not being influenced by other people they know, as stated in hypothesis **H2.11**, or that verbalise their opinion through consumer reviews, as seen in hypothesis **H2.10**. The data suggest that subjects are entirely independent of others when forming their opinions, which contradicts not only the literature related to the influence of family, peers, digital influencers, mentioned for **H1**, but also those who state that consumers' decisions are influenced by online reviews (due to its persuasiveness and trustworthiness) (Banerjee, Bhattacharyya, and Bose, 2017; Hong, Yu, Wu, and Pu, 2020). However, this lack of impact may be explained by the type of product used as a stimulus, the perception subjects had of the review (whether or not were extreme), and the source of the reviews, because, for instance, males prefer professional blogs over social networks (Prendergast et al., 2018).

Moreover, in line with the findings for **H1.10** group acceptance (**H2.8**) was not influenced by the type of app, meaning that similarly to the physical presence of peers, the virtual presence did not affect subjects in terms of the need to be approved by their friends as they tend to be less dependent on normative social influence (Mangleburg et al., 2004; Mishra et al., 2018).

The data also pointed out that when controlling for others' opinion (**H2.2.1)**, the presence (versus absence) of reviews did not yield any effect on purchase intention, meaning that both virtual and mental presence of others is indifferent in respect of subject's purchase intention, for the same motive mentioned above.

From what was stated above, it was found support hypotheses H2.1, H2.3-7 and H2.8, whereas H2.2, H2.8, H2.10, H2.11 and H2.2.1 were not supported.

9.3.3.Mirror Size: Full-length versus Small Mirror

The objective of this experimental condition was to study whether seeing a full-body reflection of the self, compared to visualising only the foot triggered an effect on subjects' attitude toward AR (H3.1), purchase intention (H3.2), and body image (H3.3). To study such effects, the existence of differences between the groups: full-length versus small mirror was assessed, using the ANOVA technique. Besides this, the moderating effects that the variables related to AR had on attitude toward this technology was tested (H.3.1.1-4), and the role that mood (H.3.2.1) played on the purchase intention. For that study, the ANCOVA technique was used.

Being exposed to a full-body mirror was not different from using a small mirror when trying the Virtual Shoes app, in terms of attitude toward AR (**H3.1**) and purchase intention (**H3.2**). These results may be explained because in a physical store experience one can find both types of mirrors for trying out shoes. Therefore, a change in size seemed not to have contributed to having a better consumption experience, nor does it create any constraints on AR experience. These findings stand in contrast to those that posit that unfavourable body image leads to a more favourable attitude toward AR and a higher intention toward the technology (Yim and Park, 2019). Therefore, both hypotheses were rejected.

It was anticipated that full-body viewing (versus partial) would lead to more negative body image (**H3.3**). However, the data indicate that there were no differences between both views in terms of purchase intention. These findings may be conflicting since when in the presence of a mirror one can compare her/his true reflection to their perception of body image, confronting her/his expectation with the reality (Thompson and Hirschman, 1995). Consequently, this hypothesis was rejected.

Further analyses revealed that the differences among mirrors size were not significant for attitude toward AR when controlling for AR expertise (**H3.1.1**), perceived augmentation (**H3.1.2**), and perceived simulation (**H3.1.3**). It could be understood that regardless of the knowledge one might have regarding AR (**H3.1.1**), it does not moderate the experience with a full-length (versus small) mirror, indicating that expertise is not a variable that influences AR experience. Indeed, the enrichment generated by AR (**H3.1.2**) is indifferent regardless of the mirror size; thus, it does not yield any impact on attitude toward AR technology, which means that the mirror was only an element needed to create the marker-based AR.

Regarding the real perceived presence (**H3.1.4**), it was also non-significant. An explanation for the results, the Virtual Shoes app favoured the visual imagery and this experience might need an overall augmentation, including, for instance, touch and some haptic feedback that may create a multisensorial experience (Heller et al., 2019b).

Moreover, the findings of our study stand in contrast with those where the quality of mental imagery is positively associated with attitude toward a product (Park and Yoo, 2020). Taken together, this information leads us to the conclusion that the three hypotheses above were not supported.

Perceived simulation (**H3.1.3**) was a partially significant controlling variable; perhaps, as it was already said, subjects rated the Virtual Shoes experience as something closer to the digital world rather than the real one. This may be explained by imagery which is a crucial element that supports decision-making (Heller et al., 2019a). However, imagery provided by the app was not enough to create a real feeling of presence in the AR environment in study, because AR solutions whose goal is to substitute a physical store fitting room show high levels of imagery generation and low levels on imagery transformation (Heller et al., 2019a; McLean and Wilson, 2019; Rodríguez-Ardura and Martínez-López, 2014). However, when unaccompanied, it was found that individuals who used the full-length mirror had a more favourable attitude toward AR than those who used the small mirror, which means that even after the value of perceived simulation was discounted, being unaccompanied and using a full-length mirror still impacts attitude toward AR. An explanation for the results might be because when alone, the experience became more pleasurable and unique to consumers.

9.3.4. Impact of the Context on Attitude toward AR and Purchase Intention

To study the impact of different m-commerce contexts on young consumers' attitudes toward AR (H4) and purchase intention (H5), it was applied a multivariate data analysis technique, the logistic regression. Firstly, both variables were categorically clustered according to the probability of having a high versus low attitude toward technology and purchase intention. Using this multivariate data analysis technique, we examined whether other experimental conditions influenced the DVs attitude toward AR (H4) and purchase intention (H5) negatively.

The data indicate that for the likelihood to have a favourable attitude toward AR (**H4**), 87.4% of overall cases were classified, i.e., approximately 87% of participants expressed a favourable attitude toward AR. Moreover, the group that expressed a significant, and opposing effect, was the one that tried the app with the reviews, unaccompanied and using the small mirror. This result may be explained by the fact that this is one condition that mimics an example of traditional m-commerce app testing, i.e. when one downloads an app s/he tries it unaccompanied, and as it is an m-commerce app the consumers use it by themselves (the use of an AR app would be social/accompanied when it enables two people to use it, through online chats [e.g., Facebook] or as it is the case of the filters of Snapchat, Instagram, and Facebook Messenger). The presence of reviews can be explained by their presence being frequent on e-commerce websites (Trevinal and Stenger, 2014).

Moreover, other variables that contributed positively to a favourable attitude toward AR are ease of use, projection, perceived augmentation, which is explained by the fact that such variables contribute to the development of an optimal AR experience. Also, negative reviews positively influence attitude toward AR, since they help to inform consumers, helping their decision-making process. The data also suggested that esteemed one's opinions (i.e., having in mind what the people one esteems believe) and the sense of autonomy (i.e., not being influenced by others' opinion) negatively influence the attitude toward AR, whereas friends' opinion influence it positively. These findings may be explained by the fact that young adults are becoming increasingly independent, and they are developing a mind of their own; thus, engaging in an affirmation of their relative independence (Palfrey and Gasser, 2008; Smith, 2019).

Additionally, the mood was also negatively associated with attitude toward AR, which means that those who are in a positive mood have a less favourable attitude toward AR. This finding is surprising because when one has a pleasant experience, it is expected that subjects report positive emotions and that their attitude toward the cause of such evaluation is positive (Gardner and Hill, 1988). However, it is reported in the literature that a positive mood impacts negatively decision-making (Etkin and Ghosh, 2018), and that might be a reason to explain the less favourable attitude toward AR. Therefore, H4 was not supported.

For the likelihood of buying shoes using an AR m-commerce app (**H5**), the model successfully classified 83.6% of overall cases. Thus, almost 84% of the subjects revealed a favourable intention to purchase shoes using Virtual Shoes app. The experimental condition that influenced participants significantly, and against what was expected, was trying the app without reviews, unaccompanied and using the full-length mirror. This may be explained by the fact that being unaccompanied represents the most common situation when buying through a mobile app/website. Also, the full-length mirror helps the simulation of the physical store environment. However, not having reviews is a contradictory finding, since they are relevant for decision-making, especially for males (Jiménez and Mendoza, 2013; Trevinal and Stenger, 2014). Moreover, the data shows that young males are more prone to have a favourable purchase intention when using an AR m-commerce app, possibly because using retailers mobile apps creates enjoyable experiences (McLean, Al-Nabhani, and Wilson, 2018).

In contrast to the findings related to the attitude toward AR, where there was a prevalence of variables related to the AR experience, for purchase intention, only projection and real perceived presence are significantly and positively linked to purchase intention. Whereas projection is useful in providing information regarding the shoes, real perceived presence is relevant to the realism of the augmented product, which also contributes to gathering more information regarding the product and ultimately affects the purchase decision. This fact is relevant because AR is a technology that helps to provide more information to the consumers when compared to an online purchase, thus reducing mental intangibility and consequently evaluation difficulty and perceived risk (Cruz et al., 2019; Huang and Liao, 2015; Laroche et al., 2005).

It was also found that influencers and sellers & experts opinions are positively associated with a favourable purchase intention, possibly because consumers perceive them as knowledgeable individuals, whose opinion is informed, not biased, original and unique (Casaló et al., 2020).

Additionally, online reviews exert a negative influence over purchase intention, possibly explained by issues related to the tone of the review, the source of credibility, and the type of review presented, maybe because subjects were only exposed to text, and perhaps they would appreciate having more information, like some photographs or video (Prendergast et al., 2018). As predicted, attachment to the physical store is negatively linked to purchase intention because the lower the degree of the attachment of a consumer to a physical store, the higher her/his intention to purchase using an m-commerce app (i.e., of replacing the physical store by a virtual one) (Brocato et al., 2015).

Finally, body image also indicates a negative association to purchase intention, meaning that individuals who have a less favourable body image show a more favourable purchase intention. Despite there being some support to the claim that body image is related to purchase intention (Rieke et al., 2016), the negative connection we found could be explained by the fact that those with lower body image prefer to shop unaccompanied, without the presence of others (which, according to the above-presented results, is the main characteristic of m-commerce shopping). Therefore, H5 could not be sustained.

9.4. Theoretical Contributions

This study contributes to the existing body of knowledge by shedding some light on consumer behaviour in new digital media, through the study of consumers' shopping experience using mobile apps and different levels of social presence. More precisely, this research compares the presence (versus absence) of physical peers (shopping context), the presence (versus absence) of virtual others (reviews) (the type of app), and the type of body visualisation (full body versus partial view) in young adults' m-commerce experience.

This research provides the groundwork for the study of consumers attitude toward AR technology and their intention to purchase when using AR m-commerce apps; thus contributing to the understanding of the emerging trend of m-commerce and the incorporation of AR in firms' strategies, that lead to the development of more immersive customers experience (Flavián et al., 2019; Watson, Alexander, and Salavati, 2018).

Until now, very few studies have focused on the study of shared AR experiences within the retail context. The majority of studies that focus on AR shared experiences are related to the use of collaborative AR interfaces to promote remote collaboration, for training, education, and gaming (Billinghurst and Kato, 2002; Echeverría et al., 2012; Rolland et al., 2005; Von Der Pütten et al., 2012). However, the study of AR uses in the retail industry has started to emerge recently (Caboni and Hagberg, 2019; Grewal et al., 2020).

Shopping can be perceived as a networked experience (especially for emerging adults), no longer limited to the retail store, since consumers are always connected to their social networks and other digital forms of communication (Pantano and Gandini, 2018). The rise of social AR in the retail industry has garnered notable attention (Caboni and Hagberg, 2019), especially for mobile augmented reality (MAR) apps (Scholz and Duffy, 2018). Examples of that are Sephora app[33] and Dulux Visualizer App [34] that enable consumers to try make-up and to choose the colour of the living place, respectively, and share it with friends; thus creating a new communication channel (Grewal et al., 2020; Hilken et al., 2020).

Additionally, MAR apps provide other sources of value for:

- Consumers, due to MAR ability to enhance projection, perceived real presence, and increasing products tangibility (Heller et al., 2019b; Vonkeman et al., 2017), and
- Retailers, creating engaging customers' experiences (Bonetti, Warnaby, and Quinn, 2018; Scholz and Smith, 2016), garnering more information about customer's behaviour, increasing sales volume (Caboni and Hagberg, 2019), among others.

Moreover, AR has been incorporated in fashion retailing; therefore, this study provides some measurement of such an impact (Colombi, Kim, and Wyatt, 2018).

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[33] Sephora Visual Artist, https://sephoravirtualartist.com/landing_5.0.php?country=US&lang=en&x=&skintone=&currentModel, accessed on 26/01/2020

[34] Dulux Visualizer App, https://www.dulux.co.uk/en/articles/dulux-visualizer-app, accessed on 26/01/2020

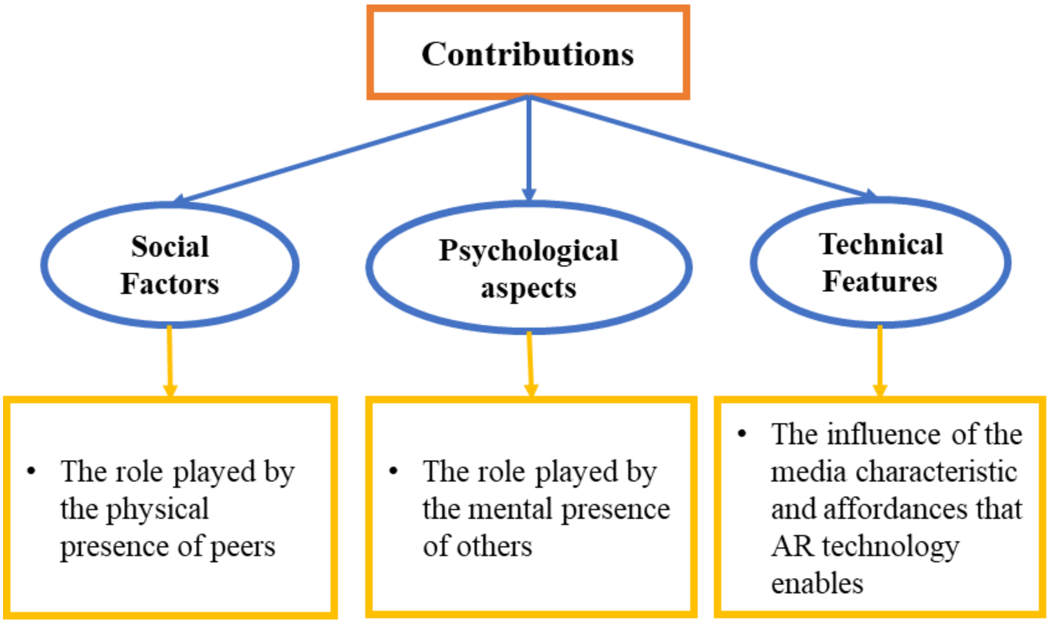
Furthermore, this research presents some knowledge regarding how the social network dimension applies to AR fashion m-commerce, especially among young adults who are the early adopters of AR-enabled shopping (DigitalBridge, 2017). The results of our work indicate that neither the physical presence of peers, the virtual presence of reviews, nor the mental presence of others has a significative impact on the attitude toward AR or purchase intention, at least for the young adults under analysis.

Another contribution to this area of study is the fact that even for novel consumptions platforms, there are some characteristics from e-commerce websites that should be kept constant when moving to an m-commerce app, as it is the case of the presence consumers ratings and reviews.

From a multivariate analysis perspective, when studying consumers attitudes toward AR, the most pertinent variables are those related to the AR experience (e.g. ease of use or perceived augmentation) show that particular attention should be paid to these elements (Kim and Hyun, 2016). On the other hand, when the research focus is the purchase intention, the emphasis is more on variables related to other's opinion (e.g. influencer's or sellers & experts).

The contributions supplied by our research are threefold, (1) by providing a better comprehension of the role of **social factors** (introduced by the physical presence of peers), (2) **psychological aspects** (presented by the role of the mental presence of others), as well as (3) **technical features** (the media characteristic and affordances that AR technology enables) within and AR m-commerce app, regarding consumers attitude toward technology and purchase intention. Moreover, some interesting findings to the literature related to social influence on consumer psychology in the age of digital and mobile technology are presented (Argo, 2020; Argo and Dahl, 2020) (see Fig. 9. 1).

Fig. 9. 1 – Summary of the main contributions of our thesis



Summing up, the contributions from this research bring insights from different disciplines and areas, such as marketing, psychology, and human-technology interaction, aiming to create a holistic comprehension of the impact of technological developments have on the retail environment and subjects.

9.5. Managerial Implications

Augmented Reality is a field in constant change and development which demands continuous research that helps practitioners to better comprehend and apply such technology.

Within the scope of this study, this work aims to contribute to managers practice, especially those who utilise mobile augmented reality (MAR) apps. Managers can use MAR apps for multiple goals, such as increasing brand awareness, developing interactive advertisements, fostering consumers-brands relationships, but most importantly for m-commerce solutions, helping consumers to visualise the product (for apparel purchase) or the final result of a purchase (e.g. in the case of make-up and decoration apps). Therefore, m-tailers (retailers that use m-commerce channel) should redefine their marketing strategies taking into consideration that customers (especially younger ones) value convenience (Wang et al., 2015) and realistic and vivid product visualisations. Therefore, for those apps that rely only on visual augmentation (such as IKEA for furniture, Ray-Ban for eyewear, or Wanna Kicks for trainers), companies should invest in developing

MAR apps whose imagery quality is high (Park and Yoo, 2020). It is in this condition that strategies can be delineated to develop a ubiquitous experience, highly customised, which creates a unique shopping experience. Moreover, they should invest in other technical aspects, such as haptic and sound control and feedback (Heller et al., 2019b) which makes the intangible product more tangible.

A second element that managers should take into consideration is the increasing evidence of social AR. Although in this research, no evidence was found that supported the need to consider the role played by third parties in the mobile shopping context. Other studies are starting to analyse the incorporation of social network platforms and image sharing within their AR apps (Grewal et al., 2020; Hilken et al., 2020). This incorporation of the social aspect can be reached by adding a sharing option within the app that allows consumers to create communication channels to those people who may exert some influence over their decisions.

Moreover, as logistic regression results showed, if a company focuses on delivering enhanced customers experiences whose focus is not a direct purchase intention, it should invest in improving technical affordances of technology. If the target is the direct purchase intention, firms must invest in the social element of the purchase, as well as the sensory enrichment, i.e., they should provide an experience beyond the visual augmentation, for instance appealing to the sense of touch or a multisensory experience.

Thirdly, managers could rethink the rationale behind the m-commerce experience, meaning this experience does not necessarily have to involve only one person. If firms invest in AR m-commerce solutions that allow two consumers to interact with the technology, they can broaden its scope to permit the inclusion of a companion where both people involved can choose the apparel or fashion accessory simultaneously. This makes the mobile shopping experience more similar to the one in a physical store where it is known that people tend to shop more when accompanied (Borges et al., 2010).

9.6. Limitations and Direction for Future Research

This research contains some limitations that require acknowledgement. Firstly, the target population of this study was Portuguese university students, with a mean age 20-21 years old. Although this demographic represents the early adopters of AR technology, other age groups should be considered, namely adults. Also, some cross-cultural comparison studies should be conducted to assess whether there are differences amongst young Portuguese college students versus those from other countries (e.g. Anglo-Saxon, Arabic, Northern Europe, and those from Eastern countries) (Pantano et al., 2017).

The type of product used in the stimulus (shoes) is also a limitation since one could use other products (apparel or accessories) which elicited more involvement. Therefore, future research should use the same type of experimental design comparing products with different degrees of product involvement (e.g. shoes versus clothes versus fashion accessories).

Furthermore, the replication of the study with the markerless AR (ML AR) app (such as Wanna Kicks[35]) would also be another direction for future research. The main reason for that is that ML AR apps potentially allow two different people to try the same shoe, fostering the study of mobile co-shopping (Wei, Seedorf, Lowry, Thum, and Schulze, 2017). Moreover, it would allow for the comparison of the effectiveness of both marker-based and ML tracking systems, similar to the work of Brito and Stoyanova (2018). Also, its user interface is designed in such a way that the buttons to share on social networks are more visible, promoting the study of social AR (Hilken et al., 2020), and by using it, one could effectively measure the actual purchase of trainers because it is linked to the Amazon.com website. Among the drawbacks of such app, there is the fact that it was only available on after the conclusion of our empirical study and that it only offers trainers, and it limits the field of view of the app, making it similar to the small mirror condition.

Moreover, it could also have been developed another experimental condition where it was compared to the used platform, allowing for the com mobile app versus website.

Another issue that requires attention is related to the variables in the study. For example, other variables related to the human-technology relationship and shopping could have been included. Those related to technology are technology readiness, i.e., "*people's propensity to embrace and use new technologies for accomplishing goals in home life and at work*" (Parasuraman, 2000, p. 308, emphasis in original) and trust, to assess subjects predisposition to purchase in mobile platforms and the related impact of perceived social presence (Baker et al., 2019). Shopping motivation could also have been included as an alternative measurement of product involvement, given that the motivation

[35] Wanna Kicks: https://wanna.by/ accessed on 01/11/2019

to buy the product is an element that forms part of the preponderance process in the attitude and consumption experience (Wenzel and Benkenstein, 2018).

In relation to the social influence component, this study falls short on the differentiation of the type of influence that the different reference groups have on the subjects, i.e. informational versus normative influence versus value-expressive (Argo, 2020; Luo, 2005; Mangleburg et al., 2004; Mascarenhas and Higby, 1993). Moreover, the distinction between active versus passive social presence was only conducted for the physical and the virtual presence of others (Argo and Dahl, 2020). Therefore, in the future, the same distinction should be applied to assess the level of mental presence of other people.

Another experimental condition that should be explored in the future is the presence of family members, in order to verify or not the replication of this study replacing the company of peers by family, would yield the same results of past studies, that the presence of family deters shopping intention (Borges et al., 2010; Luo, 2005).

Additionally, it would be relevant to have some assessment of the ‘direct’ influence of digital influencers, perhaps by incorporating short videos of them recommending products in the experimental design stimulus.

One perspective our research did not address was the use of alternative instruments to collect quantitative data which may overcome the inherent bias of self-reported measurements. Therefore, in the future, some biometrics (such as skin conductance or heart rate variability) and neurometrics (like electroencephalogram) could be used to overcome such shortcomings of traditional marketing research instruments (Noble, 2013; Perannagari and Chakrabarti, 2019).

Chapter 10 Conclusions

Our thesis aims to provide knowledge regarding the social, psychological and technical factors that influence an AR m-commerce experience, through the combination of a set of three stimuli: shopping context (unaccompanied or accompanied), type of app (with or without reviews), and type of mirror (full-length or small) and using several of constructs.

The main goal of this thesis is to answer the following research questions:

1. What is the role of social influence (induced by the presence of peers and reviews & ratings) in attitudes toward AR and purchase intention in an AR m-commerce context?
2. What impact do the mental presence of others and mood have as moderators of consumers purchase intention?
3. What impact do technological aspects inherent to augmented reality have as moderators of the consumers' attitude of toward AR? And,
4. What is the role of body image (introduced through the visualisation of the reflection of the whole body or only part of it) on consumer's attitude towards technology and purchase intention in an AR m-commerce context?

In order to answer these questions, the first step was to develop an AR m-commerce app to be used as the technological element of this study. Then, this app was tested during the conduction of the qualitative study that involved a set of 34 interviews with undergraduate students. From this study, two main aspects influence consumers AR experience were extracted: the presence of others and the quality of the app. Moreover, the qualitative study provided crucial insights into the development of new constructs (especially those related to the mental presence of others), to fine-tune some others, and to develop the questionnaire. Then, it was employed a between-subjects pre-test-post-test experimental design, where participants were exposed to one of five experimental conditions.

As a consequence, the study sought to gather knowledge regarding the AR expertise, products involvement, attachment to the physical store, focused attention, body image, family's opinion, influencers' opinion, online reviews influence, peer/friends' opinion, sellers & experts' opinion, others' opinion, autonomy, esteemed ones' opinion, negative reviews influence, imagery, projection, perceived augmentation, perceived simulation, real perceived presence, digital perceived presence, ease of use, mood, attitude toward AR, and purchase intention.

It was found that the presence (versus absence) of peers did not affect subjects' attitude toward AR nor their purchase intention; thus, answering the first research question. Moreover, neither the mood nor the mental presence of others had no impact on consumers' purchase intention. With regard to technical aspects inherent to AR, almost none of the studied variables were a moderator of the attitude toward AR, except for real perceived presence from which some effect was detected. Lastly, the introduction of different mirrors sizes did not yield any impact on the subjects' body image neither in respect of attitude toward AR nor concerning purchase intention.

Despite these findings, the main contribution of this research lies in the fact that the specific research setting could be pinpointed, as well as the variables that influenced most the attitude toward AR and purchase intention.

Overall, it was found that in the way that the AR experience was designed, AR mobile shopping is a lonely activity. However, if the app had focused more on the fostering of sharing the AR visualisation, and if the laboratory setup did not constrain it, perhaps the role of social AR could have been explored.

Moreover, when the research focus was the variable attitude toward AR, the most salient aspects were those related to the AR affordances along with mood. Conversely, when the emphasis was on the purchase intention, the mental presence variables were crucial, along with the attachment to the physical store and body image.

As a final point, this study was the first, to the best of the author s' knowledge, to approach AR mobile shopping from a social perspective, especially taking the role of physical, mental and virtual presence of others into consideration.

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APPENDICES

Appendix 1 - Questionnaire

This study aims to capture the consumer perspective on new consumption experiences in the Digital Age. Participation involves answering a questionnaire (± 15 min). Participation in this study is voluntary, and you may withdraw at any time. These answers are anonymous and confidential. The delivery of the survey is indicative of your consent to participate in this study.

All the information recorded will be strictly confidential and kept under the General Data Protection Regulation (Regulation (EU) 2016/679) (GDPR), the Data Protection Act 2018, and used only by researchers working within the research team. All the gathered data is confidential and will only be published with anonymity guaranteed, leaving no possible identification of the respondent.

If you have any questions about this project or any research-related problem, do not hesitate to contact the researcher Mafalda Teles Roxo by the email mafalda.t.roxo@inesctec.pt

1. Rate your relationship with mobile apps (apps) in terms of:

1.1 Interest	1 - Very Uninterested ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 - Very Interested ○
1.2 Frequency of use	1 – Very Rarely ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 – Very Often ○

2. What is your experience doing online shopping?

1 – Very Inexperienced ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 – Very Experienced ○

3. When was the last time you made an online purchase?

Never ○	Last Year ○	In the past 3 months ○	Last month ○	Last week ○

4. How often do you use purchase-related apps (for purchase or consultation)?

	Never	Last year	In the past 3 months	Last month	Last week
4.1 For Consultation	○	○	○	○	○
4.2 For Purchasing	○	○	○	○	○

5. Augmented Reality (AR) is the real-time overlap of digital elements in the real world, using devices such as smartphones, computers, and more. Examples include Instagram and Snapchat filters, the IKEA app. Given this fact: How do you position yourself regarding Augmented Reality?

5.1	1- Nothing Familiar ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 - Very Familiar ○
5.2	1- Very Inexperienced ○	2 ○	3 ○	4 ○	5 ○	6 ○	7- Very Experienced ○
5.3	1 - Very Misinformed ○	2 ○	3 ○	4 ○	5 ○	6 ○	7 - Very well Informed ○

6. Regarding the purchase of shoes:

	1 - Strongly Disagree	2	3	4	5	6	7 - Strongly Agree
6.1 I am particularly interested in shoes	○	○	○	○	○	○	○
6.2 Given my personal interests, this product is not relevant to me	○	○	○	○	○	○	○

6.3 Overall, I get very involved when I buy shoes	○	○	○	○	○	○	○
6.4 I can't imagine buying shoes other than in a physical store	○	○	○	○	○	○	○
6.5 I feel better when I shop in a physical store than in an online store (website or mobile app)	○	○	○	○	○	○	○
6.6 I wouldn't be comfortable if an app permanently replaced the physical store	○	○	○	○	○	○	○
6.7 Not being able to buy back from a physical store is something that worries me	○	○	○	○	○	○	○

DEMOGRAPHIC CHARACTERISTICS

Age: ________

Gender: ☐ Female ☐ Male

Nationality: ________________________

Academic Degree (last completed degree):

☐ Elementary School ☐ High School ☐ Bachelor Degree ☐ Master Degree ☐ Ph.D. ☐ Other? _________

What course do you attend? ____

What college do you attend? ____

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7. Did you find any product review in the app?

☐ No ☐ Yes

8. Did you have someone at your side to share the experience of viewing the AR shoe with you?

☐ No ☐ Yes

9. How big was the mirror you used to try the app?

☐ Small (±50cm) ☐ Full-length mirror (1,50m)

10. Even when I'm alone (unaccompanied), I feel accompanied by the people I have esteemed:

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

11. When I have to make certain decisions, even on my own (unaccompanied), I feel like I'm discussing / talking / listening to the opinions of the people I like:

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

12. I keep present in my mind the opinions of the people I value, even when they are not present

	1	2	3	4	5	6	7	
Strongly Disagree	○	○	○	○	○	○	○	Strongly Agree

13. I sometimes imagine myself exchanging ideas with people who interest me in times of some pressure

	1 2 3 4 5 6 7	
Strongly Disagree	○ ○ ○ ○ ○ ○ ○	Strongly Agree

14. Before I buy, I think about what people like, and then consider buying or not

	1 2 3 4 5 6 7	
Strongly Disagree	○ ○ ○ ○ ○ ○ ○	Strongly Agree

15. When I'm ALONE (unaccompanied) shopping, how much do you value FAMILY's opinion

	1 - Nothing	2	3	4	5	6	7 – Very Much
15.1 Physical store	○	○	○	○	○	○	○
15.2 Online store	○	○	○	○	○	○	○

16. When I'm ALONE (unaccompanied) shopping, how much do you value FRIENDS' opinion

	1 - Nothing	2	3	4	5	6	7 – Very Much
16.1 Physical store	○	○	○	○	○	○	○
16.2 Online store	○	○	○	○	○	○	○

17. When I am ALONE (unaccompanied) shopping, how much do you value the opinion of INFLUENCERS (Instagrammers, bloggers, celebrities)

	1 - Nothing	2	3	4	5	6	7 – Very Much
17.1 Physical store	○	○	○	○	○	○	○
17.2 Online store	○	○	○	○	○	○	○

18. When you buy ALONE (unaccompanied) to what extent do you value:

	1 - Nothing	2	3	4	5	6	7 – Very much
18.1 Seller's opinion in a physical store	○	○	○	○	○	○	○
18.2 Reviews in a website	○	○	○	○	○	○	○
18.3 I am not influenced by the opinion of others	○	○	○	○	○	○	○

19. What is the role of the FAMILY when you buy ALONE (unaccompanied):

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
19.1 I value family's opinion	○	○	○	○	○	○	○
19.2 I was brought up like this	○	○	○	○	○	○	○
19.3 I am not influenced by the opinion of others	○	○	○	○	○	○	○

20. What role do FRIENDS play when you buy ALONE (unaccompanied):

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
20.1 I value friends' opinion	○	○	○	○	○	○	○
20.2 To be accepted by the group	○	○	○	○	○	○	○

20.3 I am not influenced by the opinion of others	○	○	○	○	○	○	○

21. What is the role of INFLUENCERS when you buy ALONE (unaccompanied):

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
21.1 I value the opinion of influencers	○	○	○	○	○	○	○
21.2 I want to be like them	○	○	○	○	○	○	○
21.3 I am not influenced by the opinion of others	○	○	○	○	○	○	○

22. When you are shopping alone (unaccompanied) in a PHYSICAL STORE, what do you think about the influence of:

	1 - Influences LEAST	2	3	4	5	6	7 - Influences MOST
22.1 Family	○	○	○	○	○	○	○
22.2 Friends	○	○	○	○	○	○	○
22.3 Influencers	○	○	○	○	○	○	○
22.4 Experts	○	○	○	○	○	○	○
22.5 Sellers	○	○	○	○	○	○	○
22.6 I am not influenced by the opinion of others	○	○	○	○	○	○	○

23. When you are shopping alone (unaccompanied) in an ONLINE STORE, what do you think about the influence of:

	1 - Influences LEAST	2	3	4	5	6	7 - Influences MOST
23.1 Family	○	○	○	○	○	○	○
23.2 Friends	○	○	○	○	○	○	○
23.3 Influencers	○	○	○	○	○	○	○
23.4 Experts	○	○	○	○	○	○	○
23.5 Online Reviews	○	○	○	○	○	○	○
23.6 I am not influenced by the opinion of others	○	○	○	○	○	○	○

24. The presence of reviews evaluating the product I see in an online store/app change:

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
24.1 my perception of the product	○	○	○	○	○	○	○
24.2 my purchase decision	○	○	○	○	○	○	○
24.3 the perception of the product of the consumer in general	○	○	○	○	○	○	○
24.4 the purchase decision of the consumer in general	○	○	○	○	○	○	○

25. How do you adjust your online store/app purchase decision by seeing other buyers' opinions by viewing

	1 - Negatively	2	3	4	5	6	7 - Positively
25.1 positive reviews	○	○	○	○	○	○	○
25.2 negative reviews	○	○	○	○	○	○	○

26. While using the app…

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
26.1 I was deeply engrossed in the task	○	○	○	○	○	○	○
26.2 I was absorbed intently in the task	○	○	○	○	○	○	○
26.3 I was concentrated fully in the task	○	○	○	○	○	○	○
26.4 My attention was focused on the task	○	○	○	○	○	○	○

27. It is important to know the opinions of others about their shopping experience with shoes from online stores/app…

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
27.1 ... to have some assurance	○	○	○	○	○	○	○
27.2 ... to reduce my negative feelings	○	○	○	○	○	○	○
27.3 ... to reduce my uncertainty	○	○	○	○	○	○	○
27.4 ... to increase my confidence in the app as a store.	○	○	○	○	○	○	○

28. Regarding your body image:

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
28.1 I am satisfied with the way my body looks	○	○	○	○	○	○	○
28.2 I wish to change the shape of parts of your body	○	○	○	○	○	○	○

With regards to your experience with the app

29. Viewing shoes through the app was...

	1	2	3	4	5	6	7	
29.1 Unclear	○	○	○	○	○	○	○	Clear
29.2 Unreal	○	○	○	○	○	○	○	Real
29.3 Undefined	○	○	○	○	○	○	○	Defined
29.4 Indistinct	○	○	○	○	○	○	○	Sharp
9.5 Static	○	○	○	○	○	○	○	Dynamic

30. The app has affordances that…

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
30.1 ... allow me to imagine using the product	○	○	○	○	○	○	○
30.2 ... allow me to see my body with the product on me	○	○	○	○	○	○	○
30.3 … helps to simulate touching the product	○	○	○	○	○	○	○
30.4 ... helps to simulate the manipulation of the product	○	○	○	○	○	○	○

31. Indicate your degree of agreement

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
31.1 While I was using the app, I felt I was more in a ‘virtual world’ that the ‘real world’	○	○	○	○	○	○	○
31.2 While trying the app, I felt I was in a digital world	○	○	○	○	○	○	○
31.3 During my experience on the app, the product seemed to me to belong more to the ‘real world’ rather than from the ‘virtual world.’	○	○	○	○	○	○	○
31.4 While I was using the app the products were presented as if they belonged to the ‘real world’	○	○	○	○	○	○	○
31.5 The experience I had on this app was similar to memories of experiencing the product in reality	○	○	○	○	○	○	○
31.6 I experienced the product on the app like they belong to the real world	○	○	○	○	○	○	○
31.7 When using the app, I felt that something enriched my image	○	○	○	○	○	○	○
31.8 After I stopped using the app, I could still imagine myself using the product	○	○	○	○	○	○	○
31.9 The product seemed completely real	○	○	○	○	○	○	○
31.10 I felt that the product did not add anything visually	○	○	○	○	○	○	○
31.11 The app visually enriched my reality	○	○	○	○	○	○	○
31.12 The image I see conveys enough information regarding the product to understand how it really is	○	○	○	○	○	○	○
31.13 It is easy to see me with the product through the app	○	○	○	○	○	○	○
31.14 It is easier to see myself with the product using the app than on website	○	○	○	○	○	○	○

32. Indicate your degree of agreement

	1 – Strongly Disagree	2	3	4	5	6	7 – Strongly Agree
32.1 Learning to use the app was easy for me	○	○	○	○	○	○	○
32.2 It was easy to make the app do what I wanted it to do	○	○	○	○	○	○	○
32.3 My interaction with the app was clear and understandable	○	○	○	○	○	○	○
32.4 Using the app required little effort	○	○	○	○	○	○	○
32.5 I found the app easy to use	○	○	○	○	○	○	○

33. Overall, the perception of my experience using this Augmented Reality app was:

		1	2	3	4	5	
33.1	Unfavourable	○	○	○	○	○	Favourable
33.2	Bad	○	○	○	○	○	Good
33.3	Unpleasant	○	○	○	○	○	Pleasant
33.4	Negative	○	○	○	○	○	Positive
33.5	Poor	○	○	○	○	○	Rich

34. How do you rate your intention to buy shoes through this app?

		1	2	3	4	5	
34.1	Uncertain	○	○	○	○	○	Certain
34.2	Improbable	○	○	○	○	○	Probable
34.3	Impossible	○	○	○	○	○	Possible

35. Describe your current mood:

		1	2	3	4	5	
35.1	Relaxed	○	○	○	○	○	Anxious
35.2	Confident	○	○	○	○	○	Unsure
35.3	Happy	○	○	○	○	○	Unhappy
35.4	Cheerful	○	○	○	○	○	Depressed
35.5	Satisfied	○	○	○	○	○	Unsatisfied
35.6	Energetic	○	○	○	○	○	Tired
35.7	Stimulated	○	○	○	○	○	Relaxed

Appendix 2 - The profile of the interviewees

Respondent	Age	Gender	Online Shopping		Installed Apps
			Frequency	Purchased Goods	
E1	19	Female	Rarely	Books	Social Media
E2	19	Female	Rarely	Books, Clothes, Shoes	Social Media, Transportation
E3	19	Female	Sometimes	Trainers, Clothes, Swimwear	Social Media, Fashion Apps, Telecom. Service Provider, Photo Editor, Finance
E4	19	Female	Rarely	Books, Clothes	Social Media, Fashion Apps, Games, Finance
E5	19	Female	Very Often	Clothes, Gadgets, Gizmos	Social Media, Finance
E6	20	Male	Rarely	Books, Clothes	Social Media, Sports
E7	20	Male	Rarely	Clothes, Music Material, Mobile & Computer Accessories	Social Media
E8	20	Female	Very Often	Clothes, Mobile & Computer Accessories	Social Media, Photo Editor
E9	21	Female	Rarely	Books	Social Media, Sports; Health
E10	19	Male	Rarely	Clothes, Swimwear, Watches	Social Media
E11	19	Female	Very Often	Clothes, Swimwear	Social Media, Fashion Apps, Shopping, Tourism, General, Video
E12	19	Female	Sometimes	Clothes, Swimwear	Social Media, Fashion Apps, Shopping, Video
E13	22	Female	Very Often	Clothes, Shoes	Social Media, Fashion Apps, Transportation, Finance, Tourism
E14	19	Female	Rarely	Clothes	Social Media, Photo Editor
E15	19	Female	Rarely	Books	Social Media
E16	19	Female	Rarely	Books	Social Media, Fashion Apps, GPS
E17	20	Male	Rarely	Games	Social Media, Finance, General
E18	21	Female	Very Often	Clothes, Shoes, Mobile & Computer Accessories	Social Media, Health, Shopping
E19	20	Female	Sometimes	Clothes, Shoes, Mobile & Computer Accessories, Nursing Material	Social Media, Fashion Apps
E20	19	Female	Very Often	Trainers, Gadgets, Mobile & Computer Accessories	Social Media, Transportation, Shopping
E21	22	Male	Very Often	Shoes, Games, Technology, Watches	Social Media, Transportation, General, Productivity

E22	22	Male	Very Often	Technology	Social Media, Shopping, Finance, General
E23	19	Male	Rarely	Clothes, Mobile & Computer Accessories	Social Media, Games, General
E24	20	Male	Rarely	Mobile & Computer Accessories	Social Media, Sports
E25	19	Male	Very Often	Travels, Gizmos, Sports Supplements	Social Media, Shopping, GPS, Finance
E26	22	Male	Very Often	Mobile & Computer Accessories	Social Media, Shopping, News, Video
E27	19	Male	Very Often	Trainers, Technology	Social Media, Sports, Shopping, Tourism
E28	19	Male	Sometimes	Clothes, Mobile & Computer Accessories	Social Media
E29	20	Male	Rarely	Technology	Social Media, Telecom. Service Provider, Games, General
E30	21	Male	Sometimes	Sports Material	Social Media, Transportation, Shopping, GPS, Music, Finance, General, Video
E31	19	Male	Sometimes	Mobile & Computer Accessories	Social Media, Games, Transportation, Shopping, News, Finance, Productivity
E32	10	Male	Rarely	Mobile & Computer Accessories, Technology	Social Media, Health, Shopping, News, Finance
E33	19	Male	Rarely	Mobile & Computer Accessories, Technology	Social Media, Health
E34	20	Male	Rarely	Mobile & Computer Accessories, Technology	Social Media, Games, Shopping, Tourism, General, Video

Appendix 3 - Informed Consent for Participation in the Interview

Dear Participant,

We will ask you to read this short text. Before giving your permission to participate in this study, feel free to ask all the questions you want/need.

This research takes place within the PhD in Management (Strategy and Marketing) of the School of Economics and Management of the University of Porto. It aims to study some variables related to New Forms of Purchasing in the Digital Age. For this purpose, we need you to answer some questions through a semi-structured interview.

Your participation is essential. However, it is voluntary. We guarantee that all data collected is confidential and only for scientific research purposes. The investigator is available for any clarification.

I ask you to authorize the conduction of the interview and to agree to make audio recordings (and possibly get some photographs that show your interaction with a mobile application – your face will not be captured) that we need for our study.

We also request your permission to use the information and data collected in our study.

We assure the confidentiality of all information collected. The data will only be used for scientific elaboration and dissemination, respecting the privacy and anonymity of all participants.

We assure you that we will not use or disclose your name or any identifying information.

I, ____ authorize the researcher Mafalda Teles Roxo to collect data for her investigation. I authorize the recordings of the interview and declare that I am not opposed to using them for his study, provided anonymity is guaranteed.

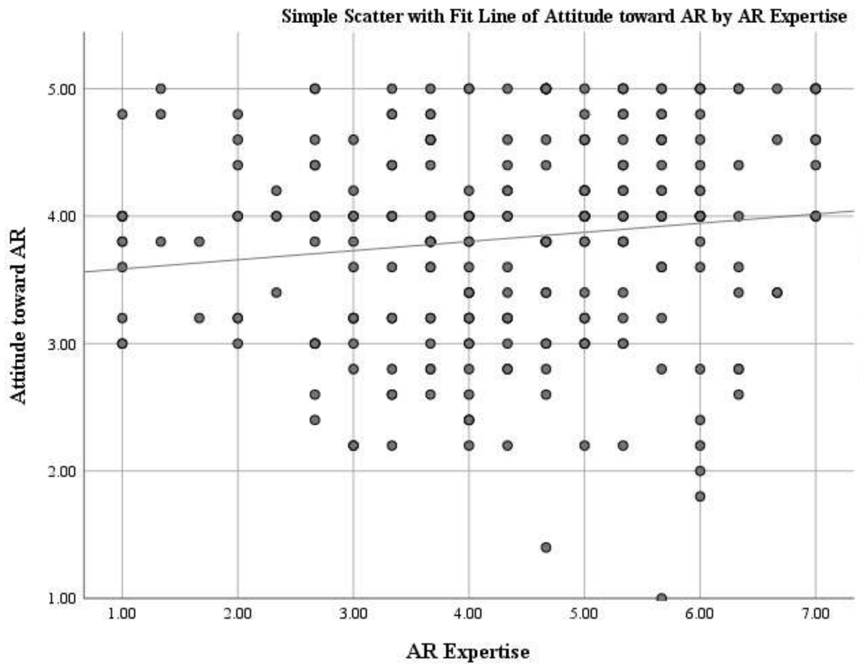
Respondent: ____________________________________

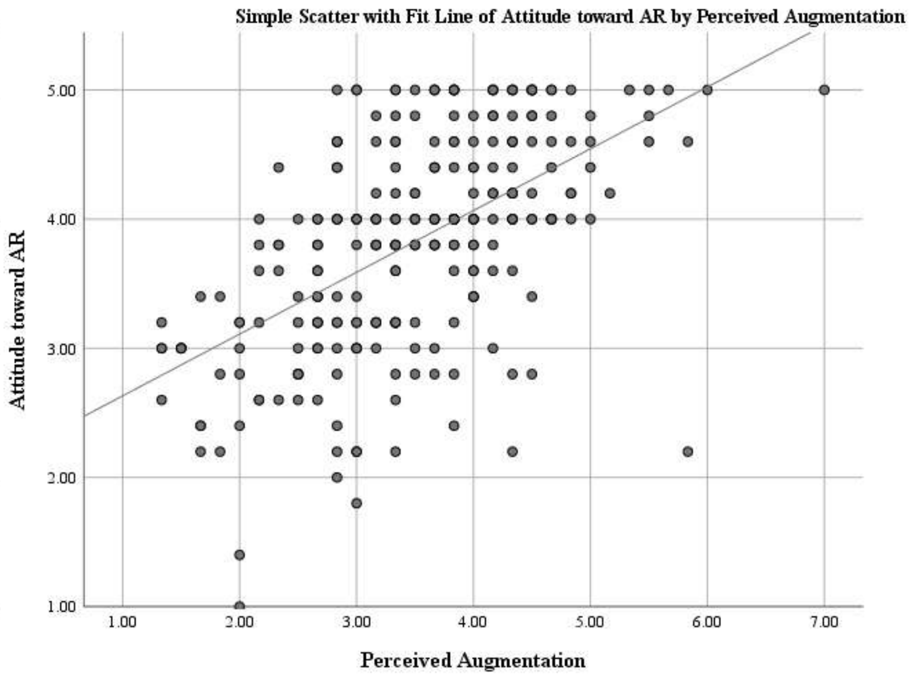
Researcher: ________________________________

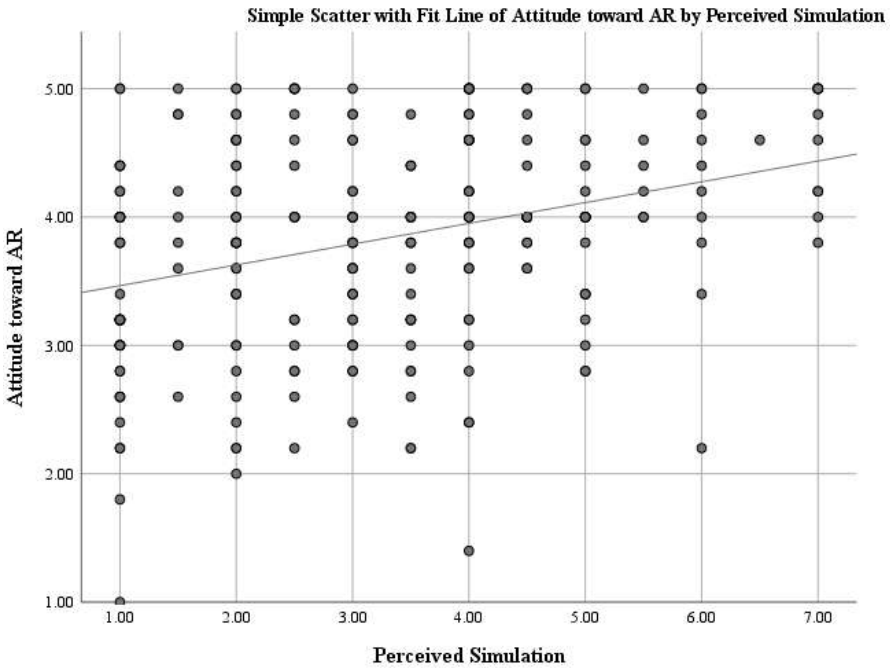
Appendix 4 - Central tendency, dispersion and shape measures

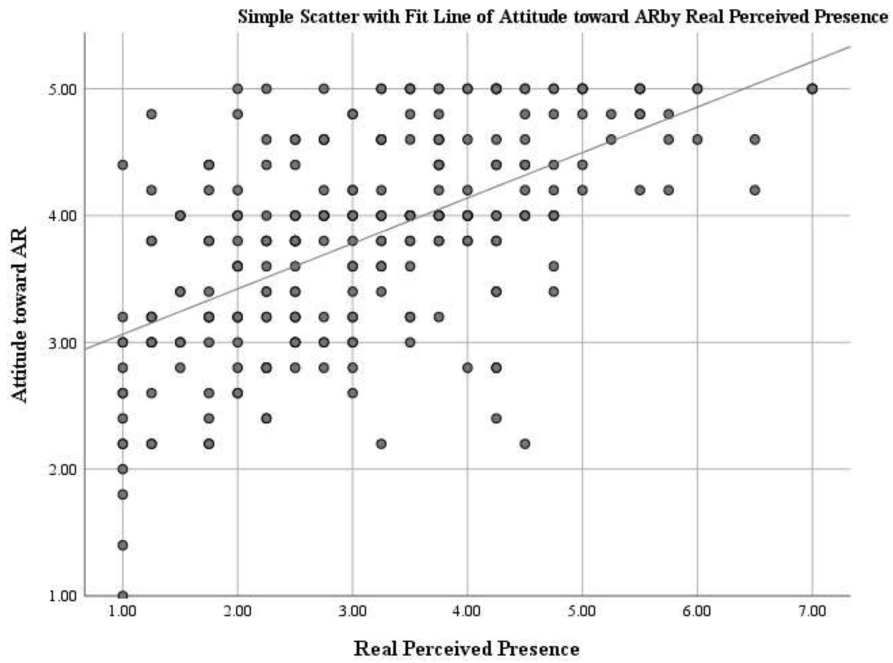
Variable	N	Mean	Std. Dev.	Variance	Skewness	Kurtosis
Attitude toward AR	264	3.827	0.814	0.663	-0.479	-0.165
Purchase Intention	264	3.035	1.074	1.154	-0.157	-0.737
Body Image	264	4.362	1.671	2.794	-0.157	-0.888
Family’s Opinion	264	3.896	1.470	2.160	-0.035	-0.861
Influencers’ Opinion	264	1.928	1.149	1.321	1.405	1.482
Friends/Peers’ Opinion	264	3.801	1.442	2.078	-0.112	-0.781
Experts & Sellers Opinion	264	3.335	1.348	1.816	0.219	-0.801
Esteemed ones Opinion	264	4.408	1.311	1.720	-0.311	-0.548
Group Acceptance	264	1.659	1.122	1.260	2.003	3.985
Others’ Opinion	264	4.903	1.371	1.879	-.648	0.196
Online Reviews Influence	264	4.808	1.404	1.971	-.401	-0.315
Autonomy	264	3.323	1.483	2.198	.541	-0.255
Perceived Augmentation	264	3.496	0.959	0.920	.082*	0.275^{+}
Perceived Simulation	264	3.231	1.639	2.688	.392	-0.544^{+}
Real Perceived Presence	264	3.128	1.335	1.782	.457*	-0.180^{+}
Digital Perceived Presence	264	3.767	1.694	2.870	-.014	-0.869
AR Expertise	264	4.350	1.476	2.178	-.372	-.394
Mood	264	2.324	0.667	0.445	0.227	-0.166
Focused Attention	264	5.218	1.45	2.100	-.623	-.353

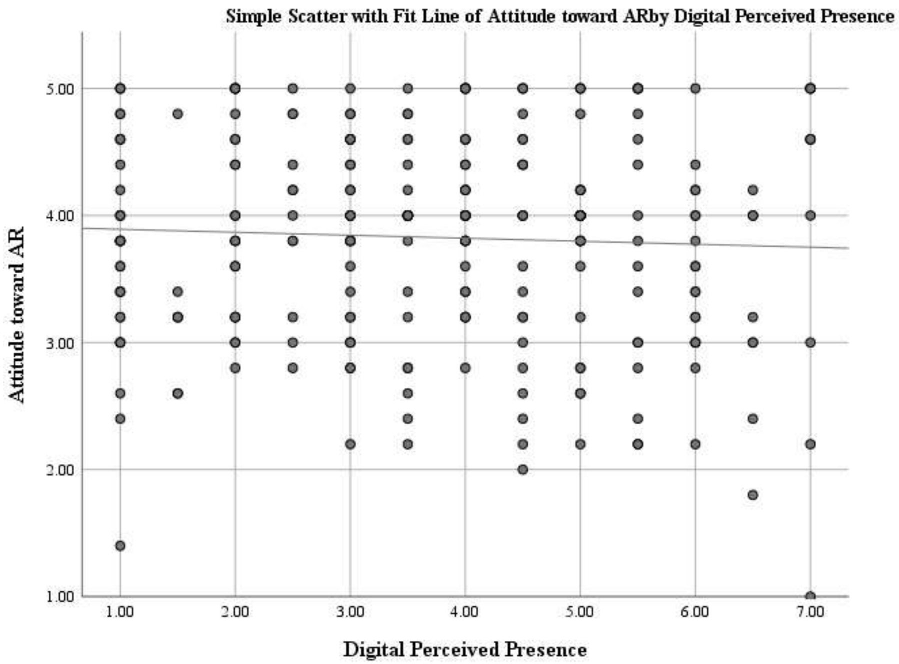
Appendix 5 - Scatter Plots

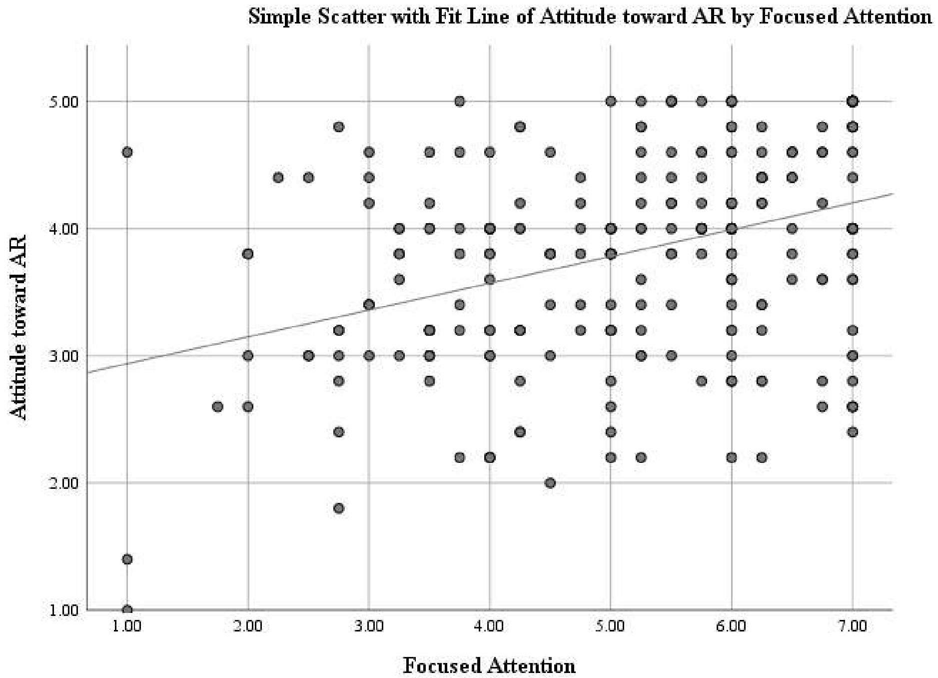


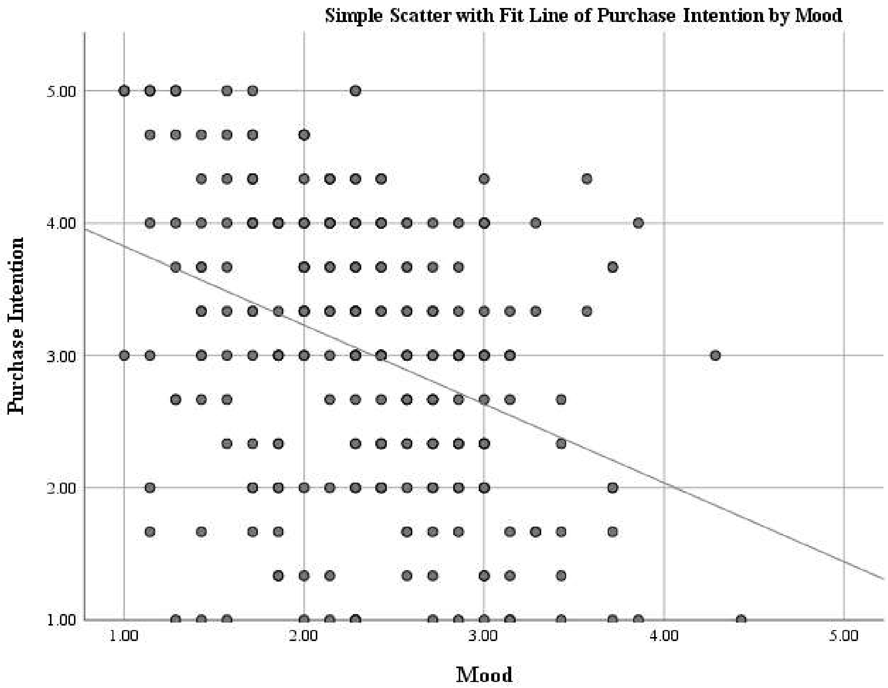


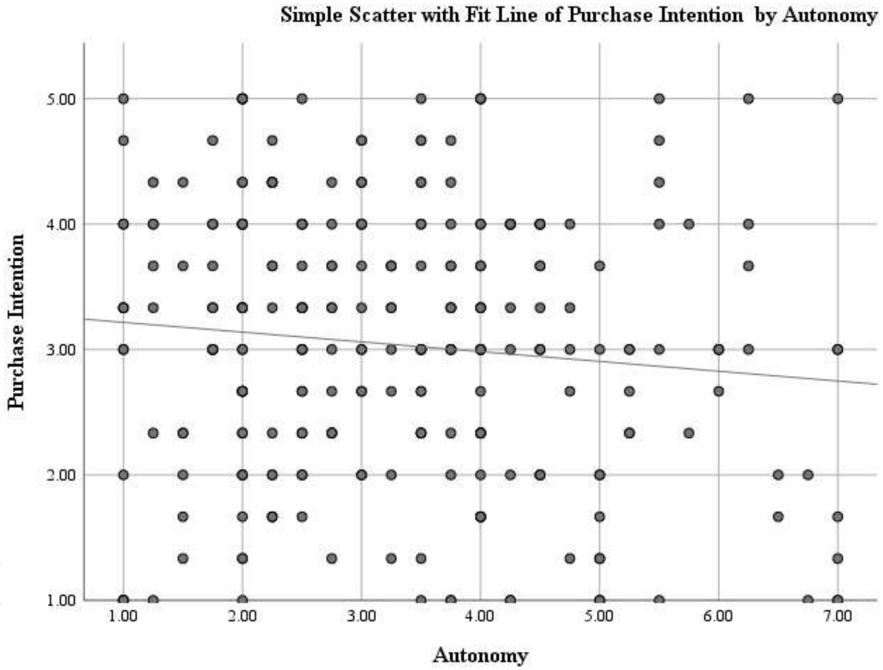

Simple Scatter with Fit Line of Attitude toward AR by Perceived Simulation
Attitude toward AR
Perceived Simulation
1.00
2.00
3.00
4.00
5.00
6.00
7.00

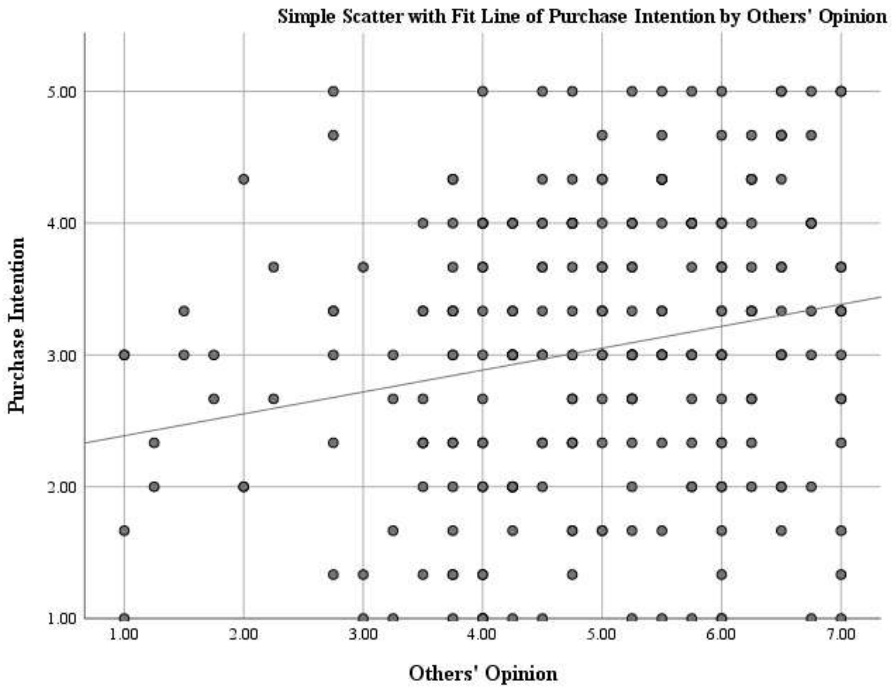

Simple Scatter with Fit Line of Attitude toward ARby Real Perceived Presence
Attitude toward AR
Real Perceived Presence
1.00
2.00
3.00
4.00
5.00
6.00
7.00


Simple Scatter with Fit Line of Attitude toward ARby Digital Perceived Presence
Attitude toward AR
5.00
4.00
3.00
2.00
1.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Digital Perceived Presence


Simple Scatter with Fit Line of Attitude toward AR by Focused Attention
Attitude toward AR
5.00
4.00
3.00
2.00
1.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Focused Attention


Simple Scatter with Fit Line of Purchase Intention by Mood
Purchase Intention
5.00
4.00
3.00
2.00
1.00
1.00
2.00
3.00
4.00
5.00
Mood


Simple Scatter with Fit Line of Purchase Intention by Autonomy
Purchase Intention
5.00
4.00
3.00
2.00
1.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Autonomy


Simple Scatter with Fit Line of Purchase Intention by Others' Opinion
5.00
4.00
3.00
2.00
1.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Purchase Intention
Others' Opinion

Appendix 6 – Measures

Dimension	Items	Cronbach α
AR Expertise	• Nothing Familiar vs. Very Familiar • Very Inexperienced vs. Very Experienced • Very Misinformed vs. Very Well informed	0.924
Product Involvement Adapted from Chandrashekaran (2004)	• I am particularly interested in this product • Given my interests, this product is not relevant to me • Overall, I get very involved when I buy this product	0.763
Physical Attachment Adapted from Brocato et al. (2015)	• I can't imagine buying the product other than in a physical store • I feel better when I shop in a physical store than in an online store (website or mobile app) • I wouldn't feel comfortable if an app permanently replaced the physical store • Not being able to buy back from a physical store worries me	0.802
Focused Attention Adapted from Lin et al. (A. Lin et al., 2008) and Novak et al. (T. P. Novak et al., 2000)	• While using the app, I was deeply engrossed in the task • While using the app, I was absorbed intently in the task • While using the app, I concentrated fully in the task • While using the app, my attention was focused on the task	0.948
Body Image Adapted from Yim and Park (2019)	• I am satisfied with the way my body looks • I wish to change the shape of parts of my body	0.739
Family's Opinion	• When you are shopping alone (unaccompanied) in a PHYSICAL STORE what do you think about the influence of Family • When shopping ALONE (unaccompanied) I value family's opinion • When I'm ALONE (unaccompanied) shopping, how much do you value FAMILY's opinion at the physical store • When you are shopping alone (unaccompanied) in an ONLINE STORE what do you think about the influence of Family • When I'm ALONE (unaccompanied) shopping, how much do you value FAMILY's opinion at the online store • When shopping ALONE (unaccompanied), I was brought up to value family's opinion • Before I buy, I think about what people like, and then consider buying or not	0.897

Appendix 7 – Measures (continued)

Dimension	Items	Cronbach α
Influencers' Opinion	• When you buy ALONE (unaccompanied), I value the opinion of influencers • When you are shopping alone (unaccompanied) in a PHYSICAL STORE what do you think about the influence of Influencers • When I am ALONE (unaccompanied) shopping, how much do you value the opinion of INFLUENCERS at the online store • When I am ALONE (unaccompanied) shopping, how much do you value the opinion of INFLUENCERS at the physical store • When you are shopping alone (unaccompanied) in an ONLINE STORE what do you think about the influence of Influencers • When you buy ALONE (unaccompanied) I and to be like the influencers	0.922
Online Review Influence	• The presence of reviews evaluating the product I see in an online store/app change the perception of the product of the consumer in general • The presence of reviews evaluating the product I see in an online store/app change the purchase decision of the consumer in general • The presence of reviews evaluating the product I see in an online store/app change my perception of the product • The presence of reviews evaluating the product I see in an online store/app change my purchase decision • How do you adjust your online store/app purchase decision, by seeing other buyers' opinions by viewing positive reviews	0.915
Peers/Friends' Opinion	• When I'm ALONE (unaccompanied) shopping, how much do you value FRIENDS' opinion at the online store • When you are shopping alone (unaccompanied) in an ONLINE STORE what do you think about the influence of Friends • When I'm ALONE (unaccompanied) shopping, how much do you value FRIENDS' opinion at the physical store • When you are shopping alone (unaccompanied) in a PHYSICAL STORE what do you think about the influence of Friends • When you buy ALONE (unaccompanied), I value friends' opinion	0.911

Appendix 8 – Measures (continued)

Dimension	Items	Cronbach α
Sellers & Experts Opinion	• When you are shopping alone (unaccompanied) in a PHYSICAL STORE what do you think about the influence of Experts • When you are shopping alone (unaccompanied) in a PHYSICAL STORE what do you think about the influence of Sellers • When you are shopping alone (unaccompanied) in an ONLINE STORE what do you think about the influence of Experts • When you are shopping alone (unaccompanied) in an ONLINE STORE what do you think about the influence of online reviews • When you buy ALONE (unaccompanied) to what extent do you value the seller's opinion in a physical store • When you buy ALONE (unaccompanied) to what extent do you value reviews in a website	0.864
Others' Opinion	• It is important to know the opinions of others about their shopping experience with shoes from online stores/app to reduce my uncertainty • It is important to know the opinions of others about their shopping experience with shoes from online stores/app to reduce my negative feelings • It is important to know the opinions of others about their shopping experience with shoes from online stores/app to increase my confidence in the app as a store. • It is important to know the opinions of others about their shopping experience with shoes from online stores/app to have some assurance	0.836
Autonomy	• When you are shopping alone (unaccompanied) in a PHYSICAL STORE, I am not influenced by the opinion of others • When you are shopping alone (unaccompanied) in an ONLINE STORE, I am not influenced by the opinion of others • What is the role of the FRIENDS when you buy ALONE (unaccompanied), I am not influenced by the opinion of others? • What is the role of the INFLUENCERS when you buy ALONE (unaccompanied), I am not influenced by the opinion of others	0.826

Appendix 9 – Measures (continued)

Dimension	Items	Cronbach α
Esteemed Ones' Opinion	• When I have to make certain decisions, even on my own (unaccompanied), I feel like I'm discussing/talking/ listening to the opinions of the people I like • I keep present in my mind the opinions of the people I value, even when they are not present • I sometimes imagine myself exchanging ideas with people who interest me in times of some pressure • Even when I'm unaccompanied, I feel accompanied by the people I have esteemed	0.745
Negative Reviews Influence	• How do you adjust your online store/app purchase decision by seeing other buyers' opinions by viewing negative reviews? • When you buy ALONE (unaccompanied), I am not influenced by the opinion of others	0.179
Imagery Adapted from Bone and Ellen (1992)	• Unclear-Clear • Unreal-Real • Undefined-Defined • Indistinct-Sharp • Static-Dynamic	0.854
Projection Adapted from Laroche et al. (2005)	• The app has affordances that allow me to imagine using the product. • The image I see conveys enough information regarding the product to understand how it really is • It is easy to see me with the product through the app • It is easier to see myself with the product using the app than on the website	0.833
Perceived Augmentation Adapted from Javornik (2016b)	• The app has affordances that allow me to see my body with the product on • When using the app, I felt that something enriched my image • After I stopped using the app, I could still imagine myself using the product • The product seemed completely real • The app visually enriched my reality • I felt that the product did not add anything visually	0.778
Perceived Simulation Adapted from Javornik (2016b)	• The app has affordances that help to simulate touching the product • The app has affordances that help to simulate the manipulation of the product	0.800

Appendix 10 – Measures (continued)

Dimension	Items	Cronbach α
Real Perceived Presence Adapted from Klein (2003) and Verhagen et al. (Verhagen et al., 2014)	• During my experience on the app, the product seemed to me to belong more to the ‘real world’ rather than from the ‘virtual world.’ • While I was using the app, the products were presented as if they belonged to the ‘real world.’ • The experience I had on this app was similar to memories of experiencing the product in reality • I experienced the product on the app as they belong to the real world	0.831
Digital Perceived Presence Adapted from Klein (2003) and Verhagen et al. (Verhagen et al., 2014)	• While I was using the app, I felt I was more in a ‘virtual world’ that the ‘real world • While trying the app, I felt I was in a digital world	0.858
Ease of Use Adapted from Davis (1989)	• Learning to use the app was easy for me • It was easy to make the app do what I want it to do • My interaction with the app was clear and under stable • Using the app requires little effort • I found the app easy to use	0.887
Attitude toward AR Adapted from Yim et al. (Yim et al., 2017)	• Unfavourable–Favourable • Bad–Good • Unpleasant–Pleasant • Negative–Positive • Poor-Rich	0.926
Purchase Intention Adapted from Yim et al. (Yim et al., 2017)	• Uncertain-Certain • Improbable-Probable • Impossible-Possible	0.888
Mood Adapted from Djamasbi et al. (2010), Lorr and Wunderlich (1988), and Mehrabian and Russel (1974)	• Unfavourable–Favourable • Bad–Good • Unpleasant–Pleasant • Negative–Positive • Poor-Rich • Uncertain-Certain • Improbable-Probable • Impossible-Possible	0.824

Appendix 11 - Covariate homogeneity across factor levels

Hypotheses	Experimental condition: Shopping Context	
	Full-length Mirror	**Small Mirror**
H1.1.1.-5.	F (1,104) = 0.613; p = 0.435 > 0.05	F (1,102) = 0.305; p = 0.555 > 0.05
H1.2.1.-3	F (1,104) = 0.745; p = 0. 387 > 0.05	F (1,104) = 5.967; p = 0.749 > 0.05
	Experimental condition: App with and without reviews	
H2.2.1.	F (1,102) = 2.350; p = 0. 128 > 0.05	
	Experimental condition: Mirror Size	
	Accompanied	**Unaccompanied**
H3.1.1.-4.	F (1,107) = 0.026; p = 0. 873 > 0.05	F (1,100) = 2.291; p = 0. 133 > 0.05
H3.2.1.	F (1,107) = 0.322; p = 0. 571> 0.05	F (1,100) = 0.197; p = 0. 658 > 0.05

Appendix 12 - Homogeneity of Regression Slopes

Hypotheses	Experimental condition: Shopping Context	
	Full-length Mirror	**Small Mirror**
H1.1.1. AR Expertise	F (1,102) = 0.010; p = 0.920> 0.05	F (1,100) = 2.827; p = 0.096> 0.05
H1.1.2. Perceived Augmentation	F (1,102) = 0.207; p = 0.650> 0.05	F (1,100) = 0.010; p = 0.920> 0.05
H1.1.3. Perceived Simulation	F (1,102) = 0.007; p = 0.935> 0.05	F (1,100) = 0.010; p = 0.920> 0.05
H1.1.4. Real Perceived Presence	F (1,102) = 2.437; p = 0.122> 0.05	F (1,100) = 4.030; p = 0.047< **0.05***
H1.1.5. Focused Attention	F (1,102) = 0.000, p = 0.999> 0.05	F (1,100) = 8.330; p = 0.005< **0.05***
H1.2.1. Mood	F (1,104) = 0.721; p = 0.398> 0.05	F (1,100) = 4.282; p = 0.041< **0.05***
H1.2.2. Autonomy	F (1,102) = 1.470; p = 0.228> 0.05	F (1,100) = 4.282; p = 0.008< **0.05***
H1.2.3. Others' Opinion	F (1,102) = 2.376; p = 0.126> 0.05	F (1,100) = 0.155; p = 0.695> 0.05
	Experimental condition: App with and without reviews	
H2.2.1. Others' Opinion	F (1,100) = 0. 570; p = 0.452> 0.05	
	Experimental condition: Mirror Size	
	Accompanied	**Unaccompanied**
H3.1.1. AR Expertise	F (1,105) = 0. 586; p = 0.350 > 0.05	F (1,98) = 0. 925; p = 0.339> 0.05
H3.1.2. Perceived Augmentation	F (1,105) = 0.027; p = 0. 870 > 0.05	F (1,98) = 3. 304; p = 0.072> 0.05
H3.1.3. Perceived Simulation	F (1,105) = 0.099; p = 0. 754 > 0.05	F (1,98) = 0. 067; p = 0796> 0.05
H3.1.4. Real Perceived Presence	F (1,105) = 0.135; p = 0. 714 > 0.05	F (1,98) = 0. 813; p = 0.369> 0.05
H3.2.1. Mood	F (1,105) = 1. 462; p = 0.229 > 0.05	F (1,98) = 2. 534; p = 0.115> 0.05

***** As the groups presented an approximate dimension (Small mirror: $N_{unaccompanied}$ =51 versus $N_{accompanied}$=53), ANCOVA is considered robust when this assumption is violated (Hamilton, 1977; Olejnik and Algina, 1985; Sullivan and D'Agostino, 1996). Therefore, the analysis proceeded apace.

Appendix 13 - Descriptive statistics for full-length mirror H1.1-H1.3

Variable	Condition	N	M	SD
H1.1. Attitude toward AR	Unaccompanied	50	4.004	0.778
	Accompanied	56	3.882	0.819
H1.2. Purchase Intention	Unaccompanied	50	3.180	1.153
	Accompanied	56	3.000	0.981
H1.3. Body Image	Unaccompanied	50	4.470	1.692
	Accompanied	56	4.241	1.392

Appendix 14 - Descriptive statistics for small mirror H1.1-H1.3

Variable	Condition	N	M	SD
H1.1. Attitude toward AR	Unaccompanied	51	3.769	0.650
	Accompanied	53	3.857	0.849
H1.2. Purchase Intention	Unaccompanied	51	3.052	0.895
	Accompanied	53	3.120	1.211
H1.3. Body Image	Unaccompanied	51	4.500	1.588
	Accompanied	53	4.576	1.812

Appendix 15 - Levene's Test Homogeneity of Variances H1.1-H1.3

Variable	Levene's Test Homogeneity of Variances	
	Full-length Mirror	Small Mirror
H1.1. Attitude toward AR	$F(1,104) = 0.523; p = 0.471 > 0.05$	$F(1,104) = 2.731; p = 0.101 > 0.05$
H1.2. Purchase Intention	$F(1,104) = 1.998; p = 0.160 > 0.05$	$F(1,104) = 5.967; p = 0.016 <$ **0.05***
H1.3. Body Image	$F(1,104) = 2.777; p = 0.099 > 0.05$	$F(1,104) = 0.523; p = 0.471 > 0.05$

Appendix 16 - Descriptive statistics for the full-length mirror

Variable	Condition	N	M	SD
H1.4. Family's Opinion	Unaccompanied	50	4.034	1.551
	Accompanied	56	3.895	1.319
H1.5. Influencers' Opinion	Unaccompanied	50	3.961	1.428
	Accompanied	56	1.840	1.119
H1.6. Online Reviews Influence	Unaccompanied	50	2.054	1.238
	Accompanied	56	1.953	1.183
H1.7. Friends/Peers' Opinion	Unaccompanied	50	4.956	1.613
	Accompanied	56	4.911	1.195
H1.8. Experts & Sellers's Opinion	Unaccompanied	50	4.932	1.401
	Accompanied	56	3.848	1.538
H1.9. Esteemed One's Opinion	Unaccompanied	50	4.075	1.460
	Accompanied	56	3.968	1.494
H1.10. Group Acceptance	Unaccompanied	50	3.440	1.495
	Accompanied	56	3.702	1.212

Appendix 17 - Descriptive statistics for the small mirror

Variable	Condition	N	M	SD
H1.4. Family's Opinion	Unaccompanied	50	3.798	1.396
	Accompanied	56	3.636	1.557
H1.5. Influencers' Opinion	Unaccompanied	50	3.716	1.475
	Accompanied	56	1.801	1.016
H1.6. Online Reviews Influence	Unaccompanied	50	2.101	1.271
	Accompanied	56	1.954	1.157
H1.7. Friends/Peers' Opinion	Unaccompanied	50	4.690	1.295
	Accompanied	56	4.736	1.347
H1.8. Experts & Sellers's Opinion	Unaccompanied	50	4.714	1.316
	Accompanied	56	3.545	1.459
H1.9. Esteemed One's Opinion	Unaccompanied	50	3.638	1.190
	Accompanied	56	3.592	1.323
H1.10. Group Acceptance	Unaccompanied	50	3.026	1.315
	Accompanied	56	3.104	1.242

Appendix 18 - Levene's Test of Homogeneity of Variances H1.4-H1.10

Variable	Levene's Test Homogeneity of Variances	
	Full-length Mirror	**Small Mirror**
H1.4. Family's Opinion	F (1,104) = 2.613; p = 0.109 > 0.05	F (1,104) = 0.982; p = 0. 324 > 0.05
H1.5. Influencers' Opinion	F (1,104) = 3.886; p = 0. 051 > 0.05	F (1,104) = 3.765; p = 0.055 > 0.05
H1.6. Online Reviews Influenc**e**	F (1,104) = 4.101; p = 0. 045 **< 0.05***	F (1,104) = 0.639; p = 0.426 > 0.05
H1.7. Friends/Peers' Opinion	F (1,104) = 0.514; p = 0. 475 > 0.05	F (1,104) = 2.418; p = 0. 123 > 0.05
H1.8. Experts & Sellers's Opinion	F (1,104) = 3.5174; p = 0. 064 > 0.05	F (1,104) = 0.000; p = 0. 998 > 0.05
H1.9. Esteemed One's Opinion	F (1,104) = 3.382; p = 0. 069 > 0.05	F (1,104) = 2.351; p = 0. 128> 0.05
H1.10. Group Acceptance	F (1,104) = 5.601; p = 0. 020 **< 0.05***	F (1,104) = 0.121; p = 0. 729 > 0.05

Appendix 19 - Descriptive statistics for presence versus absence of reviews H2.3-H2.8

Variable	Condition	N	M	SD
H2.1. Attitude toward AR	Absence of Reviews	54	3.630	0.922
	Presence of Reviews	50	4.004	0.778
H2.2. Purchase Intention	Absence of Reviews	54	2.840	1.112
	Presence of Reviews	50	3.180	1.153
H2.3. Family's Opinion	Absence of Reviews	54	4.114	1.526
	Presence of Reviews	50	4.034	1.551
H2.4. Influencers' Opinion	Absence of Reviews	54	1.830	1.080
	Presence of Reviews	50	1.840	1.119
H2.5. Friends/Peers' Opinion	Absence of Reviews	54	3.874	1.530
	Presence of Reviews	50	3.848	1.538
H2.6. Experts & Sellers's Opinion	Absence of Reviews	54	3.377	1.406
	Presence of Reviews	50	3.440	1.495
H2.7. Esteemed One's Opinion	Absence of Reviews	54	4.477	1.451
	Presence of Reviews	50	4.500	1.401
H2.8. Group Acceptance	Absence of Reviews	54	1.926	1.490
	Presence of Reviews	50	1.460	0.762
H2.9. Other's Opinions	Absence of Reviews	54	4.644	1.584
	Presence of Reviews	50	4.755	1.714
H2.10. Influence of Online Reviews	Absence of Reviews	54	4.748	1.573
	Presence of Reviews	50	4.956	1.613
H2.11. Autonomy	Absence of Reviews	54	3.250	1.744
	Presence of Reviews	50	3.350	1.557

Appendix 20 - Levene's Test of Homogeneity of Variances H2.3-H2.8

Variable	Levene's Test Homogeneity of Variances
H2.1. Attitude toward AR	$F(1,102) = 2.638; p = 0.107 > 0.05$
H2.2. Purchase Intention	$F(1,102) = 0.052; p = 0.820 > 0.05$
H2.3. Family's Opinion	$F(1,102) = 0.166; p = 0.685 > 0.05$
H2.4. Influencers' Opinion	$F(1,102) = 0.003; p = 0.954 > 0.05$
H2.5. Friends/Peers' Opinion	$F(1,102) = 0.202; p = 0.654 > 0.05$
H2.6. Experts & Sellers's Opinion	$F(1,102) = 0.234; p = 0.630 > 0.05$
H2.7. Esteemed One's Opinion	$F(1,102) = 0.006; p = 0.937 > 0.05$
H2.8. Group Acceptance	$F(1,102) = 10.743; p = 0.001$ **< 0.05***
H2.9. Other's Opinions	$F(1,102) = 0.340; p = 0.561 > 0.05$
H2.10. Influence of Online Reviews	$F(1,102) = 0.007; p = 0.933 > 0.05$
H2.11. Autonomy	$F(1,102) = 1.650; p = 0.202 > 0.05$

Appendix 21 - Descriptive statistics for accompanied H3.1-H3.3

Variable	Condition	N	M	SD
H3.1. Attitude toward AR	Small mirror	53	3.857	0.849
	Full-length mirror	56	3.882	0.819
H3.2. Purchase Intention	Small mirror	53	3.120	1.211
	Full-length mirror	56	3.000	0.981
H3.3. Body Image	Small mirror	53	4.576	1.812
	Full-length mirror	56	4.241	1.392

Appendix 22 - Descriptive statistics for unaccompanied H3.1-H3.3

Variable	Condition	N	M	SD
H3.1. Attitude toward AR	Small mirror	51	3.769	0.650
	Full-length mirror	51	3.984	0.783
H3.2. Purchase Intention	Small mirror	51	3.052	0.895
	Full-length mirror	51	3.144	1.170
H3.3. Body Image	Small mirror	51	4.500	1.587
	Full-length mirror	51	4.471	1.675

Appendix 23 - Levene's Test Homogeneity of Variances H3.1-H3.3

Variable	Levene's Test Homogeneity of Variances	
	Small Mirror	**Full-length mirror**
H3.1. Attitude toward AR	F (1,107) = 0.041; p = 0.840 > 0.05	F (1,100) = 1.896; p = 0.172 > 0.05
H3.2. Purchase Intention	F (1,107) = 3.486; p = 0. 065 > 0.05	F (1,100) = 4.709; p = 0.032 < **0.05***
H3.3. Body Image	F (1,107) = 5.455; p = 0. 021 < **0.05***	F (1,100) = 0.513; p = 0.475 > 0.05

Appendix 24 – Values of Skewness and Kustosis

	Mean	Std. Deviation	Skewness		Kurtosis	
			Statistic	Std. Error	Statistic	Std. Error
Mood	2,3241	,66727	,227	,150	-,166	,299
Purchase Intention	3,0354	1,07415	-,157	,150	-,737	,299
Attitude toward AR	3,8265	,81398	-,479	,150	-,165	,299
Ease of Use	5,8576	1,11894	-1,078	,150	1,309	,299
Projection	4,6875	1,36666	-,431	,150	-,465	,299
Imagery	4,5614	1,20702	-,292	,150	-,409	,299
Body Image	4,3617	1,67139	-,157	,150	-,888	,299
Focused Attention	5,2178	1,44904	-,623	,150	-,353	,299
AR Expertise	4,3497	1,47567	-,372	,150	-,394	,299
Product Involvement	4,2702	1,40320	-,138	,150	-,590	,299
Physical Attachment	4,9375	1,57221	-,654	,150	-,354	,299
Perceived Simulation	3,2311	1,63947	,392	,150	-,544	,299
Perceived Augmentation	3,4975	,95891	,082	,150	,275	,299
Real Perceived Presence	3,1278	1,33503	,457	,150	-,180	,299
Digital Perceived Presence	3,7670	1,69423	-,014	,150	-,869	,299
Family's Opinion	3,8956	1,46954	-,035	,150	-,861	,299
Influencers' Opinion	1,9280	1,14933	1,405	,150	1,482	,299
Online Reviews' Influence	4,8083	1,40388	-,401	,150	-,315	,299
Friends' Opinion	3,8008	1,44153	-,112	,150	-,781	,299
Sellers&Experts' Opinion	3,3352	1,34763	,219	,150	-,801	,299
Others' Opinion	4,9025	1,37076	-,648	,150	,196	,299
Autonomy	3,3277	1,48251	,541	,150	-,255	,299
Esteemed Ones' Opinion	4,4081	1,31145	-,311	,150	-,548	,299
Negative reviews Impact	3,1307	1,17926	,304	,150	-,191	,299
Group Acceptance	1,6591	1,12239	2,003	,150	2,985	,299