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Augmented reality as a tool to improve decision-making in online shopping: mitigating the problem of product return

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Tesis Doctoral

AUGMENTED REALITY AS A TOOL TO IMPROVE DECISION-MAKING IN ONLINE SHOPPING: MITIGATING THE PROBLEM OF PRODUCT RETURN

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UNIVERSIDAD DE ZARAGOZA

Dirección de Marketing e Investigación de Mercados

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Doctoral Thesis

Augmented reality as a tool to improve decision-making in online shopping: mitigating the problem of product return

PhD Candidate

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2023

melODO

A mis padres, Isabel y Antonio, y a mi hermana, Esther,

por su apoyo y amor incondicional, por creer en mí SIEMPRE

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ANOVA:	Analysis of Variance
AR:	Augmented Reality
AVE:	Average Variance Extracted
CB-SEM:	Covariance Based Structural Equation Modeling
CFA:	Confirmatory Factor Analysis
CFI:	Comparative Fit Index
CLT:	Construal Level Theory
CR:	Composite Reliability
ELM:	Elaboration Likelihood Model
HSM:	Heuristic-Systematic Model
HTMT:	Heteroit-monotrait Ratio of Correlations
JCR:	Journal Citation Report
LM:	Linear regression Model
M-commerce:	Mobile commerce
NFI:	Normed Fit Index
NNFI:	Non-Normed Fit Index
PLS:	Partial Least Squares
R^2:	R-Squared
RESET:	Regression Equation Specification Error Test
RMSEA:	Root Mean Squared Error of Approximation
SEM:	Structural Equation Modeling
SLR:	Systematic Literature Review
SOR:	Stimulus-Organism-Response
SRMR:	Standardised Residual Mean Square Root
TAM:	Technology Acceptance Model
U&G:	Uses and Gratifications Theory
UTAUT:	Unified Theory of Acceptance and Use of Technology
VIFs:	Variance Inflation Factors
VR:	Virtual Reality
VTO:	Virtual Try-on
WoS:	Web of Science

1. Introduction

1.1 Online shopping

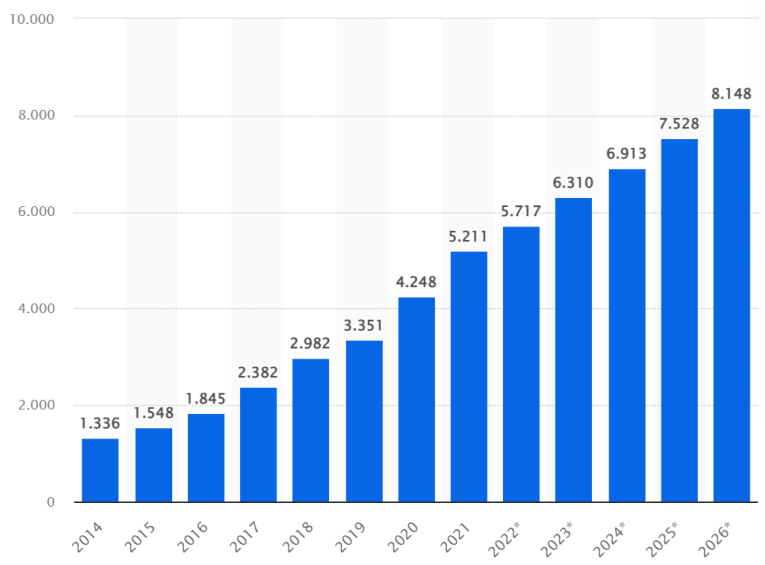
Traditional online shopping has undergone significant changes over the years, as technology has advanced and consumer preferences and expectations have evolved. Online shopping offered numerous advantages over traditional shopping (Chiang & Dholakia, 2003; Javadi et al., 2012). First, one of the most significant advantages of online shopping is convenience. Consumers can shop from the comfort of their homes or on-the-go, without the need to physically visit a store (Jiang et al., 2013). Second, online shopping provides consumers with access to a greater variety of products than traditional shopping. Online retailers can offer a wider range of products due to their lack of physical space constraints, and can also source products from around the world (Blake et al., 2003). Third, online retailers often offer lower prices than their brick-and-mortar counterparts due to lower overhead costs. Additionally, online shopping allows consumers to easily compare prices across different retailers and make informed purchasing decisions. Fourth, consumers can save time, as they do not need to spend time traveling to and from stores, finding parking, or standing in long checkout lines (Chiang & Dholakia, 2003). The consumer can easily search for products, compare prices, and place orders without wasting time in the stores. Fifth, the consumer can access to a wide range of information. Consumers can quickly and easily find the products they need using search and filtering tools. In this sense, online shopping allows consumers to access product information, reviews, and ratings from other customers. This information can help them make an informed purchasing decision and avoid buying products that do not meet their needs. These advantages and the evolution of online shopping have increased its relevance yearly. Furthermore, predictions are remarkable, projecting that global online sales could exceed 8.1 trillion dollars by 2026 (see Figure 1.1).

In the early days of online shopping, retailers simply offered basic e-commerce websites where customers could browse and purchase products (Koli et al., 2016). However, it is important to note that online commerce sites have been evolving due to the progressive development of the web environment (Rose et al., 2011). The early online shopping websites had basic website designs, with simple layouts and limited graphics (Rosen & Purinton, 2004). Throughout the years,

additional elements have been incorporated into websites (e.g. consumer reviews). Moreover, the payment options were quite limited. Most of the transactions were processed through credit cards (Tamimi et al., 2003). Over time, online retailers began to offer a wider range of payment options, including e-wallets, PayPal, and other secure payment gateways. In addition, online retailers offered slow shipping times, often had slow shipping times, with products taking several weeks to arrive. The improvements in shipping infrastructure and logistics has allowed online retailers to made much faster deliveries (Sharma & Jhamb, 2020). Despite these changes shown, the increasing popularity of online shopping led retailers to work enhancing the online shopping experience in a variety of additional ways (Alimamy & Gnoth, 2022; Close & Kular-Kinney, 2010; Hilken et al., 2022a).

One of the key trends in the evolution of traditional online shopping has been the rise of mobile-commerce (m-commerce). With the widespread adoption of smartphones and mobile devices, consumers were increasingly using these devices to shop and make purchases online (Aldas-Manzano et al., 2009; Wang et al., 2015). To improve the shopping experience in the mobile devices, retailers developed mobile-optimized websites and mobile apps to make it easier for customers to shop on the go (Tang, 2019). This fact led to significant changes in the way that retailers marketed and sold their products, as well as in the expectations and behaviours of consumers. M-commerce led to the increase use of data and analytics to inform marketing and sales strategies. By collecting and analysing data on consumer behaviour, preferences, and purchase history, retailers could better understand their customers and tailor their marketing and sales efforts accordingly (Niranjanamurthy et al., 2013). This could help to improve the effectiveness and efficiency of marketing campaigns, as well as to optimize product offerings and pricing strategies (Marinkovic & Kalinic, 2017; Shao & Yi, 2009). This data allowed retailers to offer customised recommendations. However, with the increasing amount of sensitive information being transmitted through mobile devices, the adoption of mobile commerce led also to a greater emphasis on mobile security (Niranjanamurthy et al., 2013; Zhang et al., 2013). Retailers had to ensure that their mobile apps were secure, thus protecting consumer data.

Figure 1.1. Revenue from global e-commerce sales between 2014 and 2026 (in billion U.S. dollars)



Source: eMarketer (2022)

Furthermore, the ability to shop and make purchases from anywhere have generated concrete expectations to consumers. Consumers now expect retailers to offer a seamless and convenient shopping experience across all channels and touchpoints (Nguyen et al., 2018; Rahman, 2015). This has led to increased demand for features such as mobile payments, mobile coupons, and mobile loyalty programs, as well as for fast and reliable shipping and delivery options (Zhang et al., 2012). Likewise, the development of the different channels during the shopping experience led to a paradigm shift towards an omnichannel approach (Brynjolfsson et al., 2013; Verhoef et al., 2015). To meet the expectations of consumers, retailers started to offering a range of digital channels and touchpoints. This fact enabled retailers to reach consumers at every stage of the purchasing journey, from initial awareness and consideration, to purchase and post-purchase engagement. Thus, another important trend in the evolution of traditional online shopping has been the increasing integration of online and offline channels. Many retailers have developed omnichannel strategies that allow customers to seamlessly switch between the different channels provided (Lemon & Verhoef, 2016). For example, customers may be able to order products online and pick them up in-store, or they may be able to return products purchased online to a physical retail location. In addition, the progressive development of social media has enabled retailers to

engage with customers via this medium (Cummins et al., 2016; Demmers et al., 2020). Retailers can provide customer service via social media platforms, or use social media to promote in-store events or sales.

Finally, the emphasis on customer experience has led to the adoption of immersive technologies. In this sense, Augmented Reality (AR) and Virtual Reality (VR) can have a significant impact on the evolution of traditional online shopping (Ameen et al., 2022; Flavián et al., 2019a; Rauschnabel et al., 2022). These technologies allow retailers to create more immersive and engaging shopping experiences, by allowing customers to interact with products in a more realistic way (Loureiro, 2022; tom-Dieck et al., 2021).

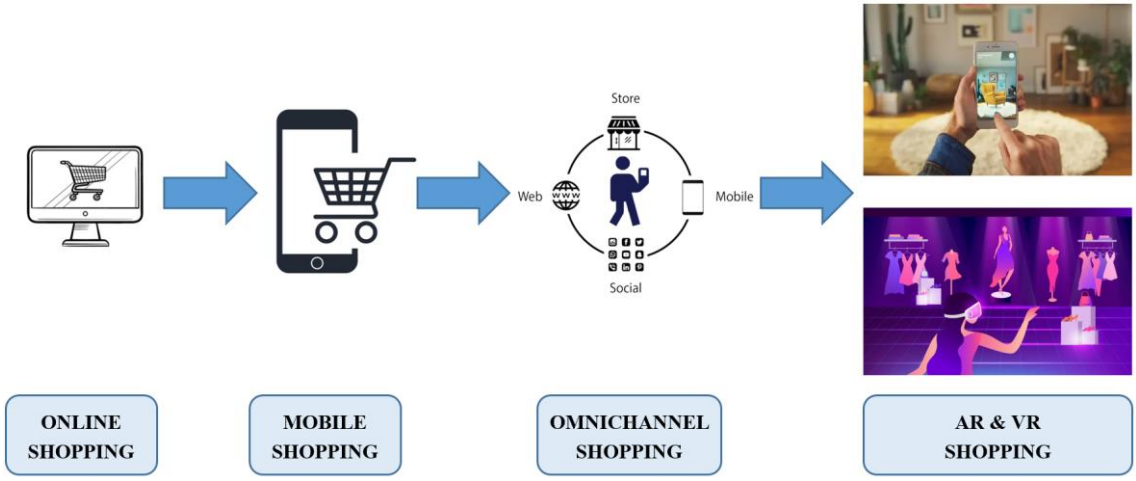
VR is a technology that creates an immersive environment generated by computers in which users can navigate and possibly interact, triggering real-time simulation of their senses, what makes them feel present in the virtual environment displayed (Guttentag, 2010). Thus, VR can be used to create a virtual experience which allows customers to explore a new product or brand in a 3D space. Furthermore, VR can provide customers with product customization options in a virtual environment. For example, a customer could use a VR headset to design and customize their own clothing. On the other hand, AR can be defined as the medium in which digital information is overlaid on the physical world in real-time and has both a temporal and spatial registration with the real world (Craig 2013). Though the use of AR consumers can visualize products in a more realistic way. For example, they can use their smartphone or tablet to see how a piece of furniture would look in their home before making a purchase. In addition, AR can be used to have Virtual Try-on (VTO) experiences. In these experiences, consumers can virtually see how the product looks like on their body by projecting a virtual representation of the product (e.g. beauty products or clothes).

In conclusion, traditional online shopping has undergone significant changes over the years, as technology has advanced and consumer preferences and expectations have evolved. From the rise of mobile commerce and the increasing emphasis on customer experience, to the integration of online and offline channels and the emergence of new immersive technologies, retailers have worked to enhance the online shopping experience in a variety of ways. As technology continues

to evolve, it is likely that the online shopping experience will continue to evolve as well, providing customers with even more convenient, engaging, and personalized ways to shop for products online.

Picture 1.1 represents the main changes discussed above.

Picture 1.1. Main changes in online shopping



Source: Own elaboration

1.2 Product returns: the current problematic of online shopping

The constant growth of online commerce and the increasing competitiveness among retailers is leading to the implementation of several marketing instruments to boost their sales (Statista, 2023a). These marketing instruments can not only impact sales, but also product returns (El Kihal & Shehu, 2022). However, when assessing the performance of marketing instruments, retailers often ignore potential return effects. Theoretically, marketing instruments could increase or decrease returns, depending on how they affect expected and experienced costs and benefits related to a product. In this sense, a comprehensive set of marketing instruments (newsletters, catalogues, coupons, free shipping, paid search, affiliate advertising and image advertising) do not reduce the product returns. In fact, newsletters, paid search, catalogues and free shipping increase returns substantially by up to 18% (El Kihal & Shehu, 2022). Similarly, further research has confirmed that free shipping promotions increase the overall return rate (Shehu et al., 2020).

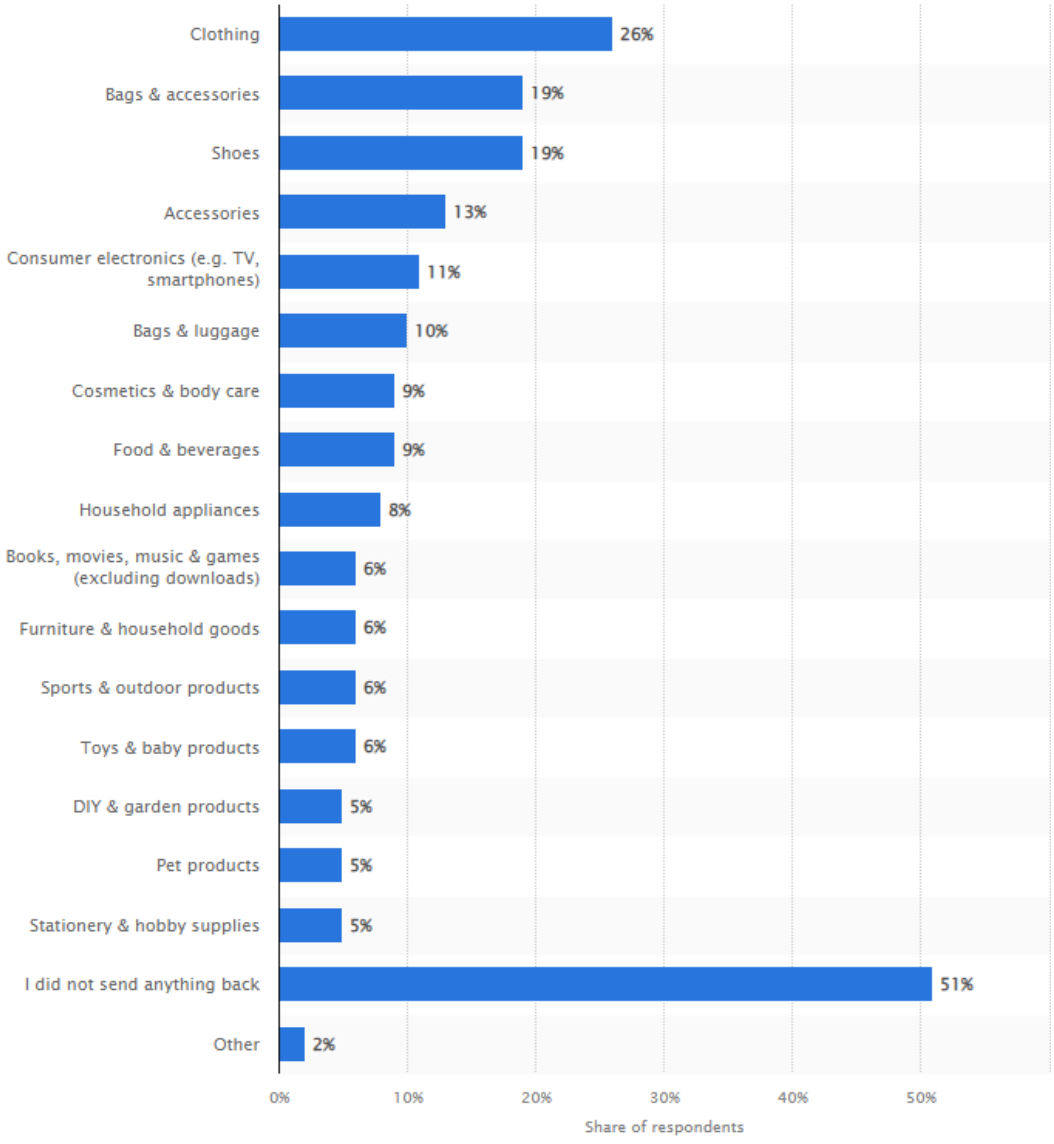
Moreover, some of the positive aspects that could be generated by product returns, such as the purchase of products in the store when the consumer returns the product (Petersen & Kumar, 2009), have become less relevant. Nowadays, the facilities offered by online retailers require the consumers to bring the product to a pick-up point or the shipping company collects the product from their home.

From a managerial perspective, online returns can lead to many negative consequences. First, product returns are very costly for online retailers. Return handling costs include, among others, repackaging costs, reconditioning costs and the cost of reverse logistics (Zhou et al., 2018). In fact, almost half of online the retailers state that operational costs related to returns are a problem for them because they negatively influence their profit margin (Martínez-López et al., 2022). Second, it is necessary to properly plan and devote a large amount of technological and human resources to the correct handling of product return systems (Dev et al., 2020). Third, online returns have a major environmental impact. The unnecessary transport and huge packages involved in e-commerce returns lead to more greenhouse gas emissions and increased resource consumption on a global scale (Li et al., 2021). Fourth, the costs of returns hurt the company's profits, leading to an increase in the price of products, which has an impact on competitiveness (Chen & Chen, 2016). Thus, the competitiveness problem generated by the use of marketing instruments that encourage sales, but also returns, is accentuated.

According to recent reports, the rise in e-commerce sales has resulted in an increase in product returns (CNBC, 2022; Statista, 2022a). In fact, in 2022, almost half of consumers in the US reported returning a product (see Picture 1.2). This trend of rising consumer product returns raises serious issues among business professionals. In particular, handling product returns is two to four times more expensive than handling outbound dispatches, and the cost of processing returned products equals the entire profit margin on the cost of goods sold (Johnson, 2003). Massive product returns incur considerable costs for e-retailers, erode their competitiveness and make their product returns management complex and difficult. In fact, due to this recent problematic, big companies such as Inditex have recently changed their return policies by charging a small fee for each online

return (Reuters, 2023). Similarly, Amazon, one of the most important online retailers, has also developed strategies to deal with the large number of returns received. Specifically, a new section in its online shop called "Amazon Warehouse" has been created in which consumers can buy products that have been returned at a lower price than if they were new (Amazon, 2023).

Picture 1.2. Most returned online purchases by category in the U.S in 2022



Source: Statista (2022a)

Consequently, the high costs that online retailers assume with their returns and the growth expectations make this an issue that needs to be addressed. From a managerial perspective the problematic issue of product returns in online shopping needs to be researched in depth. In this way,

online retailers will understand the strategies and actions to implement in order to reduce their return rate and improve their economic benefits and competitiveness. This issue becomes even more relevant if the increased use of mobile devices in online shopping is considered. In this sense, research has shown that consumers are more willingness to make product returns when shopping on mobile devices, compared to computers (Seeger et al., 2019). To address this problematic, the implementation of new technological tools in the online shopping process can play a key role. In particular, AR (easily accessible to consumers) can help to make the decision clearer through the virtual product visualisation.

1.3 Augmented reality as a technological tool to improve decision-making

With the emergence of immersive technologies such as AR and VR, the online shopping experience has been transformed (Flavián et al., 2019a). These technologies allow customers to interact with products in a more realistic and engaging way, providing a more immersive shopping experience. In VR experiences, the user is completely isolated from the real world. With the use of VR glasses or a cave assisted virtual environment, the user is immersed and can navigate and interact in a computer-generated 3D environment. Thus, VR can be used to create entirely virtual shopping experiences, where customers can explore and interact with products in a virtual environment. However, in AR experiences the digital information is overlaid on the physical world (Flavián & Barta, 2022). Through a stationary (e.g. AR mirror), mobile (e.g. smartphone), computer or wearable (e.g. AR glasses) device this information is displayed. The cameras and/or global positioning system on these devices recognise a marker and display the digital information related to it (Flavián & Barta, 2022). Compared to a VR headset, the greater accessibility that consumers have to AR devices makes this immersive technology the most widely adopted today (Statista, 2023b). Despite the development of VR and the progressive reduction in the price of VR headsets, the price is still too high for mass technology adoption (Statista, 2023b).

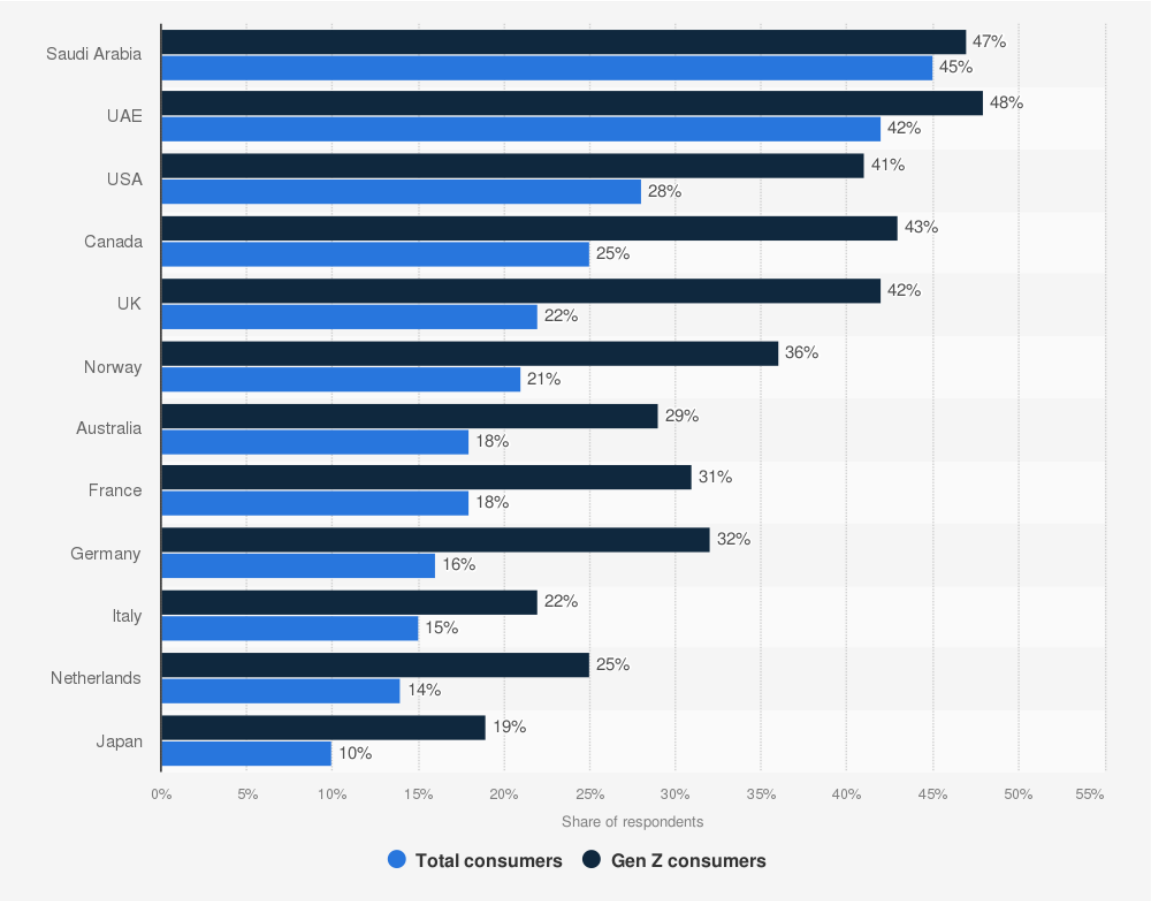
On the contrary, augmented reality (AR) has generated great interest in recent years due to its potential to revolutionise the way we interact with our environment (Rauschnabel et al., 2022). AR is a cutting-edge technology that superimposes digital information onto the real world, producing a mixed reality where the virtual and physical realms merge flawlessly (Flavián & Barta, 2022). This main attribute of AR has immense potential to bring about a major transformation in the retail sector (Chyllinski et al., 2020; Hilken et al., 2018).

In the retail industry, AR has emerged as a game-changing technology, enabling retailers to enhance customer experience and increase sales by providing innovative and personalized shopping experiences (Caboni & Hagberg, 2019). AR technology can be integrated into retail operations to create a unique shopping experience, in which consumers can interact with products before making a purchase (Flavián & Barta, 2022). One of the most significant benefits of AR in retail is its ability to bridge the gap between online and in-store shopping experiences. AR technology enables retailers to create virtual storefronts, allowing consumers to explore products and make purchases from the comfort of their homes. Additionally, AR can be used to provide consumers with detailed product information, such as product features, specifications, and reviews, which can help consumers make informed purchase decisions. The ability to superimpose digital content in the real environment provided by AR makes it a more suitable tool for the consumer's purchasing decision process (Flavián et al., 2019a). Moreover, future forecasts are outstanding. In the United States, 28% of all online consumers are expected to be using AR by 2025, with a much higher percentage in other countries such as the United Arab Emirates (see Picture 1.3).

The development of AR technology has led to the emergence of several applications in the retail sector. Due to the increase in sales that AR provides and other advantages it brings to the consumer experience through more interactive experiences (Chylinski et al., 2020; Hilken et al., 2020; Tan et al., 2022), multiple companies have developed their own AR apps. Table 1.1 shows some of the existing applications offered by well-known brands. This highlights the importance that AR is currently acquiring in this sector.

AR can be enabled through various types of devices, such as smartphones, tablets, wearables, and specialized headsets, which use cameras and sensors to track the user's position and movements (Carmigniani et al., 2011; Zhan et al., 2020). In order for AR to function, it requires an enabler, which is typically software that is designed to interpret the user's movements and display computer-generated content in real-time (Rejeb et al., 2021a). This enabler can take the form of an application or program that is installed on the user's device, or it can be integrated into the hardware of specialized AR devices. Furthermore, AR also requires a marker, which is a physical object or point in the environment that is used as a reference point for the AR software to overlay digital content onto. Markers can take various forms, such as printed images, Quick Response (QR) codes, or physical objects with distinctive features that can be recognized by the AR software (Massa & Ladhari, 2023).

Picture 1.3. Forecast share of consumers who will have used AR when buying products online worldwide by 2025, by country



Source: Statista (2022b)

Table 1.1. Main apps in retailing sector

Products	Device	Function	Companies
Beauty products	Computer / Webcam	Allow virtually try-on make up	L'Oreal, NYX cosmetics, Maybelline, Charlotte
	Phone / Tablet		Sephora, Modiface
Clothes and shoes	Phone / Tablet	Allow virtually try-on clothes and/or shoes	Tryo, Walmart, Timberland, Gucci
		Scan consumers' feet and recommend the best size	Nike
Glasses	Computer / Webcam	Allow virtually try-on glasses	Mister Spex, Luna, Ray-ban
	Phone / Tablet		Warby Parker
Furniture and decoration	Phone / Tablet	Place selected furniture in consumers' home	Ikea, Wayfair, Lowe's
		Allow change the colour of walls in the room	Dulux visualizer, Home Depot
Watches	Phone / Tablet	Allow virtually try-on watches	Rolex
	Computer / Webcam		Tissot
Rings	Phone / Tablet	Allow virtually try-on rings and wedding bands	Diamond Hedge, Tiffany
Different products	Phone / Tablet	Allow consumers to see how Amazon products would look in their homes	Amazon
Tatoos	Phone / Tablet	Allow consumers to place virtual tattoos on their body	Ink Hunter
Print	Phone / Tablet	Makes print media interactive by overlaying it with virtual features	Layar
Cars	Phone / Tablet	Allow users to configure and customize a virtual BMW car	BMW
Product development	AR Glasses	Augmented collaboration design platform for the design of operating rooms	Stryker

Source: Own elaboration

The combination of these elements (the device, enabler, and marker) enables AR to create a seamless blend between the physical and digital worlds, allowing users to interact with and manipulate digital content within their physical environment (Rauschnabel et al., 2022). Due to the implications that the type of device can have on consumer perceptions and experience (Barta et al., 2021; Flavián et al., 2019a), the different types of AR according to the device will be explained in detail below. A brief description of the use-case for each device in the retail sector is also provided. Based on the type of device used, AR can be classified into 4 main categories:

▪ **Stationary:** this type of AR technology involves integrating digital content into real-world stationary objects, such as books, posters, or screens. AR stationary utilizes software and hardware components, such as cameras, sensors, and processors, to recognize specific markers or patterns and overlay digital content in real-time on the stationary object (Rauschnabel et al., 2015). The digital content that is overlaid onto the stationary object can take various forms, such as 3D models, videos, animations, or interactive elements, and can be designed to provide users with an immersive and engaging experience (Scholz & Smith, 2016).

Stationary AR has several applications in the retail sector (Caboni & Hagberg, 2019). For example, an AR-enhanced poster could provide additional information about a product or service through interactive animations or videos. This fact can increase brand awareness and engagement by providing interactive and immersive content. Furthermore, virtual mirrors based on AR are digital tools that allow users to virtually try on clothing, accessories, or makeup, without physically having to put them on. Virtual mirrors use AR technology to superimpose the user's image onto a screen or device, and then overlay digital content, such as clothing or makeup, onto the user's image in real-time. The technology behind virtual mirrors involves using cameras and sensors to capture the user's image and track their movements (Xiong et al., 2021). In this way, users can interact with the virtual content through hand gestures or touch controls, and can see themselves from different angles and in different lighting conditions, providing a realistic and immersive experience (Chylinski et al., 2020).

These devices have both advantages and disadvantages. Stationary devices are located in a specific place and are usually not moved, at least during use, which can generate a high level of attention. In addition, they can be permanently powered and are therefore not dependent on batteries. However, they are only usable in one place, which is usually public. This aspect may affect the early stage use of these devices, as people generally prefer to use the technology in a private environment (Barta et al., 2022a; Rauschnabel, 2018). Focusing on virtual mirrors, their use is not yet widespread in many countries, being currently used mainly in Asia (China, South Korea).

Overall, AR stationary is a promising technology that has the potential to revolutionize the way we interact with stationary objects, providing new and innovative ways to learn, advertise, and entertain. Virtual mirrors based on AR has the potential to transform the way consumers shop for clothing and beauty products, making the experience more convenient, efficient, and engaging.

- **Mobile:** it is a type of AR technology that utilizes mobile devices, such as smartphones and tablets, to provide users with an interactive and immersive experience. AR mobile technology works by overlaying digital content onto the user's real-world view, using the device's camera and sensors to track the user's movements and position the digital content in real-time (Flavián & Barta, 2022).

AR mobile comprise apps that can be downloaded and installed on a user's mobile device. These apps use AR technology to provide users with an enhanced experience, allowing them to interact with virtual objects or characters that appear to be part of their real-world environment (Caboni & Hagberg, 2019). In marketing, AR mobile can be used to create interactive and engaging advertisements, allowing users to interact with products or services in a more immersive and memorable way. As smartphones and tablets are equipped with technology relevant for AR (camera), they can be used to project 3D models of a product in the environment where the consumers are. Furthermore, the mobile devices can be used to try on products on the consumers' body through the use of the device's internal and external camera (Samini et al., 2021). This last type of app is known as VTO apps. Through the internal camera of the mobile, the consumers can see how a product fits on their face, or by using the external camera they can see how a product looks on the rest of their body (e.g. shoes or watches).

Although it is the most widely used AR type in the retail sector, among other reasons because it does not require the separate purchase of hardware, it has some limitations. Concretely, consumers need at least one hand to hold and control the device, which reduces the immersive level of the experience. Furthermore, these devices have a small display size, which makes easier that consumers are aware that the experience in AR is not real.

Despite these limitations, this AR type is continually evolving, with new applications and use cases emerging on a regular basis (Statista, 2023c). As the technology becomes more accessible and user-friendly, it is likely that AR mobile will continue to grow in popularity and become an increasingly important part of the consumers' daily lives.

- **Desktop computers and laptops:** the use of AR in these devices is possible as a result of the development of Web AR. This is a technology that allows users to access AR experiences using a web browser, without the need for a dedicated mobile app or software (Qiao et al., 2019). Web AR works by leveraging the capabilities of web browsers and integrating them with AR technology, enabling users to experience AR content directly through their browser on a range of devices, including smartphones, tablets, desktop computers and laptops (Arena et al., 2022). It allows users to experience AR content without requiring the installation of a dedicated app, making it more accessible to a wider audience.

Through the use of computers, once the user has granted permission, the web page will display the AR content, which can take various forms, such as face filters or interactive elements. The user can then interact with the AR content using gestures or other inputs, such as tapping, swiping, or voice commands (Qiao et al., 2019). The main way in which Web AR can be used in retail is through VTO experiences. Using the device's camera, customers can superimpose virtual versions of clothing, accessories, or cosmetics onto their own image, enabling them to see how the products would look on them before making a purchase. This can help to reduce uncertainty and increase confidence in purchasing decisions, which can ultimately lead to higher conversion rates and customer satisfaction (Tan et al., 2022; Barta et al., 2023a).

One of the key benefits of the use of AR on computers is its accessibility, as users do not need to download and install a dedicated AR app to experience AR content (Qiao et al., 2019). This can make it easier for businesses and organizations to incorporate AR into their marketing and promotional strategies, as users can simply access the AR experience through a webpage.

- **Wearable: AR** technology is integrated into devices that can be worn on the body, such as glasses and headsets, or in the body, such as smart contact lenses. AR wearables use sensors and

cameras to capture the user's view of the real-world environment and overlay digital content onto that view, providing users with an immersive and interactive experience (Rauschnabel et al., 2015).

One key application of wearable AR in retail is in-store navigation and wayfinding (Rauschnabel, 2021). By using wearable devices, customers can be provided with real-time directions and product information as they navigate through the store. This can help to improve the customer experience, reduce frustration and confusion. Furthermore, the freedom of the hands that these devices imply would allow them to continue to access information about nearby shops while carrying the purchase on the way home.

Moreover, virtual showrooms can be created. Retailers can create virtual environments that allow customers to interact with and customize products in real-time. This can be particularly useful for products such as furniture or home decoration, where customers may want to see how different configurations or colours would look in their own home. By providing customers with the ability to customize and visualize products in this way, retailers can increase engagement and interest (Caboni & Hagberg, 2019). In addition, wearable devices can also be used in retail to provide interactive product demonstrations and training. Virtual training environments may allow employees to interact with and learn about new products, while also providing customers with informative and engaging product demonstrations (Scavarelli et al., 2021). This can help to increase employee knowledge and confidence, while also improving the customer experience and driving sales (Berman & Pollack, 2021).

Despite the potential benefits of AR wearables, there are still challenges that need to be overcome, such as the development of more compact and user-friendly devices, as well as the need for improved battery life and processing power (Caria et al., 2019). The in-body technologies for AR currently exist only as concepts. In this sense, there are still significant challenges that need to be addressed, such as the development of safe and reliable implantable devices, as well as the need for ethical considerations and regulations. However, as technology advances and these challenges are overcome, AR wearables will offer new opportunities for enhanced communication, interaction, and control of our own bodies.

1.4 Research objectives and structure

Focusing on the consumer experience during online shopping, the main objective of this doctoral thesis is to understand the causes of the shopping experience that explain product returns; and subsequently analyse how AR can contribute to solve this issue through the enhanced consumer decision process it provides.

The main objective is divided into specific objectives that are detailed below. These specific objectives are addressed through an in-depth literature review and the development of several empirical studies.

- **Research objective 1**: *analyse the mechanism through the flow state generates the product return.*

The knowledge of the perspective with which the issue of product returns has been explored is essential for the further development of empirical studies to contribute to this field. Therefore, the most relevant academic research in the field over the years is analysed, and areas still to be explored are identified. Specifically, traditional research has been carried out from an operations and distribution perspective without focusing on the consumer perspective. Focusing on the latter perspective, research has explored the impact of psychological concepts (e.g. cognitive dissonance). However, there are other psychological states that may be relevant in the field (e.g. flow) to be further explored. This leads to the second objective.

Previous research has extensively examined the benefits that flow generates in the consumer experience (Hsu et al., 2012; Lee et al., 2019). However, flow is a psychological state of total concentration and enjoyment in which the consumer feels that time flies, resulting in a loss of consciousness (Barta et al., 2021). As a result, the consumers may carry out actions that they may later regret, resulting in the product return.

- **Research objective 2:** *analyse the current state of the literature in AR to establish research gaps about its role in decision-making process.*

A Systematic Literature Review (SLR) about the role of AR on consumer behaviour is conducted to avoid the well-known limitations of literature selection in narrative reviews and expert reviews (Kitchenham et al., 2009; Tranfield et al., 2003). Furthermore, SLR synthesizes the existing research findings in a transparent way (Snyder, 2019). The subsequent thematic analysis carried out identifies the most researched topics. In addition, this review sheds light on the issues to be explored in future research.

- **Research objective 3:** *analyse the effect of AR on purchase behaviour and its impact on cognitive dissonance.*

Immersive technologies can generate flow states because of the immersion they provide (Serravalle et al., 2023). This aspect has been extensively demonstrated in AR research (Argashi & Arsun-Yuksel, 2022; Gupta et al., 2021; Kumar, 2022; Perannagari & Chakrabarti, 2020). Due to the results obtained previously in which the flow can generate regret when the consumer is not satisfied with their purchase, it is studied how AR can improve the decision-making process to avoid a wrong decision. Furthermore, qualitative studies have postulated that the use of AR may increase cognitive dissonance due to the quick and convenience it offers to try on many alternatives (Romano et al., 2021). However, AR could also reduce it because of the virtual product visualisation it offers. In an empirical way, a response to this controversy is provided.

- **Research objective 4:** *analyse the effect of AR on consumer decision-making process through the role of risk perception.*

Perceived risk refers to the subjective evaluation of potential negative consequences or harm that may arise from engaging in a particular activity or using a particular product or service (Dowling, 1986). The risk perception has been shown to be key in online shopping behaviour (Hassan et al., 2006; Wai et al., 2019). Some studies have postulated that AR may reduce the perception of risk due to the virtual product testing it allows to consumers (Ghafoori et al., 2022). However, if the consumers testing the product virtually are not able to make a clear decision, their perception of risk in the online purchase could increase. Therefore, similar to the objective 3, it is intended to provide an empirically answer to this controversy.

- **Research objective 5:** *analyse the effect of AR on consumer information processing and decision-making.*

With the aim of further exploring the effect of AR on the consumer's decision-making process, its effect on the consumer's information processing is analysed. On the basis of Construal Level Theory (CLT), the psychological distance may influence the consumers' information processing (Trope et al., 2007). As AR shows the product in the consumer's environment, the perceived distance using AR to the product may change. Therefore, the aim is to investigate how AR modifies information processing because of the product's presence generated. In addition, data collection in a lab environment allowed measuring the time participants took to make the decision. This contributes to the scarce literature explaining the effect of AR on actual consumer behaviour (for an exception, see Tan et al., 2022).

The structure of this doctoral thesis is shown in Figure 1.2. The present chapter introduces the research motivations and the objectives of the dissertation.

Chapter 2 comes to respond to the research objective 2. This chapter reviews the most researched areas in the literature on product returns. Once the gap has been identified, an empirical study contributes to the knowledge of factors which explain product returns from a consumer perspective. Concretely, the psychological mechanism of flow state that can lead to the product return is analysed.

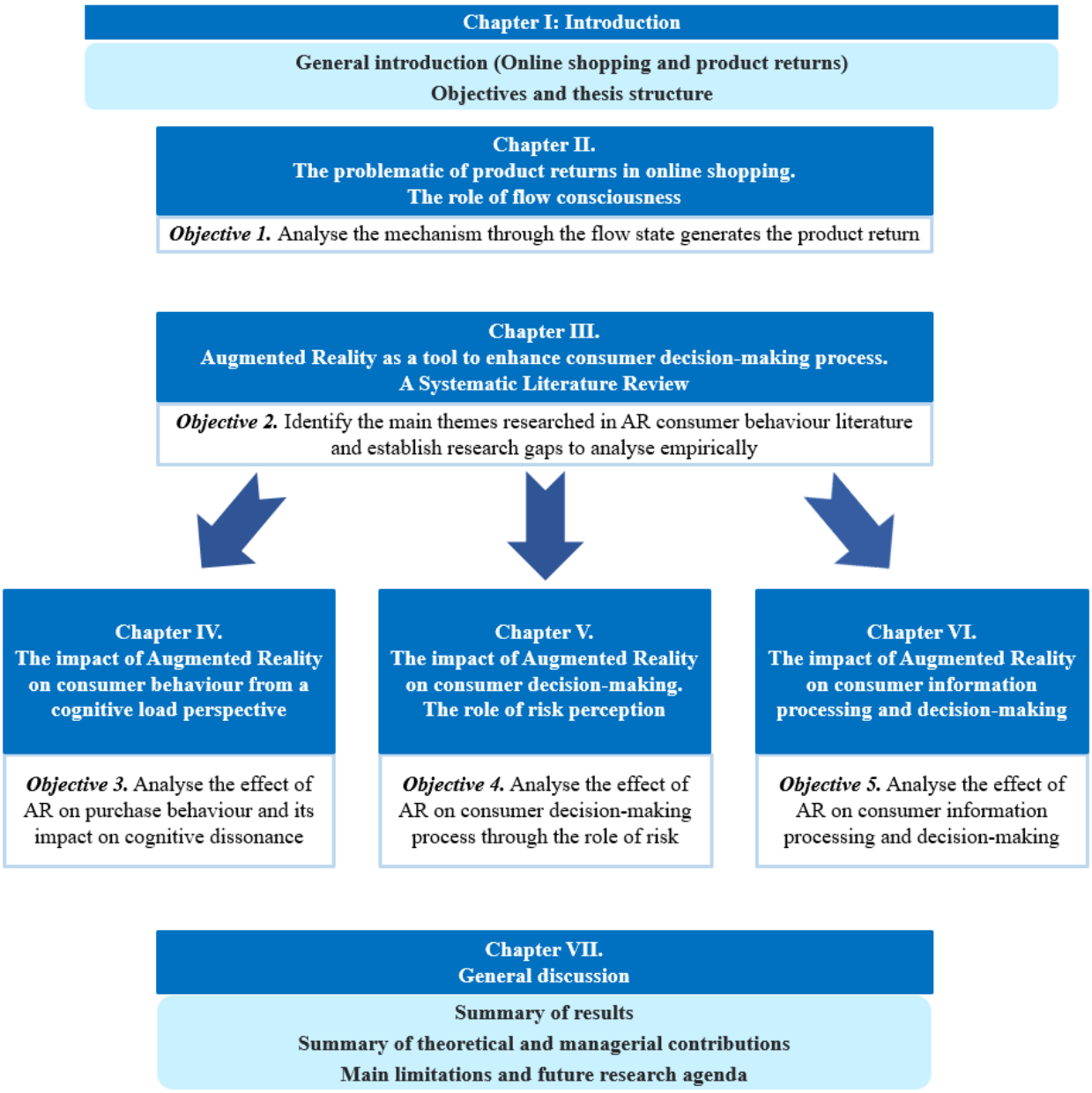
After that, chapter 3 aims to respond to the research objective 2. This chapter is devoted to a review of the literature on AR in consumer behaviour. The chapter shows the evolution of research in this field is presented, from the initial stages to the present day. This in-depth literature review allows to identify several gaps in the literature to be covered in the next part of this doctoral thesis.

The following chapters covers the empirical analysis of AR in this dissertation. Chapters 4, 5 and 6 analyse how AR affects the decision-making process and consumer responses. Chapter 4 aims to cover the research objective 3. It deepens in the knowledge of factors that generate purchasing behaviour from the perspective of cognitive load theory and the concept of cognitive

dissonance. The chapter 5 cover the research objective 4. This chapter, under the perspective of risk reduction, demonstrates how the use of AR improves the consumers' decision-making process, enhancing their shopping experience. Chapter 6 deepens the understanding of the impact of AR on the decision-making process, analysing how it affects the heuristic-systematic processing on the basis of CLT. Therefore, chapter 6 provides an answer to the last research objective established (research objective 5).

Finally, chapter 6 shows the general conclusions derived from the research and highlights the main theoretical and managerial implications. Moreover, this chapter details the general limitations of this dissertation and provides an extensive research agenda regarding the impact of AR in consumer behaviour.

Figure 1.2. Thesis structure



2. The problematic of product returns in online shopping: the role of flow consciousness

2. The problematic of product returns in online shopping: the role of flow consciousness

2.1 Introduction

Due to the current business relevance of product returns, it is necessary to investigate the causes that can generate them in greater depth. Understanding the potential factors that contribute to product returns can inform strategies and actions for online retailers to mitigate this issue. For this purpose and to address the first objective established, this chapter reviews the main studies on product returns and conducts an empirical study. Specifically, from a consumer perspective, this study aims to explain how consumer flow states, widely considered in online shopping experience (see Lee et al., 2019; Wang & Hsiao, 2012; Wu et al., 2020), influence product returns.

As mentioned earlier, product returns have negative impacts on consumers, sellers, and society as a whole. While consumers may receive a refund for the product, they are not compensated for the effort and time invested in the purchase process (Bijimult et al., 2021). Furthermore, to make a return consumers have to repackage the product and even occasionally take it to a pick-up point to complete their part of the process to return the product. In relation to online retailers, they have to develop efficient returns management systems and bear logistics and storage costs, which are significant cost that affects their business results (Ambilkar et al., 2022). In addition, returns also impact the environment, affecting sustainability (Forbes, 2022). In addition to the material cost of repackaging returned products, product transportation also has environmental consequences, such as increased use of fuel and resulting emissions of pollutant gases (Forbes, 2022). As the number of returns continues to grow and their impact on consumers, retailers, and society becomes increasingly evident, it is critical to gain a deeper understanding of the key factors that drive returns.

In online shopping, flow states have proven to be a key aspect in creating attractive experiences. The shopping experience can be valuable but becomes less relevant as the product is used (Grewal & Roggeveen, 2020; Pine & Gilmore, 2011). Instead, product performance becomes increasingly important in the purchase evaluation. Thus, the consumers may have enjoyed a pleasant shopping experience but may only achieve full satisfaction afterward if they feel they have made a good choice (Barta et al., 2022b). This can lead to the emergence of negative feelings for the consumer, such as regret (Connolly & Zeelenberg, 2002).

2. The problematic of product returns in online shopping: the role of flow consciousness

Flow's impact on positive responses has been widely examined (Whittaker et al., 2021; Ye et al., 2020). However, much less research has focused on understanding the impact that flow and the fact of being aware of the flow have on negative consequences (Barta et al., 2022b; Kaur et al., 2016). Furthermore, few empirical studies have been conducted to understand the negative aspects that flow may cause. In this sense, scarce research has examined the impact of flow consciousness on consumer regret. Recently, it has been noted that flow can generate consumer regret through impulse buying and flow consciousness (Barta et al., 2022b; Wulandari & Risqiani, 2021). However, the effect of flow consciousness on consumer regret has not been discerned between different types, such as process regret or outcome regret (Connolly & Zeelenberg, 2002). To fill this gap, this chapter aims to shed light on the issue of whether the good shopping experience implied by the flow can become a negatively valued aspect if the consumer regrets the purchase. For this purpose, the research analyses the role of flow consciousness on consumer regret from a dual perspective, making a distinction between process and outcome regret.

After conducting a review of the most relevant studies in the product returns literature, this chapter aims to make several contributions through an empirical study. Firstly, the chapter extend the knowledge in the product returns literature examining how flow and consumer regret generates returns from a consumer perspective. Thus, the impact of other psychological concepts besides those already studied is analysed (e.g. cognitive dissonance; Ahsan & Rahman, 2021). Secondly, the study examines post-purchase regret from a dual perspective (process regret and outcome regret) to examine the underlying mechanism through the flow leads to product return. Understanding this phenomenon helps e-commerce retailers properly manage the regret that the consumer can generate. The knowledge of all these aspects allows retailers to reduce the number of product returns received and, consequently, the associated costs. This will also shed light on strategies or actions to develop to improve the online consumer experience in order to mitigate the number of returns received.

2.2 Product returns literature

A narrow body of academic literature has studied product returns from an ethical perspective, focusing on those returns that are made in a premeditated way to the purchase (called deshopping behaviour in its origins; Schmidt et al., 1999). Subsequent articles have examined this aspect from a qualitative approach in certain cases (Harris, 2008; Johnson & Rhee, 2008; King & Dennis, 2006; Piron & Young, 2000). Thus, research literature can be classified into general product returns and fraudulent returns (Dailey & Ülkü, 2018). As this chapter aims to understand the most important factors explored that explain the return of a product, it will focus on general product returns, in which there is no intention to return the product prior to purchase.

The large body of research has focused on the impact of return policies on product return or non-return. The belief that more lenient return policies are more likely to encourage product purchase than return has been extensively explored, and this belief is generally supported (Janakiraman et al., 2016). Empirical research found that while the lenient return policy led to an increase in purchases, it did not result in higher return rates compared to the restrictive return policy (Wood, 2001). However, some studies have noted that lenient return policies lead to both higher purchase and higher returns (Petersen & Kumar, 2010). Furthermore, a positive relationship has also been found between the number of purchases and the number of product returns, suggesting that increasing product purchases leads to greater product returns (Bonifield et al., 2010).

Apart from the leniency or strictness of the refund policies offered, the impact of the elements of these policies have also been considered in the literature. For example, the impact of whether an exchange or cash back is offered, whether or not a ticket is required, whether or not the original packaging is required, whether or not visible signs of use are allowed, and the time limit for return has been explored (Davis et al., 1998). Other elements have also been further analysed, such as whether the costs of the return were fully or partially covered by the retailer, or whether they were not covered at all (Heiman et al., 2001). Research has shown that a customer who experiences a free-based product return is more likely to purchase more in the future than a consumer who experiences a fee-based product return (Bower & Maxham, 2006). Moreover, the

impact of the retailer's return policy format has been studied through mathematical modeling, analysing how the return policy can influence the company's operational decisions and omnichannel retailing (Jena & Meena, 2022). It has also been analysed whether the return policy influences the choice of one sales channel or another, finding no preference for the purchase between a marketplace or a reseller channel (Alaei et al., 2022). Despite the results obtained, these studies use panel data from an operational perspective rather than from a consumer behaviour perspective, which does not provide insight into consumer perceptions. Therefore, studies focused on consumer perceptions with higher external validity are also needed (Mookherjee et al., 2021).

Concerning the theoretical frameworks in the research on the effect of return policies on purchases and returns, five theoretical mechanisms have been the most widely used (Ahsan & Rahman, 2021). First, the perceived risk theory has been employed, suggesting that return policies reduce financial and product risk in the purchase (Van den Poel & Leunis, 1999). Second, signalling theory has been used to explain how return policies act as positive quality signals (Nasr-Bechwati & Siegal, 2005; Wood, 2001). Furthermore, the products' package is also a signal that influences returns (Wallenburg et al., 2021). Concretely, products shipped in premium packaging are less return-likely than products shipped in ordinary packaging. Third, CLT has been used for propose that decreasing return deadlines can have the counterintuitive effect of increasing return rates (Janakiram & Ordóñez, 2012). Fourth, to explain postpurchase customer satisfaction, expectation de/confirmation theory is used to identify relationships between product quality, customer dissatisfied and product returns service (Wang et al., 2020). Fifth, dissonance theory allows to identify mental status related to the decision that could lead to the product return (Chen et al., 2020; Walsh et al., 2016). Table 2.1 shows a summary of these frameworks.

From a consumer perspective the research is much more scarce. The firm–customer exchange process is comprised of three essential components: (1) firm-initiated marketing communications, (2) customer purchasing behaviour, and (3) consumer product return behaviour (Petersen & Kumar, 2009). To date, the marketing literature has focused primarily on how marketing communications influence customer purchasing behaviour. Furthermore, it has been

extensively studied factors that encourage customer purchasing behaviour. In relation to the third component, the literature on product returns is scant, particularly in terms of analysing the product return behaviour of individual customers (Ambilkar et al., 2022; Duong et al., 2022). However, the increase in return products has stimulated the development of review papers in the field that call for research on this emerging issue (Ahsan & Rahman, 2022).

Table 2.1. Description of main frameworks used

Theory	Description
Risk theory (Taylor, 1974)	Describes consumer's perceived risk from product returns (financial, social, physical, or a combination) and returns behaviour.
Signalling theory (Spence, 1973)	Explanation of the returns policy in detail as well as leniency is indicative of quality. The theory demonstrates how a strong reputation (a quality indicator) can reduce product return rates.
Construal level theory (Trope & Liberman , 2010)	Return deadlines are likely to behave as temporal deadlines and return effort is likely to be perceived as a low-level concrete and peripheral stimuli.
De/confirmation theory (Anderson & Sullivan, 1993)	To explain post–purchase consumer satisfaction, the expectation de/confirmation theory identifies relationships between product quality, consumer dissatisfaction, and product return service.
Dissonance theory (Festinger, 1957)	Examines product returns from consumers behavioural or mental issues, such as whether a person is unhappy or dissatisfied with their planned or unplanned purchasing decision.

Source: Own elaboration

The existing literature on product returns from a consumer perspective have focused on product and consumer characteristics. Regarding product characteristics, retailers can use customized products to induce some consumers who otherwise would buy and return a standard product to switch to lower-return-rate customized products (Esenduran et al., 2022). Moreover, products received as gifts are less likely to be returned than products not received as gifts; and the products purchased during the holiday season are more likely to be returned than products purchased during the rest of the year (Petersen & Kumar, 2009). In addition, the ease of returns and refunds positively influence customer loyalty for both low- and high-risk products, but not for medium-risk products (Ramanathan, 2011). Research has also shown that low-priced products and items sold by a retailer at lower prices than competitors are less likely to be returned (De et al., 2013). On the other hand, the body of literature focusing on consumer characteristics has focused on the level of consumer purchase motivation and socio-demographic characteristics. Previous

studies show that the likelihood of product return is influenced by the level of consumer involvement (Bechwati & Siegal, 2005; Rao et al., 2014). Furthermore, the hedonic shopping motivation of the consumer increases the product returns (Seo et al., 2015). Also, older people and those with a higher frequency of purchase and those with return habits are more likely to return the product (Griffis et al., 2012; Sahoo et al., 2013). In addition, some demographic characteristics as gender affect the intention to return the product in some products category (Minnema et al., 2017).

2.3 Empirical study

After reviewing the existing literature, there is a lack of research examining how the online shopping experience may affect the occurrence of these returns. Therefore, this section aims to contribute in this direction by conducting an empirical study. This study analyses how the shopping experience (reflected in the consumer's flow state) can generate negative emotions that lead to the product return.

2.3.1 Flow and consumer regret

Flow is the feeling people have when they are in an optimal state of mind, totally involved in a single task they feel they control (Csikszentmihalyi, 1975). Flow could be explained as the pleasant experience people feel when acting with total involvement and being immersed in the activity (Wu et al., 2021). In this optimal experience, the individual perceives absolute concentration and enjoyment, perceiving a higher value in the experiences (Hong et al., 2022). However, during flow, the individuals report a large loss of self-awareness (Nakamura & Csikszentmihalyi, 2014). This flow-related loss of self-awareness can lead individuals to engage in behaviours they would later prefer not to perform. Due to the loss of consciousness that the flow state implies, the role of the individual's subsequent awareness of having experienced flow has been examined (Herrando et al., 2018).

The research that investigates the relationship between flow and regret experiences is scarce. In an educational context, it has been examined if the decision mode for engaging in a task

is relevant for the experience of regret (Kuhnle & Sinclair, 2011). The study reflected that the flow experience did not reduce the regret. In more recent studies, the influence of flow on the regret experience in social networks sites is still unclear. It is shown that concentration is an aspect that generates regret. However, the enjoyment implied by the flow experience has no significant effect on regret, although a tendency to reduce it is observed (Kaur et al., 2016). In this regard, it is noteworthy how a hedonic dimension of experience, such as enjoyment, does not have an effect on reducing regret. In contrast, a cognitive dimension, such as task-focused attention, affects regret in the other sense. Therefore, it is necessary to explore this field further due to the lack of studies linking flow and regret, and the results obtained from them, observing different effects depending on the flow dimension.

Regret arises from individuals' perceptions of the cognitive effort they spent comparing the chosen option with the rejected options (Lee & Cotte, 2009). When individuals perceive after the purchase that a decision was unreasonable or inexplicable, they tend to feel responsible for making a wrong choice (Van Dijk et al., 1999). Decision justification theory suggests individuals can feel regret due to: a) the evaluation of the process; and b) the evaluation of the outcomes (Connolly & Zeelenberg, 2002). Individuals may assess the quality of their decision-making processes by examining the amount of information they collect (Janis & Mann, 1977). On the one hand, when individuals regret the process regardless of the purchase outcome, they can feel regret if they believe they failed to undertake the decision-making process as they intended, that is, in an intention-behaviour inconsistency (Zeelenberg & Pieters, 2007). Process regret may also arise when individuals consider they have not properly managed the information needed to decide. In this sense, they may regret it because they have spent too much time making a choice or collected insufficient information (Lee & Cotte, 2009).

On the other hand, outcome regret is an emotional state in which one feels sorry about various things, such as limitations and mistakes (Landman, 1993). This type of regret has been defined as a negative, cognitively determined emotion consumers experience when realizing or imagining that their present situation would have been better if we acted differently (Zeelemberg

& Pieters, 2007). Outcome regret, thus, is a consequence of decision-making in risky situations and may arise when individuals believe they have made the wrong decision, even if the decision appeared to be correct at the time it was made.

Few studies have addressed consumer regret from a dual perspective, as in this instance, process regret and outcome regret (Zulkarnain et al., 2020). Instead, these studies focused on the crucial role that brands can have in persuading customers to identify with the product/company as a means of reducing consumer regret and how personality affects the process and outcome regret from the perspective of the "big five" (Ditinjau et al., 2018). Table 2.2 shows a compilation of studies on regret experiences.

Table 2.2. Examples of studies addressing regret experience

Reference	Context	Methodology	Main results
Kuhnle & Sinclair (2011)	Education	Surveys	Intuitive decision (full attention) has a positive relationship with flow. Consequently, less regret arises. Flow does not mediate the relationship between decision mode and regret.
Kaur et al. (2016)	Social networks (Facebook)	Surveys	Older adolescents and those who spend more time on Facebook experience higher regret. Concentration leads to regret. No significant effect on regret found for the enjoyment dimension.
Davvetas & Diamantopoulos (2017)	Consumer behaviour	Surveys	Consumer-brand identification attenuates the negative effects of regret on satisfaction and behavioural intentions and strengthens the positive impact of satisfaction on brand repurchase/recommendation intention.
Verkijika (2020)	Technology adoption	Surveys	Affect and anticipated regret has a significant positive influence on behavioural intentions to adopt mobile payments, while the influence of anxiety is not significant.
Li et al. (2021)	Consumer behaviour	Experiment	Consumers who experienced downward anticipated regret showed more online impulsive buying behaviour than those who experienced upward anticipated regret. Moreover, anticipated regret moderates the relationship between product involvement and online impulsive buying behaviour.
Wulandari & Risquiani (2021)	Consumer behaviour	Surveys	Flow state affects online impulse buying and the impulse buying has a positive effect on post-purchase regret.
Xiao & Spanjol (2021)	Digital products users	Experiments	The perceived changes of the new version of the app leads to adoption procrastination. Anticipated inaction regret acts as a counteracting mechanism, reducing the adoption procrastination.

Table 2.2. Examples of studies addressing regret experience (to be continued)

Reference	Context	Methodology	Main results
Zhao et al. (2021)	Consumer behaviour	Experiments	Anticipated regret mediates the interactive effect of warning message type and preference ranking on liking and purchase intention.
Barta et al. (2022)	Consumer behaviour	Surveys	Flow consciousness has a negative effect on outcome regret.
Kurtoğlu et al. (2022)	Internet users	Surveys	Regret has a negative effect on brand loyalty and a positive effect on brand hate and negative word of mouth. Brand hate and brand loyalty mediates the effect of consumer regret on negative word of mouth.
Pizzutti et al. (2022)	Consumer behaviour	In-depth interviews and longitudinal survey	Consumers can engage in post-decision information search in the pre- and post-consumption phases to maximize the utility of a purchase, reduce regret, and satisfy curiosity about a purchase and pre-purchase information search behaviour.
Sameeni et al. (2022)	Consumer behaviour	Surveys	Brand betrayal for utilitarian (vs hedonic) products leads to stronger feelings of regret. The discovery of betrayal from others (vs. personal experience) intensifies the effect of brand betrayal, which is stronger for utilitarian (vs. hedonic) products.
This study	Consumer behaviour	Surveys	Outcome regret has a positive effect on return intention. Process regret does not affect the return intention. Flow consciousness increases process regret and negatively affects outcome regret for satisficers consumers.

Source: Own elaboration

2.4 Theoretical framework and hypotheses development

The research model is based on the cognitive processing model (Austin, 1997). The flow state is a cognitive state that involves a loss of consciousness leading the consumer to process information automatically. This may be followed by an active processing through schemas that allow the interpretation of previously collected information (flow consciousness and consumer regret in the research model). After this occurs, the consumer will wonder if the schema used to process the information has been appropriate, resulting in a series of responses to modify the processing. In this case, the response is the product's return because of the strong link to purchase regret (Duong et al., 2022).

2. The problematic of product returns in online shopping: the role of flow consciousness

The flow state involves full concentration and enjoyment, which implies a loss of self-consciousness and can lead to losing track of time (Zeelenberg & Pieters, 2007). Meanwhile, flow consciousness is the individual's knowledge of having experienced flow (Barta et al., 2022b). The attentional processes carried out by individuals shape their perceptions of the experiences they have had (Nakamura & Csikszentmihalyi, 2014). The flow state involves absolute concentration, enhancing attention on a task or activity. This means that when the individuals realize afterward how much abstraction they have had while performing the task, they are aware of the state of absolute concentration they were experiencing. In addition, emotional aspects of the experience may facilitate its recall (Rolls, 1990). The enjoyment experienced during the flow state can facilitate the recall of the flow experience, making the individual aware of being in flow.

H1: Flow state has a positive effect on flow consciousness.

From a psychological point of view, people attempt to avoid experiencing regret and take steps to regulate it when they do (Landman, 1993). The flow consciousness allows consumers to be aware of the pleasant experiences they enjoyed during their flow states. Therefore, this aspect will allow for a positive recall of the purchase process, even if the consumer is aware of having been carried away by the flow state during the purchase decision. Although the consumers, being aware of the flow state, know that they have been carried away and have been in a state of total immersion during the buying process, they consider flow consciousness a positive aspect (Herrando et al., 2018). In this sense, they are aware that they have had an enjoyable decision process because of the flow state they experienced. This dimension of enjoyment that they attribute to the flow will allow them to reduce their regret for having spent too much time on the decision process or not considering enough information for the choice.

H2a: Flow consciousness reduces the process regret.

Flow has proven to improve subjective well-being (Kim & Hall, 2019). When consumers become aware that a better, alternative outcome is available, they experience more regret than when they remain unaware that a better outcome is available (Ogbanufe & Pavur, 2022). To achieve this, they try to find enough facts to relinquish personal responsibility. Flow consciousness allows

consumers to be aware of the pleasant experiences they enjoyed during their flow states and, in addition, allows them to more easily identify external factors that caused their mistakes (Barta et al., 2022b). In a gaming context, it has been observed how flow states can generate addictive behaviours (Brandtner et al., 2022). If the users are at least aware of the great time they have had because of their flow state, this can improve their well-being. That is, users may regret having wasted too much time playing games. However, if they are aware of their positive experience by reaching flow states, this will mitigate the sense of wasted time. Similarly, flow consciousness could have the same effect when consumers regret their purchased product. The awareness of having reached the flow state enables reducing the regret generated due to the positive recall of the purchase experience (Chen & Lin, 2022), despite not being satisfied with the product's performance.

H2b: Flow consciousness reduces the outcome regret.

Regret with the purchase process means that the consumer is not satisfied with how they made their purchase (Lee & Cotte, 2009). This regret is often caused by the consumers considering that they did not compare information on different websites or take advice from the different recommendations. Thus, gathering less information than necessary to make a purchase decision is one of the causes of process regret (Lee & Cotte, 2009). The lack of information collected during the purchasing process increases the likelihood of purchasing a product that does not meet the consumer's needs (Puccinelli et al., 2009). Consequently, the lack of information makes a wrong choice of product more likely, leading to outcome regret (Tzeng & Shiu, 2019). On the other hand, process regret can also arise when individuals have put too much time and effort into the buying process. When individuals overthink their decision-making process, they regret collecting unnecessary information that may not have improved their decision. According to the cost-benefit paradigm (Marshall, 2009), having spent much time to get a result equal to what would have been obtained without spending so much time may promote the appearance of final regret with the product's performance.

H3: Process regret has a positive effect on outcome regret.

When people realize they have made mistakes in their conduct, they experience negative emotions such as regret. However, individuals also want to reduce this regret to feel better about themselves (Zeelenberg & Pieters, 2007). Consumers can accomplish this by adjusting their beliefs but also taking measures to overcome regrets. They can behave in this way, for example, by returning the item. When consumers regret the process, they know they have not made the purchase well. To avoid this process regret, the consumers may likely return the product and make the purchase decision again later. When the consumers have more time to examine the alternatives offered or have more information on the topic, they will make a purchase decision again. However, for the time being they will return the product they feel they need to buy in the right way.

H4a: Process regret has a positive effect on return intention.

Nowadays, some tasks have become much more accessible in online commerce. In particular, product returns are very easy to make, but there are still some disadvantages, such as taking the product to a pick-up point, among other aspects (Sahoo et al., 2018). Moreover, in the case of Amazon, if the product is from an external seller, other costs may also have to be assumed, such as shipping. Nevertheless, due to the available facilities for returning products in online commerce, it is likely to proceed with the product return.

Balance theory postulates that the relationship between an individual and an object should be balanced, as balanced relationships are preferred (Heider, 1958). Therefore, if the individual has a bad perception of the object, it is possible that he also performs behaviours in consonance with the poor evaluation of the product, such as the return of the product. If the consumers are disappointed with the product's performance, they will likely evaluate it negatively (Nam et al., 2020). The perception that they have been cheated will lead to a willingness to return the item to reduce the losses incurred by the purchase. Although there are aspects they will not get back, such as the time invested, this return will allow them to recover most or all of the money they spent.

H4b: Outcome regret has a positive effect on return intention.

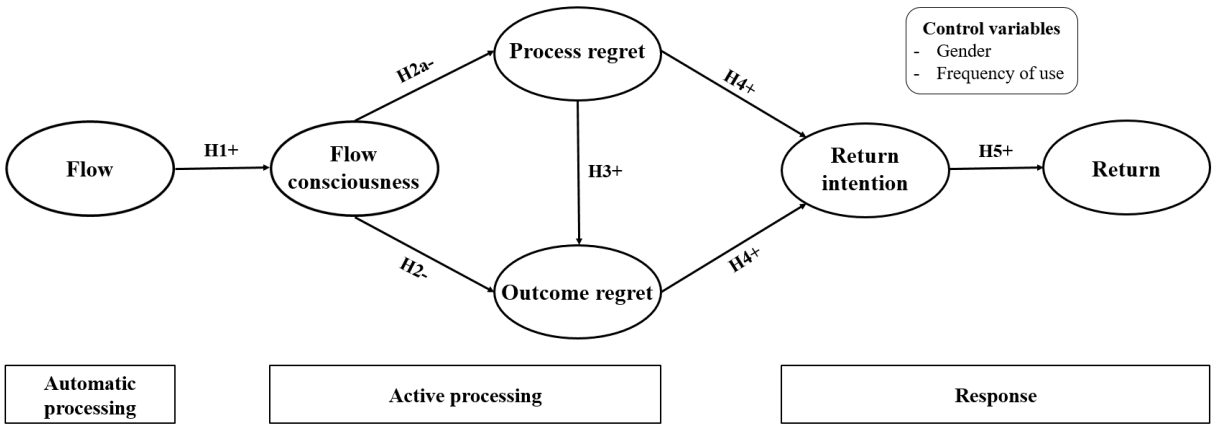
Intentions are the main predictor of actual behaviour (Ajzen, 1991). However, the intentions do not always affect individuals' actual behaviour (Webb & Sheeran, 2006). The discrepancy between intentions and actual behaviour is most evident when dealing with issues where there may be social desirability in the responses (Fisher, 1993). In this regard, it should be noted that product returns have already become a common process for online shoppers, so there is no reason for the social desirability bias (CNBC, 2022). Moreover, the fact that this is already a standard process for consumers encourages turning intentions into actual behaviour (Verplanken & Orbell, 2022). Thus, if the consumers plan to return an item, they will likely start the process. This process is usually costly for the consumers, as they have to repack the product and sometimes take it to a pick-up point to return the product to the seller. Thus, if the consumers are willing to carry out this process, it implies they truly want to return the product. In line with previous literature that has shown that intentions are an antecedent of actual behaviour (Koronios et al., 2021; Wang & Li, 2022), it is proposed:

H5: Return intention has a positive effect on return behaviour.

To ensure thoroughness, individual aspects were included as control variables. Specifically, the impact of gender and the frequency of use the online platform was controlled because of the effects that previous studies found on the product return (Rodgers & Harris, 2003; Sahoo et al., 2013).

Figure 2.1 depicts the proposed research model.

Figure 2.1. Research model



2.5 Methodology

2.5.1 Participants and procedure

The data used to carry out the research were collected from real consumers based on their online shopping experiences. A market research company selected the participants and they were economically rewarded. The company allows for a broad reach, providing demographically representative samples. In addition, it allows a higher quality of data than other possible online methods (Peer et al., 2017). To take part in the survey, they were required to have made a recent online e-commerce purchase (in the last week) on Amazon that cost between $20 and $50, in which they would have already received the product, and they were not completely satisfied. The average price consumers spend per item on Amazon is $34.08 (Pressreader, 2022). Therefore, when setting this interval, consumers were asked to refer to a regular purchase on the platform. Particular emphasis was also put on the fact that this should not be an opportunistic purchase (e.g., a purchase to use the product once and return it). The reasons to choose Amazon as an online retailer are because it is the most widely used platform for online shopping, and shipping on most of its products is fast, with delivery usually taking less than two days from the purchase moment (Statista, 2022c).

Due to the cross-sectional data collection, some of the suggestions provided by Maier et al. (2023) were considered. Specifically, a sampling strategy was carried out to gather a representative sample of the context of the study. Moreover, the sample size requirements for finding the proposed effects were calculated. For the proposed model, to find a medium effect size, with a power level of 0.80 and a significance level of 0.05, the required sample size is 170 (Soper, 2023). Once the minimum sample size was calculated, a large dataset was gathered. Consequently, data from 261 completed questionnaires were collected. Based on the attention check set in the questionnaire ("if you are reading this, check four"), four responses were removed from the dataset. Therefore, 257 valid questionnaires were collected. This sample size fulfilled the minimum sample size requirements of 200 needed to use the Covariance-Based Structural Equation Modeling (CB-SEM) established (Astrachan et al., 2014).

2.5.2 Measures

At the beginning of the survey, the participants were asked to recall a shopping experience with the characteristics previously required to participate in the study. To help them remember this shopping experience, they were asked an open-ended question in which they had to explain what the product was and what they would use it for. At the same time, this question allowed researchers to ensure that the participant was eligible to participate. Then, respondents were asked about the variables in the research with items on a 7-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Previously validated scales were used to measure concentration (four items adapted from Ghani & Deshpande, 1994), time distortion (three items adapted from Agarwal & Karahanna, 2000), enjoyment (four items adapted from Kourfaris, 2002), flow consciousness (two items adapted from Sicilia et al., 2015; Barta et al., 2022b), process regret (four items adapted from Lee & Cotte, 2009), outcome regret (four items adapted from Bonifield & Cole, 2007), return intention (three items adapted from Lee & Yi, 2017). The items that did not meet the factorial loading criteria were successively eliminated (one from process regret scale, see Table 2.3; Anderson & Gerbing, 1988).

Different measurements of flow have emerged in the academic literature. According to the research context, it has been considered both a unidimensional and multidimensional construct (Norsworthy et al., 2021). For example, in the tourism context, there is a recent tendency to consider it a unidimensional construct with items covering different aspects such as concentration, temporal distortion and immersion (Atzeni et al., 2022; Kim et al., 2020). In working environments, it is more common to use multidimensional scales composed of dimensions such as absorption, enjoyment and intrinsic motivation (Bakker, 2008; Taser et al., 2022; Tse et al., 2022). However, in this research, similar to previous research on consumer behaviour, flow state was measured through the three dimensions of concentration, time distortion and enjoyment (Barta et al., 2022b; Herrando et al., 2018; Siekpe, 2005). Finally, to find out their actual behaviour, they were asked if they had returned the product or started the return process. These items are indicated in Table 2.3.

Table 2.3. Scale items

Concentration (Adapted from Ghani & Deshpande, 1994)
During the purchase…
CONC1. I was absorbed intensely in the activity
CONC2. My attention was focused on the activity
CONC3. I concentrated fully on the activity
CONC4. I was deeply engrossed in the activity
Time distortion (Adapted from Agarwal & Karahanna, 2000)
During the purchase…
DIST1. Time seemed to go by very quickly
DIST2. I tended to lose track of time
DIST3. Time flies while I was surfing
Enjoyment (Adapted from Koufaris, 2002)
The shopping experience was…
ENJ1. Interesting
ENJ2. Enjoyable
ENJ3. Exciting
ENJ4. Fun
Flow consciousness (Adapted from Barta et al., 2022b; Sicilia et al., 2005)
The word "flow" is used to describe a state of mind sometimes experienced by people who are deeply involved in some activity. An example of flow is where a professional athlete is playing exceptionally well and has achieved a state of mind where nothing else matters outside of the game; the athlete is completely and totally immersed in it. Activities that lead to flow completely captivate a person for a period. When one is in flow, time may seem to stand still and nothing else seems to matter. Thinking about the experience you had on Amazon that you have named at the beginning of the questionnaire, respond to the following:
CONS1. I experienced flow
CONS2. It was a very intense sensation
Process regret (Adapted from Lee & Cotte, 2009)
PROC1. I expended too much effort in making my decision
PROC2. I wasted too much time in making my decision
PROC3. I think I put too much thought in the buying process
PROC4. I feel that too much time was invested in getting this product
Outcome regret (Adapted from Bonifield & Cole, 2007)
OUT1. I should have chosen an alternative product
OUT2. I regretted buying this product
OUT3. After received this product, I felt bad about ordering it
OUT4. In retrospect, I felt that I could have made a better choice by choosing a different product
Return intention (Adapted from Lee & Yi, 2017)
RET1. I will likely return the product
RET2. It is probable I will return the product
RET3. I am going to return the product
Gender
Frequency of use
How often do you use Amazon?
Hardly ever
Several times a month
Several times a week
Several times a day
Return: *Have you returned the product or started the return process?*
Yes
No

Note: item in italics was deleted during the validation process.

2.5.3 Participants

The sample is composed of North American consumers who are relatively young (66.15% under 45 years old). More than half of the sample has university education and is quite balanced in terms of gender and they have wide experience on Amazon (almost half of the participants use it several times a week). According to these features, the sample is representative of North Americans who tend to use e-commerce (GWI, 2022). Table 2.4 presents a description of the sample used in the study.

Table 2.4. Sample description

Label	Frequency	Percentage
Age (N = 257)		
18-24	34	13.23%
25-34	60	23.35%
35-44	76	29.57%
45-54	48	18.68%
55-64	33	12.84%
More than 64 years old	6	2.33%
Gender (N = 257)		
Female	141	54.86%
Male	116	45.14%
Education (N = 257)		
High school degree	67	26.07%
Undergraduate degree	122	47.47%
Graduate degree	68	26.46%
Frequency of using Amazon (N = 257)		
Hardly ever	23	8.95%
Several times a month	116	45.14%
Several times a week	95	36.96%
Several times a day	23	8.95%

2.6 Results

2.6.1 Non-response bias and common method bias assessment

The study's method of data collecting using surveys may result in non-response bias. Early and late responses were compared to determine the absence of non-response bias. Two groups (early and late respondents) were formed based on the time used to complete the questionnaire. The group

of early respondents consisted of the 80% of participants who finished the survey the quickest, while the group of late respondents comprised the other 20%. This research's mean values for each reflective construct were determined, and t-tests were performed to compare the two groups. There were no significant differences between groups ($p > 0.05$). Thus, non-response bias is not an issue in this study.

Concerning common method bias, steps were taken to eliminate the possibility of common method bias due to the use of surveys to collect data. First, the recommended procedures to minimize this risk through research design were followed. To encourage respondents' honesty, their responses were anonymized and it was clarified that there were no correct or incorrect responses. In addition, the items were carefully constructed to prevent ambiguity, and a pre-test with six participants was conducted to ensure that the items were correctly understood (Podsakoff et al., 2003). Confirmatory factor analysis was also used to examine any common method variance. To assess the amount of trait, method, and error variance (Bagozzi & Phillips, 1982), the following four models (containing all model variables) were developed: (1) a null model in which variance in measures is explained by random error; (2) a trait-only model in which variance in measures is explained by traits plus random error; (3) a method-only model in which variance in measures is explained completely by method factors plus random error; and (4) a trait-method model in which variance in measures is explained by trait factors, method factors, and random errors combined (Podsakoff et al., 2003). The null model is nested in both the method-only and trait-only models, while the trait-method model is nested in the method-only model. As a result, chi-square ($\chi 2$) differences can be used to detect trait and method variation. The results are shown in Table 2.5. The results show that models 2 and 4 fit much better than models 1 and 3, implying that trait variance exists (Bagozzi & Phillips, 1982). In addition, as models 3 and 4 fit substantially better than models 1 and 2, some variation is due to the method. The variance estimation shows that the method accounts for 2.63%, being trait factors the main source of variance. This amount of method variance is notably lower than the average variance obtained in previous research (28.9% in the psychology field and 23.8% in the business field; Cote & Buckley, 1987).

Table 2.5. Nested confirmatory factor analyses tests for trait and method effects

MODEL	$\chi 2$	d.f.	*p*	Model comparison	$\chi 2$ difference	d.f.	*p*
NULL	5797.676	253	<0.001	1 vs 2	5357.642	44	<0.001
TRAIT-ONLY	440.034	209	<0.001	3 vs 4	3257.435	44	<0.001
METHOD-ONLY	3566.840	230	<0.001	1 vs 3	2230.836	23	<0.001
TRAIT-METHOD	309.405	186	<0.001	2 vs 4	130.629	23	<0.001

2.6.2 Measurement model assessment

A Confirmatory Factor Analysis (CFA) was carried out using the EQS 6.4 program to examine the reliability and discriminant validity. CB-SEM is used to test the hypotheses and it is appropriate for confirmatory research when a theory-based model should be explained using data (Astrachan et al., 2014). In addition, CB-SEM uses chi-square to determine the differences between the observed and implied covariance matrices. Its different analytical requirements are stringent, yielding several Goodness-of-Fit indices. Furthermore, this methodology can be used when second-order reflective models exist, as in this study. Researchers have recognized that when measuring psychological constructs that describe attitudes or behaviours it is better to use reflective indicators because they are the origin of the observed variable, and their effects are reflected in the variable (Agarwal & Karahanna, 2000; Siekpe, 2005).

To check the validity of the measurement model, the internal consistency of the constructs was checked (all composite reliabilities were higher than 0.80; Hair et al., 2009). Convergent validity was evaluated through the Average Variance Extracted (AVE) indicator and this exceeded the recommended threshold of 0.50 (Fornell & Larcker, 1981). Finally, we assessed the model's discriminant validity by verifying that the inter-construct correlations were lower than the square roots of the AVEs of each variable (Fornell & Larcker, 1981). As all pairs of constructs met this criterion, it can be concluded that the model has an acceptable level of discriminant validity. Table 2.6 shows these values. Finally, the results also showed satisfactory fit values for the structural model: (χ^2 = 440.034, 209 d.f, $p < 0.01$; NFI = 0.924; NNFI = 0.950; CFI = 0.958; and RMSEA = 0.066).

Table 2.6. Latent variable reliability

Variables	CR	AVE	1	2	3	4	5	6	7
(1) Concentration	0.943	0.804	**0.897**						
(2) Time distortion	0.917	0.786	0.757	**0.887**					
(3) Enjoyment	0.948	0.821	0.637	0.649	**0.906**				
(4) Flow consciousness	0.886	0.796	0.499	0.573	0.447	**0.892**			
(5) Process regret	0.930	0.815	0.175	0.288	0.260	0.459	**0.903**		
(6) Outcome regret	0.870	0.626	0.069	0.091	-0.040	0.060	0.408	**0.791**	
(7) Return intention	0.958	0.884	0.231	0.185	0.172	0.236	0.231	0.539	**0.940**

Notes: CR = Composite reliability; AVE = Average Variance Extracted. The diagonal elements (in bold) are the square roots of the AVEs. Values below the diagonal elements are the inter-construct correlations.

2.6.3 Structural model assessment

Following the verification of the measurement scales, the hypotheses were tested. Before analysing the hypotheses developed, the effect that individual variables could have on the intention to return the product was analysed. Specifically, the effect of gender and frequency of use of Amazon on the intention to return the product was analysed. T-tests for independent samples and Analysis of Variance (ANOVA) analyses were carried out for this purpose. The results show no differences between genders ($M_{male} = 4.520$; $M_{female} = 4.740$; T-statistic = 1.052; $p > 0.05$). However, the frequency of use affects the intention to return the product, with consumers more used to its use being more likely to want to return it (F statistic = 3.118; $p = 0.027$).

The findings show that the flow state positively affects flow consciousness ($\beta = 0.760$; $p < 0.05$; H1 supported). However, contrary to the expectations, flow consciousness has a positive effect on process regret ($\beta = 0.481$; $p < 0.05$; H2a not supported) and no significant effect on outcome regret ($\beta = -0.109$; $p > 0.05$; H2b not supported). Concerning the process regret, it positively affects the outcome regret ($\beta = 0.365$; $p < 0.05$; H3 supported), but not the return intention ($\beta = 0.023$; $p > 0.05$; H4a not supported). However, outcome regret positively affects the return intention ($\beta = 0.640$; $p < 0.05$; H4b supported). R-squared (R^2) values represents the proportion of the variance for a dependent variable that is explained. These relationships partially explain the endogenous variables used in the model: flow consciousness ($R^2 = 0.380$), process regret ($R^2 =$

0.212), outcome regret ($R^2 = 0.180$) and return intention ($R^2 = 0.288$). R^2 values of 0.20 and above are considered high in the consumer behaviour discipline (Hair et al., 2016). In this sense, flow consciousness, process regret and return intention satisfy the requirements of the index. Overall, the structural model fit showed good values: ($\chi^2 = 392.033$, 220 df, $p < 0.01$; NFI = 0.921; NNFI = 0.958; CFI= 0.964; and RMSEA = 0.055). Table 2.7 shows these results.

Table 2.7. Results of hypotheses tests

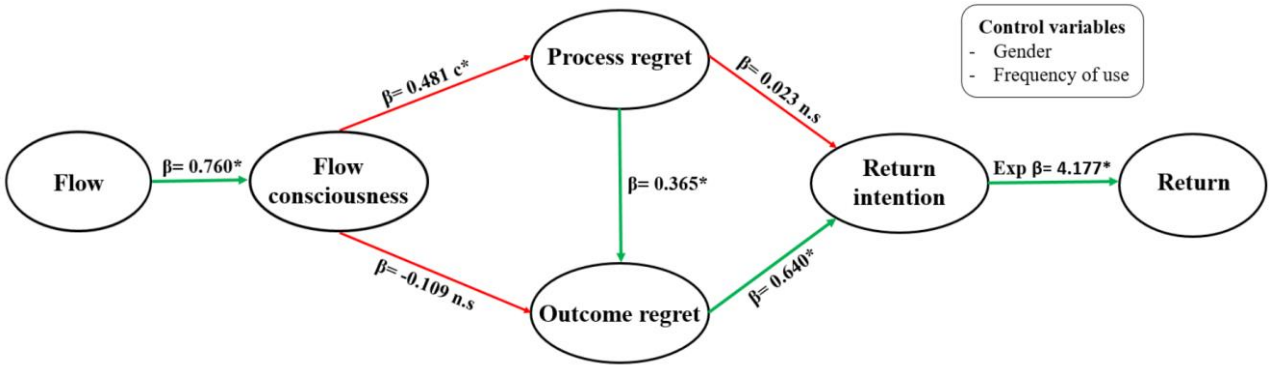
Hypotheses	Relationship	Result
H1	Flow → Flow consciousness	Supported
H2a	Flow consciousness → Process regret	Not supported*
H2b	Flow consciousness → Outcome regret	Not supported
H3	Process regret → Outcome regret	Supported
H4a	Process regret → Return intention	Not supported
H4b	Outcome regret → Return intention	Supported
H5	Return intention → Return	Supported

Note: * = supported at 0.05 level contrary to hypothesis.

2.6.4 Actual behaviour

Knowing if the consumer had made the return or planned to make the return, an analysis was carried out to determine if the intentions could explain the actual behaviour. To test this hypothesis, the dependent variable was coded into two categories (0 = Non-product return; 1 = Product return). After this, a binary logistic regression analysis was conducted. The results indicate that the intention to return the product significantly affects actual consumer behaviour (Wald-statistic = 44.614; Exp (β) = 4.177; $p < 0.001$). Figure 2.2 shows the results of the study.

Figure 2.2. Structural model results



Notes: * = supported at 0.05 level; n.s. = not significant; c* = supported at 0.05 level contrary to hypothesis

2.7 Discussion and implications

Flow has multiple advantages, such as improved consumer experience, higher purchase intention and intention to revisit the website (Kautish & Khare, 2022). However, the loss of self-consciousness in this state can subsequently generate purchases that the consumer regrets them. So, when companies try to induce flow states to encourage buying in the online environment, special attention should be paid to ensure that the consumer will be satisfied with the decision. For this reason, it is very important to facilitate the decision-making process for consumers. If the consumer makes the wrong choice, feelings of regret can arise (Barta et al., 2022b). This regret generates product returns, in line with recent studies (Barta et al., 2023b). Consequently, there is a need to investigate how retailers can improve the consumer decision process. The emergence of new technologies (e.g., AR and VR) and their applications in online commerce could contribute to enhance the decision-making process (Hoyer et al., 2020).

Moreover, flow may ultimately generate outcome regret through the emergence of flow consciousness and process regret. Flow itself does not cause regret. Being aware that the consumer has been carried away during the process, having a pleasant feeling, and spending much time, leads to the appearance of regret with the way they made their purchase. Process regret often means that the consumer is dissatisfied with how they made their purchase, and there is a need to have had to look elsewhere online for information or to have spent less time making their choice. In this sense, it has been observed that, contrary to expectations, being aware of the flow increases process regret. Therefore, when consumers are dissatisfied with the way the purchase was made, they consider the flow as something negative, attributing the responsibility for the failure to it.

Furthermore, the occurrence of regret in the decision-making process often implies dissatisfaction with the product's performance, resulting in outcome regret. This regret generates the need to return the product, encouraging the consumer to take the necessary actions to return the product. So, the willingness to return a product depends mainly on its performance, in line with previous research that indicates that product performance and return rates are inversely related (Dzyabura et al., 2019).

2.7.1 Theoretical contributions

In the same way that the shopping process may generate smart shopping feelings and consumer satisfaction (Flavián et al., 2019b), it may also result in regret. This study provides knowledge about the mechanism through which consumers develop regret. Unlike other mechanisms of regret already explored that focus on cognitive style (Qiu et al., 2017), this research analyses a mechanism based on two types of regret that may appear after the purchase, providing several theoretical contributions.

First, the study extends the previous knowledge in which a flow effect on regret through impulse purchases was shown (Wulandari & Risqiani, 2021), or the effect of flow consciousness on outcome regret (Barta et al., 2022b). This study expands the knowledge of these studies by analysing the relationship between flow consciousness and regret from a dual perspective: process and outcome regret. The study sheds light on the relationship between flow consciousness and two types of regret that can arise after product purchase (process and outcome regret). Contrary to expectations, flow consciousness increases process regret. However, flow consciousness does not affect to outcome regret. This result highlights the relevance of distinguishing between process regret and outcome regret in the online consumer experience. Previous research that has addressed the impact of flow on feelings of regret from a more general view (without differ between process and outcome regret) found that flow reduces regret (Barta et al., 2022b). Thus, it is necessary to consider the different types of regret that exist to properly understand the real impact of the flow experiences on regret.

Second, the research contributes to the literature on product returns. It contributes to the knowledge of the factors that can explain the product return through a mechanism based on flow consciousness and consumer regret from a double route. Focusing on returns that are not opportunistic behaviour, it is shown that being aware of the flow could decrease the intention to return the product through reduced outcome regret. This highlights the relevance of studying product returns from a consumer perspective as well. From this perspective, it has been observed how psychological states that can arise during the online shopping experience can have a negative

impact. Contrary to some studies, when the consumer is dissatisfied with their decision, flow becomes a negative element of the shopping experience. Therefore, the results of this study contribute to the product returns literature by explaining how the flow could generate them after a wrong decision. This expands the psychological aspects considered in the literature in the field (e.g. cognitive dissonance; Ahsan & Rahman, 2021).

2.7.2 Managerial implications

The results suggest that companies should consider all aspects of flow state. Flow has many positive aspects for both businesses and consumers but also some negative aspects. It has been observed that flow can cause regret, encouraging the return of purchased products. Proper management of this aspect would have great benefits. Consumer satisfaction would increase, and companies would not have to handle many returns. Furthermore, it will allow logistics and repackaging savings, contributing to sustainability.

Proper integration of the different sales channels can reduce uncertainty, reducing the number of returns (Wang et al., 2021). It is also important to sell products that meet consumers' expectations to avoid the emergence of regret. While creating unrealistic expectations about a product may lead to a short-term sales boost, it can damage a company's reputation due to a surge in complaints and a high number of returns, resulting in significant costs (Dailey & Ülkü, 2018).

Generally, it is the mistake during the purchase process that results in outcome regret and, ultimately, the return of the product. Therefore, providing a pleasant, intuitive shopping experience, incorporating information and tools that facilitate the consumer's decision (e.g., 360º photos, VTOs) would help to reduce the process regret. In this regard, it should be considered that technology integration into business strategy complicates marketing communications, fostering the need for more advanced marketing performance analytics. Therefore, companies should not only consider integrating new technology tools, but also develop the appropriate methods to measure how they affect consumer behaviour in different aspects, such as increasing the rate of sales or reducing the rate of returns (Buhalis & Volchek, 2021).

2.7.3 Limitations and future research directions

This chapter has several limitations. Although this study has addressed two types of regret consumers may feel after making a purchase, future studies could introduce into the mechanism other types of regret that may arise before a purchase, such as anticipated regret. In this sense, in other contexts, it has been observed how it influences the motivation to perform specific behaviours (Verkijika, 2019). Furthermore, due to the current growing trend in product returns, it would be interesting to carry out a study controlling the impact of some variables, such as the time available to make the return or the purchase cost. For this purpose, the collaboration between academics and practitioners may allow conducting field experiments that could help to investigate further this current problem.

Little empirical research has examined the relationship between flow consciousness and online regret. The results of the study shed light on the actual behaviour of consumers. However, moderating effects related to consumer characteristics could be analysed. Recent research has shown that the type of consumer in terms of maximize or satisficer is key to understand the relationship between flow and consumer regret (Barta et al., 2023b). Thus, future research should explore more characteristics that can influence this relation.

To reduce the rate of returns, new technological tools could be introduced into the purchase process. AR and VR are technologies that solve mental and physical intangibility issues (Mishra et al., 2021). Therefore, online retailers can use AR to enable their customers to virtually try out the products they offer from multiple suppliers (e.g., Amazon's Try at Home feature for selected products; Dwivedi et al., 2021). Based on the advantages that research has shown to have on the consumer decision-making process (Chyllinski et al., 2020; Hilken et al., 2017; Jessen et al., 2020), it would be interesting to explore further how this technology could affect the decision-making. Improving this process will allow consumers to make better decisions, reducing regret with their choice and, consequently, product returns.

3. Augmented reality as a tool to improve consumer decision-making process: a systematic literature review

3.1 Introduction

Due to the need to improve decision-making in online shopping and mitigate the problem of product returns that emerged in the previous chapter, it is important to understand the role that new technologies can play in this process. Immersive technologies have been linked to flow because of the interactivity and immersion that characterises them (Massa & Ladhari, 2023). However, in view of the results obtained in chapter 2, flow can represent a negative aspect of the shopping experience if the consumer makes a wrong decision and regrets it. Therefore, it is necessary to facilitate the consumer's decision-making to avoid wrong choices which generate regret.

In this sense, AR can be crucial because it enriches the shopping experience through the representation of virtual information in the consumer's real environment (Flavián & Barta, 2022). During the decision-making process this can be a very valuable aspect for consumers. Using AR, consumers can visualize how the 3D representation of a product looks in the real environment, making it easier for the consumer to imagine the actual appearance of the product, anticipating the consumer experience (Hilken et al., 2022a). Furthermore, as explained in chapter 1 of this thesis dissertation, many AR apps do not require complex hardware that consumers specifically need to purchase. Through a smartphone or tablet they can use valuable AR apps in the retail sector. Therefore, due to the high accessibility and its characteristics AR technology has the potential to change the way consumers make purchasing decisions, reducing wrong choices and, consequently, contributing to reducing the number of returns (Modgil et al., 2022).

Due to the high accessibility, AR has been considered one of the main technological tools with the greatest impact in the retail sector in the last years (Rauschnabel et al., 2022; Rejeb et al., 2021b). At the same time that this tool has gained importance in retail companies, the academic world has also focused on the study of this technology. Some research has shown how AR can improve the consumer experience and the brand relationships, and generate better shopping decisions (Scholz & Duffy, 2018). Overall, AR technology has the potential to revolutionize the retail industry by providing retailers with new and innovative ways to enhance the consumer

experience, improving the customer satisfaction and reducing the number of returns, ultimately leading to increased sales (Barta et al., 2023a, b; Berman & Pollack, 2021). As AR technology continues to evolve, it is likely that more exciting and innovative applications in the retail sector appear in the coming years.

Despite the existing research on the topic and the existence of several literature reviews, it is necessary to deepen the knowledge of the most current state of research in the field. In this way, in the following empirical chapters of this thesis, it will be possible to provide answers to the detected research needs. Several narrative literature reviews have been conducted some years ago. Javornik (2016a) shows the media characteristics of AR and its impact on consumer responses. Moreover, practical applications and several motivations to implement immersive technologies from the perspective of retailers and consumers have been provided (Bonetti et al., 2018). However, in their research, Bonetti et al. (2018) address the issue from a broader perspective, considering AR and VR. In addition, Hilken et al. (2018) show the role of AR to promote omnichannel experiences throughout the shopping journey.

Concerning to previous SLR, some of them have been conducted a couple of years ago and have some limitations. For example, the SLR provided by Perannagari & Chakrabarti (2019) focus on the variables used in AR technology adoption research available until the 1st of March 2019, using only one database (EBSCOhost research database). Similarly, other literature reviews only consider articles published up to 2020 with a strong focus on human-technology interaction with AR, performing a subsequent thematic analysis highlighting the research needs at that time (Chen et al., 2022a). Other SLR shows the main AR characteristics that influence consumer behaviour, the drivers and outcomes of AR in online retail and the theoretical perspectives used (Kumar, 2022). However, it collects articles published until 17 March 2021 and only one database (Scopus) was used to conduct the process. In other cases, the review conducted is too specific, comprising articles until April (Riar et al., 2022).

Recent SLRs have examined the state of the art in immersive technologies on a very specific topic. Specifically, several SLRs focus on AR and VR studies, and the applicability of Elaboration-

Likelihood Model (ELM) in these new technologies (Hamza, 2021; Jayawardena et al., 2023). Other SLRs focus on AR technology reviewing the state of the art in various contexts, such as retail, tourism and advertising (Du et al., 2022). More recent reviews published on the impact of AR on marketing have covered a very large number of papers, which may offer a very general overview of the topic, but at the same time limit the ability to provide very concrete guidelines on the state of AR research in the decision-making process (Massa & Ladhari, 2023).

Consequently, to know the most current state of the literature in the specific context of retailing, this chapter presents an overview of the literature by focusing on the aspects studied in AR and consumer behaviour research published in journals within the "business" and/or "management" areas in the Web of Science (WoS) index. For this purpose, a systematic review was carried out using the WoS and Scopus databases to identify relevant publications over the last 7 years (from 2016 to 16th April 2023). To ensure the quality of the sample selected, only papers published in journals classified in the first two quartiles of the Journal Citation Report (JCR) and specifically in the areas of "business" or "management" were included. This search process allowed for the analysis of 69 high impact research articles.

The present chapter aims to contribute to the literature by showing an overview of several aspects. First, it shows the main objectives of AR research in the retail sector to date, while also identifying areas that remains under-researched. Secondly, the chapter provides an overview of the widely theoretical frameworks and research models used, highlighting those theoretical foundations applicable to the context of the AR that have been less explored. Thirdly, the most researched types of AR are identified, while revealing those where more academic research is needed. Fourthly, after summarising the main results and contributions made to date, it sheds light on future contributions that future studies may develop.

This chapter is structured as follows: Section 2 presents the methodology, the identification, screening and eligibility criteria. Section 3 discusses the findings obtained after an exhaustive examination of the papers under study. Section 4 shows the thematic analysis conducted. Finally,

section 5 presents the conclusions, contributions, limitations and a future research agenda which will be further developed in section 7.4.

3.2 Methodology

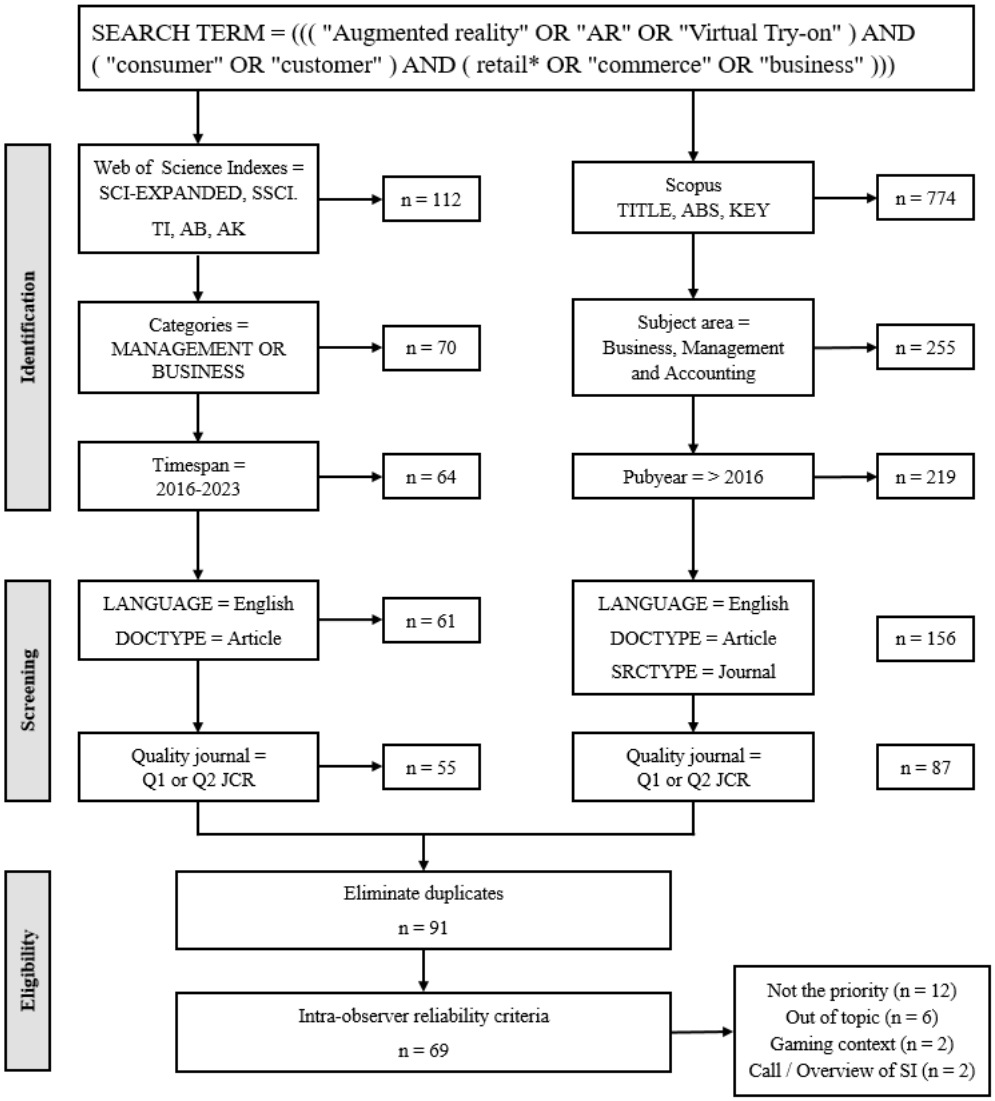
In this chapter, a systematic review of the literature was applied. This method is considered a valuable tool to provide a holistic view of existing research on a specific topic to improve its understanding and shows the extant knowledge (Bilro & Loureiro, 2020; Tsiotsou et al., 2022; Vrontis et al., 2021). With the support of this research method, it is possible to analyse a significant sample of published articles related to AR and its impact on retailing sectors, thus providing a comprehensive overview of the topic.

Following the procedures outlined in previous research, the systematic review was conducted in a three-stage procedure (Ferrer-Serrano et al., 2021; Tranfield et al., 2003). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol was used to carry out the study, including three steps (identification, screening, and eligibility; Moher et al., 2009). The PRISMA approach is widely used across disciplines in the academic world for review studies (Kumar, 2022; Tricco et al., 2018; Parums, 2021). This research search process is shown in Figure 3.1. A detailed explanation of each step is given in the following sections. After collecting the final sample of the articles collected, to give answer to the objectives of this chapter, a domain-based review and a framework-based approach in which the researcher adopts a framework or develops its own has been used (Paul & Barati, 2022; Xiao & Watson, 2019).

3.2.1 Identification

First, the WoS Web of Science and Scopus databases were used to identify relevant publications, in line with previous SLRs (Foss and Saebi, 2017; Sivarajah et al., 2017). These two databases contain the most pertinent, influential, and recent peer-reviewed academic publications (Pranckutė, 2021). The first search was conducted on February 19, 2022 and renewed on February 28, 2023, and April 16, 2023.

Figure 3.1. PRISMA



Source: Own elaboration

A procedure similar to previous SLR was carried out to identify the keywords for the search (Foo et al., 2021; Massa & Ladhari, 2023). After reading 15 articles on the topic, a list of identified keywords was compiled. Then, articles published in the two databases were searched for using strings of the identified words through Boolean operators ("AND" and "OR"). The keywords were grouped into three categories. The first set of words refers to augmented reality, including its abbreviation and the term "Virtual Try-on", also commonly used to denote AR in consumer-focused studies. The second group of words is associated with the user of AR in the research, including the British version of the word (consumer) and the American one (customer). Finally, the third group of words captures the specific context on which the focus is directed, focusing on retail.

The categories selected were Management and Business (in Scopus, this area also includes Accounting). 2016 was specified as the starting year. This year was the beginning of the widespread use of AR because of the launch of Pokemon Go (Forbes, 2016; Statista, 2023d).

3.2.2 Screening

To further guarantee objectivity, only documents that have been published in journals were included, thus excluding book chapters or documents published in conference proceedings. The search was restricted to articles published in English. At this stage of the screening process, a quality criterion was included. The database only includes articles published in journals indexed in quartiles 1 and 2 of the 2021 Journal Citation Report (JCR) impact factor in the business and/or management category. Thus, the conclusions will be based on high quality and impact publications.

3.2.3 Eligibility criteria

In this step duplicate investigations were eliminated. Finally, the criterion of intra-observer reliability is followed to eliminate articles that do not fit with the objectives of the search. All the abstracts were read, as well as several introductions and conclusions, to determine with greater robustness the exclusion or inclusion of the articles of the sample. 22 articles were removed because they do not fit the requirements. 12 articles used the terms in a collateral way, mentioning AR superficially or as one of many technological tools explored in the study. In 6 of the papers previously identified, the abbreviation “AR” was used to denote a different concept. One example is a paper where “AR” stood for “Additional Review”. 2 examined the role of AR in a gaming context, specifically in the AR-based game Pokemon Go. In addition, 2 were either a call for papers for a SI, or an overview showing the topics covered in the articles that comprised a published SI. Thus, finally, 69 articles were collected to analyse in depth.

In the next stage, an excel sheet was created for the summary of the articles with 11 parameters (Dwivedi et al., 2021). These parameters included: authors, publication year, aim, research framework, context and devices, method, main findings, independent variables, mediating and moderating variables, and dependent variables (see Table 3.1 and Table 3.2).

Table 3.1. Overview of studies

Reference	Aim	Research framework	Devices/context	Method	Main findings
Scholz & Smith (2016)	Present a framework that describes active and passive ingredients of AR.	Not available	AR experiences	Conceptual	Develop 8 recommendations managers can use to design AR experiences that maximize consumer engagement
Parise et al. (2016)	Examine the role of digital technologies in the need of receiving content, expertise and personalized solutions in real time.	Customer experience	Different industry sectors	In-depth interviews	There are 2 main technology-based models that organizations are deploying to support customers' immediate needs: the remote expert and the digital assistant.
Dacko (2017)	How, why and to what extent AR apps contribute to smart retailing.	Experiential value, smart retailing	Mobile AR; multiple AR apps	Qualitative (online survey)	Home use of AR is more common than in-store use
Poushneh & Vasquez-Parraga (2017)	Analyse the impact of AR on retail user experience and its influence on user satisfaction and willingness to buy.	Retail user experience	Mobile AR; VTO (glasses)	Lab experiment	AR improves user experience, enhancing the product quality. The user experience increase satisfaction and willingness to buy. User experience is a third order formative construct derive from pragmatic, aesthetic quality and hedonic quality by stimulation and by identification
Pantano et al. (2017)	Investigates the effect of AR on consumer behaviour by comparing two different cultural settings.	TAM model	Web AR; VTO (glasses)	Lab experiment	There is a direct influence of technology characteristics on ease of use, usefulness and enjoyment. It shows meaningful differences between Italian and German consumers in the use of AR.
Rese et al. (2017)	To examine the perception and acceptance toward AR.	TAM model	Mobile AR; cars, furniture, VTO (cosmetics and glasses)	Lab experiment	Ease of use and enjoyment do not affect usefulness. Identify factors that influence the AR adoption in marketing and retailing
Yim et al. (2017)	To evaluate the effectiveness of AR as e-commerce tool.	Interactivity and vividness	Web AR; VTO (glasses and accessories)	Lab experiment, sentiment analysis and text analytics	AR provides benefits by generating novelty, immersion, enjoyment and usefulness. Negative impact of previous media experience on novelty only occurred in the AR condition. AR product presentations are generally superior to web-based product presentations.
Gallino & Moreno (2018)	Study the value of virtual fit information in online retail.	Value of fit information	Web AR; VTO (clothes)	Field experiments	Offering virtual fit information increases conversion rates and order value. It also reduces the fulfilment costs arising from returns.

Reference	Aim	Research framework	Devices/context	Method	Main findings
Scholz & Duffy (2018)	To examine what consumer-brand relationships can be facilitated through AR from a holistic approach.	Wider and inner context of AR	Mobile AR/VTO (beauty products)	Ethnography (app reviews and in-depth-interviews)	A close and intimate (rather than transactional) relationship can emerge due to how the branded AR app is incorporated into consumers' intimate space. Explain how self-augmentations are integrated into consumers' self-concepts.
Watson et al. (2018)	Examine the effects of AR on consumers' affective and behavioural response.	SOR model	Mobile AR; VTO (beauty products)	Online experiment	The effect of AR on purchase intention is mediated by the affective response. In addition, hedonic shopping motivation moderates the relationship between augmentation and the positive affective response.
Chopra (2019)	Understand motivation of young consumers to use AI and AR in shopping.	Vroom's expectancy theory of motivation	Retailing	Grounded theory; in-depth interviews.	Intrinsic, extrinsic and force choice motivation explain the reasons of young consumers to use AI and AR. The ease of use and the competence of tools in performing desired tasks are key for the adoption.
Heller et al. (2019a)	Develop a conceptual framework to reflect how AR emulates customer's cognitive process offloading those to the technology.	Mental imagery theory	Mobile AR; (food, furniture and decoration, toys)	Lab, online and field experiments	AR improves decision comfort, positive WOM and encourage the choice of higher value products. Allowing consumers to offload a substantial part of cognitive tasks increase decision comfort.
Heller et al. (2019b)	Propose a conceptual framework to assess how sensory control and feedback modalities affect consumer value judgements.	Active inference theory	AR glasses (Hololens); furniture and decoration	Lab experiment	Touch control (vs. voice control) positively affects consumer willingness to pay. There is a positive moderating effect of congruent auditory feedback on decision comfort.
Huang (2019)	To compare the effect of AR on brand love formation.	Self-referencing theory, information technology identity.	Web AR; VTO (clothes and accessories)	Lab experiment	Self-referencing has a positive effect on brand love in a direct and indirect way through information technology identity The mechanism of brand love indicate that AR characteristics (ownership and rehearsability) may engender self-referencing which results in brand love.
Huang et al. (2019)	Examine the psychological factors impacted by AR apps.	Self-determination theory, self-evaluation.	Web AR; VTO (clothes and accessories)	Face-to-face survey	Modality, synchronous sense of ownership and reprocessability positively affect consumer's rapport experience. The most significant way to improve the use of AR is to enhance audio-visual modality and synchronize body control.

Reference	Aim	Research framework	Devices/context	Method	Main findings
Mütterlein et al. (2019)	Analyse the effects of lead-users and other users to predict behavioural intentions.	UTAUT2	Mobile AR, city tour	Online survey	Behavioural intention and the effects of influencing factors differ between lead-users and other users. Lead-usership is a construct of 4 dimensions (earlier adoption, mobile games, mobile city guides, inconvenience and dissatisfaction)
Plotkina & Saurel (2019)	To investigate how product presentation affects the exhibit human visuals corresponding to consumers' appearance.	TAM model, human model presentation.	Screenshots and videos; VTO (clothes and accessories)	Online experiment and in-depth interviews	AR is less convenient and reduces enjoyment and usefulness. No differences in ease of use. Novel AR is not yet sufficiently technology advance to offer better experiences than traditional m-commerce websites
Van Esch et al. (2019)	Analyse the influence of anthropomorphism on consumers' perceptions of AR.	Anthropomorphism theory	Mobile AR. Food products	Face-to-face survey	Anthropomorphism influence confidence, convenience of the transaction, innovativeness, product usage barrier and side effect. It does not affect to the discomfort.
Zhang et al. (2019)	How AR affects online consumers' purchase decision from an integration of utilitarian, hedonic and risk perspectives.	U&G	Mobile AR (screenshots); VTO (not available)	Online survey	Attitude toward VTO can affect the purchase intention. Provide an integrative view of utilitarian, hedonic values and risk in VTO technology.
Fan et al. (2020)	Explain how the adoption of AR in online shopping help consumers process product information and what are the driving forces.	Cognitive load theory, situated cognition theory.	Mobile AR; laptop and beauty product	Lab experiment	Simulated physical control reduces cognitive fluency. Environmental embedding has a greater impact on the experience product. Simulated physical control has a greater impact on the search product.
Jäger & Weber (2020)	Investigate the potential of 2 digital in-store technologies and advertisement message framings.	CLT	Smart mirrors in store	Field experiment	Even though the magic mirror augmented reality application attracted significantly more attention, it did not significantly boost sales compared to the digital signage technology.
Park & Yoo (2020)	Analyse the dimensions of perceived interactivity and their effect on mental imagery.	Interactivity and mental imagery	Mobile AR; VTO (beauty products)	Online survey	Highly involved consumers are more influenced by controllability and elaborate greater mental imagery than less involved consumers. Responsiveness is not key in AR technology.
Perannagari & Chakrabarti (2020)	Examine the impact of AR on retailing by conducting thematic analysis on variables studied in the existing literature.	Not available	Retailing	Thematic analysis	The eight themes form a conceptual framework to model the decision-making process of users. Provides a research agenda for scholars working in the field of consumer behaviour and human–computer interaction.

Reference	Aim	Research framework	Devices/context	Method	Main findings
Yang et al. (2020)	To explore how, why and when AR influences advertising effectiveness.	Hierarchy-of-effects model of advertising	Mobile AR; no real experience (videos)	Lab and field experiments	AR advertisement increases consumers' attitude toward the ad. Curiosity and attention mediates the effect of the ad on attitude. The effects only are significant when consumers are unfamiliar with AR technology.
Batat (2021)	To examine if AR positively contributes to a dining experience.	AR customer experience	Hospitality (restaurants)	Qualitative multi-method (online sources and in-depth interviews)	AR can influence positively or negatively consumers' perceptions of the restaurant experiences according to sensory dimensions. Identify the factors that explain the psychology behind adopting or rejecting technology innovation.
Berman & Pollack (2021)	To propose steps to properly implement AR in stores.	AR objectives (5 types)	AR in general	Conceptual	Identify steps to implement successfully AR: determine AR objectives, choose appropriate products, channels and target markets, select AR app type, design AR app, evaluate alternative AR organization formats, measure AR success.
Butt et al. (2021)	Comprehend the behavioural aspects of novel technology usage in AR.	Information systems success	Mobile AR; VTO (beauty products)	Online survey	AR apps influence innovative consumers to be satisfied with and continue to use AR. The consumers positively comply with AR if the digital infrastructure conforms to their beliefs.
Castillo & Bigné (2021)	To identify factors that influence consumers' acceptance of AR self-service technologies.	TAM model	Videos; VTO (beauty sector)	Online survey	Aesthetics and navigation are predictors of usefulness and ease of use. The self-efficacy also explains the ease of use Provide insights into the perceived value and motives for customer acceptance of AR.
Chen et al. (2021)	Synthesise journal articles on AR and develop a conceptual framework.	Not available	High quality articles between 1997 and 2020	Thematic analysis	Three major research avenues identified: AR adoption, AR user experience design and AR shopping experience and value theory. Provides a conceptual framework highlighting the functional and experiential elements based on SOR model.
Chiang et al. (2021)	Examine the systems characteristics which can affect AR adoption	TAM and CLT	Smart mirror in store (clothes)	Lab experiment	Navigation structure, graphic style and information content were identified as the three system characteristics that affect perceived ease of use and usefulness.
Chiu et al. (2021)	Identify predictors of user benefits of AR apps.	Information systems success	Video; food	Online survey	It is necessary to develop new perspectives of current interactive technologies in the restaurant and catering industry.

Reference	Aim	Research framework	Devices/context	Method	Main findings
Daasi & Debbabi (2021)	Identify factors explaining use and adoption of AR apps.	SOR model	Mobile AR; VTO (beauty products)	Face-to-face survey	Full mediating role of product presence between immersion and perceived realism. Technology stimuli do not have a direct effect on consumer's response.
Gatter et al. (2021)	To explore if AR can compensate the lack of touch shopping online.	U&G	Mobile AR; (beauty products, carpets, furniture and decoration)	Online survey	Consumers' autotelic need for touch is associated with benefits that positively impact on product attitudes or purchase intentions.
Gupta et al. (2021)	Examine the effect of AR in the production of sensory brand experience and intention to use AR apps.	TAM model and U&G	Mobile AR; VTO (glasses)	Online survey	The use of AR has impact on the creation of sensory brand experiences and the intention to use AR apps. The AR app should provide utilitarian benefits and hedonic benefits to create sensory brand experiences.
Han et al. (2021)	Examines the effect of AR-based presentation modes on consumer patronage intention, with the mediating role of immersion, enjoyment, perceived product risk and attractiveness of the online store.	SOR model	Mobile AR; VTO (glasses)	Lab experiment	There are serial indirect effects of AR presentation on patronage intention through immersion, enjoyment, product risk and attractiveness. Technophilia is a critical factor that explains consumers' psychological and behavioural responses when they are using new technologies.
Hilken et al. (2021)	To know how to combine the AR and VR in online and offline experiences.	Fluency of mental imagery	AR in-store; (food)	Online and in lab experiments	AR is more effective in stimulating purchase intentions than VR. VR is better suited for improving brand attitudes than AR, as it helps customers to form fluent context focused mental imagery. AR and VR, in combination, can improve both purchase intentions and brand attitudes, but only when the order of deployment is sequenced as AR then VR.
Hsuan-Yu (2021)	Explain how AR apps influence customers experiential value and increase continued usage intention.	SOR model, experiential AR app features.	Mobile AR; VTO (beauty products)	Online survey	AR features affects utilitarian and hedonic value, but only hedonic value affects continued usage intention. The effect of hedonic value on continued usage intention is positively moderated by perceived customer support.
Jiang et al. (2021)	Identify antecedents of consumers' innovation to use AR shopping apps.	Innovation diffusion, perceived value and attitude theories.	Mobile AR; not available	Online survey	Attitudes mediates the effect of relative advantage, compatibility, observability on consumers' intention to use AR apps.

Reference	Aim	Research framework	Devices/context	Method	Main findings
JoerB et al. (2021)	Explore if AR recommendation agents can inspire users to consider sustainability in their shopping decisions.	AR recommendation agent	AR recommendation agent; food	Online survey	The more use of AR recommendation agents, the more likely to include sustainable product options.
Kowalczuk et al. (2021)	Explore the relative advantage of AR over web-based product presentations.	Experiential hierarchy model	Mobile AR; furniture and decoration (Ikea)	Lab experiment	AR outperforms web-based product presentations generating greater immersion and enjoyment. Cognitive and behavioural responses are higher in the web condition; and only affective responses are higher in the AR condition.
Mishra et al. (2021)	Examine consumer responses to technology interfaces (AR/VR and mobile apps)	Multisensory interfaces, vividness theory.	Mobile AR; furniture and painting	Lab experiment	Touch interface users have a more satisfying experience and greater recommendation intentions, as compared with AR, for buying utilitarian products. The AR results in a better user experience for purchasing a hedonic product. Multisensory technologies lead to higher visual appeal, emotional appeal and purchase intentions.
Nikhasemi et al. (2021)	Study the effects of AR attributes on continuous intention to shopping AR and to pay a price premium.	SOR model, U&G, Technology Continuance Theory.	Mobile AR; AR apps (GAP, Ikea and Amazon)	Online survey	The moderating role of AR customisation on the relationship between utilitarian and shopping benefits and engagement is non-lineal.
Poushneh (2021)	Understand the effect of proximity to a virtual product on purchase intention through feedback and generality.	Psychological distance, CLT	Mobile AR; VTO (glasses)	Lab experiment	Generality fully mediates the effect of feedback on purchase intention. The absence of product in consumers' consideration does not moderate the effect of generality on purchase intention.
Qin et al. (2021)	How AR apps influences attitudes and shopping behaviour.	SOR model	Mobile AR; decoration and VTO	Lab experiment	Positive attitudes influence reuse mobile AR. Virtuality plays a key role in hedonic, utilitarian and informativeness
Tandon et al. (2021)	To examine the effect of VTO and other variables on trust in online shoppers.	U&G, Signalling theory	Mobile AR; VTO	Online survey	Return policy, pay-on-delivery, free shipping and VTO are predictors of trust. Vendor-specific guarantee reduces trust.
Arghasi (2022)	Investigates the chain of effects of AR features on purchase intention with AR.	SOR model	Mobile AR; VTO (shoes)	Face-to-face surveys	AR apps compared to no-AR apps trigger much positive media features (e.g., awe, novelty, and inspiration) and low negative media features (e.g., distraction and information overload). However, AR apps lead to less hedonic shopping motivation and purchase intention compared to no-AR apps.

Reference	Aim	Research framework	Devices/context	Method	Main findings
Argashi & Arsun-Yuksel (2022)	Investigate the antecedents and outcomes of consumer engagement through AR apps.	Self-determination theory, flow theory.	Mobile AR; VTO (shoes)	Online survey	The interaction of usefulness on attitude has a positive impact on consumers' engagement. Usefulness moderates the indirect effect of flow on engagement via attitude Introduces inspiration and interactivity as two driving of consumers' flow experiences in AR content.
Caboni & Pizzichini (2022)	Identify the behavioural changes that have occurred due to the coronavirus disease 2019 pandemic.	Technology affordance theory	Mobile AR; VTO (beauty products and shoes)	In-depth interviews	AR is a useful tool that can be employed to overcome retailing crises driven by external environmental factors, such as COVID-19. Reveals the role of AR technologies in transformed economic and social contexts.
Christ-Brendemühl & Schaarschmidt (2022)	Investigate fairness perceptions and customer responses associated with AR-enabled customer participation.	Equity theory	Screenshots; VTO (glasses)	Online experiment	AR-enabled customer participation decrease levels of distributive, procedural and price fairness as well as lower engagement intentions than in-store. The video try-on scenario report higher negative WOM than in the store scenario.
De Amorim et al. (2022)	Explore the impact of AR on consumers' emotional and cognitive responses.	SOR model, media richness theory	AR glasses (Hololens); supermarket	Field experiment	AR experience influences brand engagement and willingness to buy through perceived information quality and brand attitudes.
Holdack et al. (2022)	Examine factors that drive the acceptance of AR glasses as a channel in stores.	Extended TAM	AR glasses (Hololens); furniture and decoration	Face-to-face survey	Enjoyment mediates the influence of informativeness and other variables on attitude and usage intention. Retailers should focus on joy-related aspects to introduce AR apps in stores. Customers accept AR glasses if they create enjoyable experiences.
Kumar (2022)	Identify the antecedents, drives, outcomes, theoretical lenses, typology and methodological approaches in the AR literature.	Not available	Only one database (Scopus)	SLR	AR characteristics significantly influence utilitarian, hedonic, perceived risk and experiential value, ultimately resulting in a positive attitude, decision-making assistance and behavioural intentions. Provides a comprehensive framework on consumer behaviour towards AR in online retailing.
Petit et al. (2022)	To examine how consumers' intentions to purchase food change according to the visualisation mode.	Mental simulation	Mobile AR; food	Lab experiment	AR improves mental simulation of eating experiences. 3D visualisation improves purchase intention for packaged products (high instrumental properties) over served products (low instrumental properties).

Reference	Aim	Research framework	Devices/context	Method	Main findings
Romano et al. (2022)	To explore how consumers differ in terms of the value they receive from using AR, as well as the trade-offs they experience when using the technology for shopping.	Stimulus load theory	Mobile AR; furniture and decoration	Online survey	There are 4 distinct segments of consumers who vary in their attitude towards AR as a shopping tool (AR Averse, AR Hesitant, AR Open and AR Enthusiastic). The heterogeneity of consumer attitudes towards AR is driven by consumers' perceptions of decision confidence, information overload and experiential value.
Sengupta & Cao (2022)	Investigate the role of AR in consumers' shopping processes.	SOR model and consumer decision-making models	Mobile AR; furniture and decoration	Online survey	Immersion has a positive effect on decision-making quality. Privacy concerns negatively moderates the effect of decision-making quality on purchase intention.
Sun et al. (2022)	Study the effect of AR on product uncertainty reduction and product attitude.	Uncertainty reduction theory	Mobile AR; VTO (beauty products), furniture	Lab experiment	The relationships between AR and product uncertainty reduction are moderated by product involvement, need for sensory richness and self-brand connection.
Tan et al. (2022)	Investigate the impact of AR on sales in online retail.	Product uncertainty	Mobile AR; VTO (beauty products)	App real data	The effect of AR is stronger for customers who are new to the online channel or product category. AR is most effective when product uncertainty is high.
Tsiotsou & Klaus (2022)	Propose a conceptual framework of beautification services.	"Nip and tuck" service framework	Beauty services	Conceptual	The antecedents and consequences (positive and negative) of consuming face and body beautification/modification services are integrated in the framework.
Uhm et al. (2022)	Explore how diagnoscity in AR can reduce psychological distance and perceived risks in online purchasing.	Media richness theory and CLT	Mobile AR; VTO (shoes)	Lab experiment	Diagnosticity and purchase intention are higher, and psychological distance and perceived risks are lower in the group that experience AR, compared to the group that experienced conventional web-based e-commerce.
Vaidyanathan & Henningsson (2022)	Investigates how to design AR-based services that enhance customer experiences in retail.	Substantive theory	Retailing	Conceptual / design thinking	Propositions are developed to explain how AR can enhance customer experiences. Explains how different digital technologies can be used to provision new services in different app domains.
Vieira et al. (2022)	To explain the mechanism through AR influences behavioural intentions.	UTAUT	Consumer outcomes	Meta-analysis	Provides a taxonomy of four dimensions of AR (aesthetic, informativeness, usefulness and enjoyment).
Zhang et al. (2022)	To explore the theoretical mechanisms through which AR influences online store attractiveness and whether the effects differ in the purchasing contexts of hedonic and utilitarian product types.	Intrinsic and extrinsic attributes of AR	Mobile AR, VTO (glasses, contact lenses, electric pot, dishwasher)	Online experiment	AR increases online store attractiveness by creating perceived coolness (intrinsic attribute) and spatial presence experience (extrinsic attribute), which would further have a positive impact on consumers' purchase intention. The mediating mechanisms are different in purchasing contexts of various product types.

Reference	Aim	Research framework	Devices/context	Method	Main findings
Alesanco-Llorente et al. (2023)	To examine the intention to adopt mobile AR in store.	CAN model	Videos (not real experience)	Telephone survey	Effort expectancy influences the use intention to use AR only in the case of men. The social influence affects the intention to use AR only in women. Gender has a significant role for explaining the intention to use AR in store.
Butt et al. (2023)	Understand customer equity and loyalty using AR and employee services in a physical retail environment.	SERVQUAL	Smart mirrors in store	Face-to-face survey	Service experience with AR influences customer satisfaction and loyalty, but it does not affect customer equity. The SERVQUAL literature is extended in the light of service quality from the perspective of AR services.
Chekembayeya & Smidt (2023)	It examines the sequential effects of time convenience and (anticipated) emotions on consumer responses to AR apps in both pre-usage and usage stages.	Cognitive appraisal theory	Mobile AR and videos (not real experience); furniture	Online experiment	Time convenience and emotions stimulate favourable attitude towards the app and hence, behavioural intentions. Time convenience is an important construct prompting positive emotions toward AR apps.
Serravalle et al. (2023)	Explore consumers' behavioural responses by measuring the role played by product involvement in affecting the AR flow experience.	Flow theory	Mobile AR; VTO (shoes)	Online survey	Consumers' involvement with products affects their AR flow experience, along with their behavioural intentions in terms of purchase intention and intention to visit the retailer's website and recommend or share the experience.
tom-Dieck et al. (2023)	To investigate consumers' degree of involvement and if a feeling of immersion, and presence influences AR shopping satisfaction.	Presence and immersion	Mobile AR and videos; VTO (shoes and glasses), furniture	Online experiment	In a high-immersive AR experience, flow, information seeking and novelty are attributes related to immersion, while enjoyment and personalization are associated to presence. Contrastingly, in a low-immersive experience, only flow is related to immersion.
Xue et al. (2023)	To examine AR value to physical fashion retail, defines the most effective form (e.g., app vs magic mirror), and assesses AR's impact on consumer behaviour.	TAM model	Videos (not real experience). Mobile AR and magic mirror (clothes)	Focus groups and lab experiments	AR technology make the shopping experience more fun. However, the entertainment does not affect the intention to use AR. Perceived usefulness is the most crucial factor for participants to use the AR branded app, while participants perceived ease of use will influence their intention to use the magic mirror.
Zimmermann et al. (2023)	To investigate the impact of AR shopping assistant application, which uses personalized recommendations and explainable AI features on customer shopping experiences.	Shopping experience in brick-and-mortar stores	Mobile AR (groceries, luxury chocolate, shoes and books)	Online experiment	The usefulness and informativeness is higher when AI is introduced in the app. The usefulness, entertainment, informativeness and irritation is higher in the assisted shopping, compared to the unassisted one.

Source: Own elaboration

Table 3.2. Variables considered in quantitative studies

Reference	Independent variables	Mediators / moderators	Dependent variables
Pantano et al. (2017)	Aesthetic quality, interactivity, response time, quality of information	Ease of use, usefulness, enjoyment, attitude	Behavioural intention
Poushneh & Vasquez-Parraga (2017)	Level of interactivity	User experience, trade-off between price and value, user's information privacy control	Satisfaction, willingness to buy
Rese et al. (2017)	Informativeness, enjoyment	Usefulness, ease of use, attitude	Behavioural intention
Yim et al. (2017)	Interactivity, vividness, previous media experience	Novelty, usefulness, enjoyment, attitude	Purchase intention
Gallino & Moreno (2018)	Virtual product fit-information	Probability of purchase and returns, home try-on behaviour	Average price of an item, order amount, number of items
Watson et al. (2018)	Augmentation	Positive affective response, hedonic motivation	Purchase intention
Heller et al. (2019a)	AR configuration, AR transformation	Processing fluency, decision comfort, processing type, product contextuality	Choice, WOM
Heller et al. (2019b)	Active inference	Mental intangibility, decision comfort, sensory feedback, assessment	Willingness to pay
Huang (2019)	Ownership control, rehearsability	Self-referencing, information technology identity. AR vs Non-AR	Brand love
Huang et al. (2019)	Rapport experience (modality, synchronous sense of ownership, reprocessability)	Body surveillance, fashion consciousness, online clothes browsing involvement	Enjoyable interaction, personal connection
Mütterlein et al. (2019)	Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit	Lead-usership, age, gender, experience	Behavioural intention
Plotkina & Saurel (2019)	Human visualization in m-commerce	Enjoyment, convenience, ease of use, usefulness, attitude toward technology	Purchase intention
Van Esch et al. (2019)	Anthropomorphism	Confidence, convenience of the transaction, discomfort, innovativeness, product usage barrier, side effect	Attitude toward the brand
Zhang et al. (2019)	Ease of use, socialisation, product risk, privacy risk	Usefulness, enjoyment, attitude	Purchase intention
Fan et al. (2020)	Environmental embedding, simulated physical control	Cognitive fluency, cognitive load, product type (search product vs. experience product)	Product attitude
Jäger & Weber (2020)	Technology	Attention, construal level, label product	Actual purchases

Reference	Independent variables	Mediators / moderators	Dependent variables
Park & Yoo (2020)	Interactivity (controllability, responsiveness, playfulness)	Elaboration, quality, attitudes, involvement	Behavioural intentions (purchase, recommend app, revisit)
Yang et al. (2020)	AR ad vs traditional ad	Curiosity, attention, familiarity with AR	Attitude toward the ad, product purchase choice
Butt et al. (2021)	Content, system and service quality	Ease of use, enjoyment, satisfaction, environmental embedding, customization, interactivity	Continuous usage intention
Castillo & Bigné (2021)	Visual appeal, entertainment, optimism, innovativeness, need for personal interaction, navigation, self-efficacy	Aesthetics, technology readiness, usefulness, ease of use	Attitude
Chiang et al. (2021)	Navigation structure, graphic style, information content	Usefulness, ease of use	Behavioural intention
Chiu et al. (2021)	Information, system and service quality	Satisfaction, continuance intention	Individual net benefits
Daasi & Debbabi (2021)	Augmentation	Immersion, product presence, realism, attitude	Reuse intention
Gatter et al. (2021)	Need for touch, feature type	Utilitarian and hedonic benefits, imagined tangibility	App attitude, brand attitude
Gupta et al. (2021)	Ease of use, usefulness, enjoyment, flow	Sensory brand experience	Intention to use AR app
Han et al. (2021)	No AR vs AR	Immersion, enjoyment, product risk, attractiveness of online store	Patronage intention
Hilken et al. (2021)	Technology (AR and VR)	Fluency of product-focused mental imagery and context-focused mental imagery, sequencing of technologies, brand attitude	Purchase intention
Hsuan-Yu (2021)	AR app features (informative, personalization, interactive). Different user interfaces	Experiential value (utilitarian and hedonic), perceived customer support.	Continuous usage intention
Jiang et al. (2021)	Relative advantage, compatibility, complexity, trialability, observability	Attitude, perceived value	Intention to use AR app
JoerB et al. (2021)	Digital device usage	Sustainable consumption habits, technology as solution belief	AR recommendation agent reliance
Kowalczuk et al. (2021)	Interactivity, system quality, product informativeness, reality congruence	Affective (immersion, enjoyment, product liking) and cognitive (usefulness and choice confidence)	Reuse and purchase intention
Mishra et al. (2021)	Technology (AR, VR, mobile app)	Ease of use, responsiveness, product type (hedonic and utilitarian), visual appeal, emotional appeal	WOM recommendations, overall positive experience, visual appeal, purchase intentions.

Reference	Independent variables	Mediators / moderators	Dependent variables
Nikhasemi et al. (2021)	Interactivity, quality, vividness, novelty	Utilitarian and hedonic benefits, AR engagement, psychological inspiration, AR customisation	Continuous usage intention, willingness to pay price premium
Poushneh (2021)	Proximity	Feedback, generality, absence of product in consumers' consideration, physical distance to a physical store, product usefulness	Purchase intention
Qin et al. (2021)	Interactivity, virtuality	Hedonic, utilitarian, informativeness, ease of use	Attitude, behavioural intentions
Tandon et al. (2021)	VTO, free shipping, vendor specific guarantee, return policy, pay-on-delivery	Trust, perceived effectiveness	Repurchase intention
Arghasi (2022)	No AR vs AR	AR app attributes (novelty, wow-effect, inspiration, information overload and distraction), hedonic motivation (gratification, adventure, value, social, ideal, role)	Purchase intention
Argashi & Arsun-Yuksel (2022)	Interactivity, inspiration	Flow, attitude, trust, engagement, usefulness	Brand usage and brand attitude
Christ-Brendemühl & Schaarschmidt (2022)	Level of customer participation	Fairness perceptions (distributive, procedural and price)	Engagement and N-WOM intentions
De Amorim et al. (2022)	Media richness	Pleasure, arousal, attitude, information quality, brand engagement, gender, age	Willingness to buy
Holdack et al. (2022)	Ease of use	Informativeness, enjoyment, usefulness, attitude	Behavioural intention
Petit et al. (2022)	Visualisation mode	Mental simulation (process and outcome), product format (packaged vs. served), food type (healthy vs. unhealthy), packaging (transparent vs. opaque).	Purchase intention
Romano et al. (2022)	Attitude toward AR, decision confidence, information overload, experiential value.	Innovativeness, time pressure, shopping experience, price consciousness, ease of use, usefulness, demographic variables	AR segment profile
Sengupta & Cao (2022)	Use of AR	Immersion, decision-making quality, privacy concerns	Purchase intention
Sun et al. (2022)	No AR vs AR	Informativeness, presence, mental imagery, product quality uncertainty reduction, product fit uncertainty reduction. Product involvement, need for sensory richness, self-brand connection	Product attitude

Reference	Independent variables	Mediators / moderators	Dependent variables
Tan et al. (2022)	AR usage	Product characteristics (brand popularity, product appeal, product rating and product price. Customer characteristics (new to channel, new to product category)	Sales
Uhm et al. (2022)	Perceived diagnoscity	Psychological distance, perceived risks	Purchase intention
Zhang et al. (2022)	No AR vs AR	Coolness, spatial presence, attractiveness, psychological ownership, self-focused attention, purchasing context (hedonic vs utilitarian)	Purchase intention
Alesanco-Llorente et al. (2023)	Cognitive (performance expectancy, effort expectancy), affective (pleasure, arousal), normative (social influence)	Gender	Intention to use AR
Butt et al. (2023)	Service experience with employees and with AR	Interactivity, customer satisfaction	Customer equity, customer loyalty
Chekembayeya & Smidt (2023)	No AR vs AR	Interactivity, time convenience, anticipated emotions, attitude	Behavioural intentions
tom-Dieck et al. (2023)	Enjoyment, flow, information seeking, personalization, novelty	Immersion, presence	Satisfaction
Serravalle et al. (2023)	Product involvement, interest	AR flow experience, intention to visit the retailer's website and intention to recommend the experience	Purchase intention and customer loyalty
Xue et al. (2023)	Ease of use, usefulness, enjoyment	Attitude	Purchase intention, intention to visit the store
Zimmermann et al. (2023)	Brick-and-Mortar Shopping Scenarios (unassisted shopping), Assisted shopping (AR and Explainable AI and AR)	No mediators	Usefulness, entertainment, informativeness, irritation, purchase intention, trust in technology

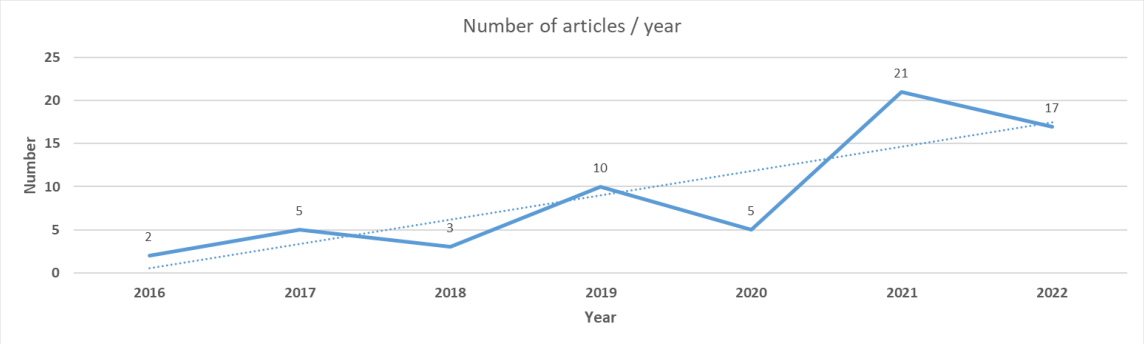
Source: Own elaboration

3.3 Overview and descriptive synthesis

3.3.1 Distribution across time

Despite fluctuations in the initial years, there is an increasing trend in the number of articles on the topic, which reflects the current relevance of AR in the retail sector. In the early years, the number of publications is relatively low. However, when progressing in the chronology, the trend of publications gains strength in 2021. This increase in publications may be due to the progressive development and implementation of AR apps in the sector, which facilitates data collection. At the time of the last search (16 April, 2023), the number of articles in 2023 is 7. Thus, it is expected that the number of publications in the current full year will remain similar to 2021 and 2022. This suggests that there is still a clear interest in the topic. Figure 3.2 shows the number of articles published in each of the full years considered in the sample.

Figure 3.2. Number of articles / year



Source: Own elaboration

3.3.2 Main theories and research frameworks

The most commonly theoretical framework applied is the Stimulus-Organism-Response (SOR) model. Furthermore, the most frequently theories and research frameworks used are related to technology adoption, with numerous studies using the Technology Acceptance Model (TAM) and Uses and Gratifications Theory (U&G). To a lesser extent, different versions of Unified Theory of Acceptance and Use of Technology (UTAUT) have also been applied. Some papers also apply theories from the psychology field used in traditional online shopping environments, such as CLT,

mental imagery, flow theory, self-determination theory or media richness theory. Based on media richness theory, AR can be seen to have a higher media richness compared with traditional online shopping. Table 3.3 presents the most relevant theories and research frameworks related to AR shopping used in the reviewed articles.

Table 3.3. Main theories and research frameworks used in the empirical articles

Main theories and models	No. of articles
SOR	9
TAM	8
U&G	5
CLT	4
Mental imagery	3
Flow	2
UTAUT / UTAUT2	2
Self-determination	2
Media richness	2

Source: Own elaboration

3.3.3 Main contexts and applications

The research contexts and type of AR studied was considered in the empirical studies. Research is dominant in mobile AR. Within this type of AR, VTOs with different products (beauty products, glasses, clothes and watches), and furniture and decoration apps are the most studied. This matches the fact that these types of apps in these sectors are the most popular and offered by well-known brands. For example, in the case of VTOs, well-known beauty and cosmetics brands (e.g., L'Oreal, Sephora, NYX cosmetics, Wanna Kicks, Ray-ban) and in the furniture sector (Ikea) are widely known and currently used apps (Statista, 2023e, Statista, 2023f). The second largest category includes studies in which participants have no real experience with AR. Instead, participants watch screenshots or videos showing how the apps work. Subsequently, Web AR is the most studied type of AR. In this sense, it is noteworthy the lack of studies focusing on beauty products, using VTOs only with glasses or clothing and watches. Finally, research on devices less widely adopted by retailers and consumers is the least numerous. 3 studies use virtual mirrors, which may potentially be used to implement AR in-store. There are also 3 papers using AR glasses (HoloLens) in their data collection.

Table 3.4 shows the number of articles focusing on different AR types and contexts studied. It should be noted that empirical papers studying different AR types and/or contexts have been included in each of the categories. For this reason, the overall number of articles reflected in the table is higher than the number of empirical papers collected in the sample.

Table 3.4. AR type and contexts studied in the empirical articles

Technology	No. of studies
Mobile AR	**54**
➢ VTOs	27
• Glasses	8
• Beauty products	12
• Clothes and watches	7
➢ Furniture and decoration	11
➢ Food	6
➢ Other apps	8
➢ Not specified	2
Web AR	**6**
➢ VTOs	6
• Glasses	2
• Clothes and watches	4
Smart mirrors	**3**
• Beauty products	1
• Clothes and watches	1
• Groceries	1
AR glasses	**3**
• Furniture and decoration	2
• Supermarket	1
Screenshots or videos	**8**

Source: Own elaboration

3.3.4 Research methods

Most of the articles are empirical (85.50% of the studies). Two empirical methods outweigh the rest (experiments and surveys). These two types of methodologies comprise 88.05% of the empirical studies, with a greater weight of experiments. Regarding the type of experiments, more than half (58.82%) are carried out in the laboratory, while 26.47% are carried out online and the rest are field experiments. The preferred way of conducting surveys is online, with 72.00% of the studies conducting them in this way. Then, in a less number of cases, there are qualitative studies conducted predominantly through in-depth interviews. Finally, there is one study with real data

collected from an AR app, which reflects the difficulty in obtaining this type of data. With regard to theoretical and conceptual studies, there is a diversity of methods, with a couple of SLRs, thematic analysis, ethnographies, and even a meta-analysis.

Table 3.5 shows the methods used in the articles analysed. As in the previous section 3.3.3, it should be noted that articles that include more than one study are counted in each of the categories in the table. For example, if an article includes in-depth interviews and lab experiments, it is counted in both categories. For this reason, the total number of studies shown in the table is higher than the number of articles in the final sample.

Table 3.5. Methods used in research

Methods used	No. of studies
EMPIRICAL (59 articles)	**67**
➢ **EXPERIMENT**	**34**
• Lab experiment	20
• Online experiment	9
• Field experiment	5
➢ **SURVEYS**	**25**
• Online survey	18
• Face-to-face survey	6
• Telephone survey	1
➢ **IN-DEPTH INTERVIEWS**	**6**
➢ **FOCUS GROUPS**	**1**
➢ **APP REAL DATA**	**1**
THEORETICAL / CONCEPTUAL (10 articles)	**10**
➢ **CONCEPTUAL DESCRIPTIVE**	**4**
➢ **SLR**	**2**
➢ **THEMATIC ANALYSIS**	**2**
➢ **ETHNOGRAPHY**	**1**
➢ **META-ANALYSIS**	**1**

Source: Own elaboration

3.4 Thematic analysis

The thematic analysis led to an integrated view of academic papers on AR. In this sense, the main articles were reviewed to classify them into broader research themes. Rather than adopting an a priori coding system, an inductive approach allows themes to emerge directly from the data (Azungah, 2018; Sabharwal & Miah, 2022; Thomas, 2006). The rationale for this approach comprises the novelty of this research area. Initially, the 69 articles in the sample were analysed for

content, considering the research aims and main constructs to determine the phenomena that each article addresses. The articles were then classified and compared to group them into thematic blocks. Finally, the thematic blocks were reviewed for redundancy and revised if necessary. This process revealed four research themes. Table 3.6 shows these groups.

Table 3.6. Themes classification

Research theme	References	No. of articles	Weight
AR app features and technology adoption	Pantano et al. (2017); Rese et al. (2017); Chopra, (2019); Mütterlein et al. (2019); Park & Yoo (2020); Butt et al. (2021); Castillo & Bigné (2021); Chiang et al. (2021); Chiu et al. (2021); Daasi & Debbabi (2021); Gupta et al. (2021); Han et al. (2021); Hsuan-Yu et al. (2021); Jiang et al. (2021); Nikhashemi et al. (2021); Qin et al. (2021); Christ-Brendemühl & Schaarschmidt (2022); Holdack et al. (2022); Vieira et al. (2022); Alesanco-Llorente et al. (2023); Butt et al. (2023).	21	30.43%
Media characteristics and consumer outcomes	Poushneh & Vasquez-Parraga (2017); Yim et al. (2017); Gallino & Moreno (2018); Watson et al. (2018); Heller et al. (2019a); Heller et al. (2019b); Zhang et al. (2019); Fan et al. (2020); Tandon et al. (2020); Yang et al. (2020); Kowalczuk et al. (2021); Mishra et al. (2021); Argashi (2022); de Amorim et al. (2022); Sengupta & Cao (2022); Tan et al. (2022); Zhang et al. (2022); Xue et al. (2023); Zimmermann et al. (2023).	19	27.54%
Psychological factors and outcomes	Huang (2019); Huang et al. (2019); Plotkina & Saurel (2019); Van Esch et al. (2019); Jäger & Weber (2020); Gatter et al. (2021); Joerß et al. (2021); Hilken et al. (2021); Poushneh (2021); Arghasi & Arsun-Yuksel (2022); Petit et al. (2022); Romano et al. (2022); Sun et al. (2022); Uhm et al. (2022); Chekembayeya & Smidt (2023); Serravalle et al. (2023); tom-Dieck et al. (2023).	17	24.64%
Recommendations for AR implementation and its advantages	Scholz & Smith (2016); Parise et al. (2016); Dacko (2017); Scholz & Duffy (2018); Perannagari & Chakrabarti (2019); Batat (2021); Berman & Pollack (2021); Chen et al. (2021); Caboni & Pizzichini (2022); Kumar (2022); Tsiotsou & Klaus (2022); Vaidyanathan & Henningsson (2022).	12	17.39%

Source: Own elaboration

3.4.1 AR attributes and technology adoption

The most common research theme in the extant literature deals with the AR attributes and how they impact on the adoption of this technology. Many researchers consider ease of use, usefulness, and attitude towards the app to be critical aspects for technology adoption (Chopra, 2019; Pantano et al., 2017). For example, Pantano et al. (2017) show the relevance of technology attributes through the virtual interactions, and demonstrates meaningful differences between Italian

and German people. Other papers have included hedonic elements to explain AR adoption, such as enjoyment (Rese et al., 2017). In this sense, some studies show outstanding results such as the fact that ease of use and enjoyment do not affect the perceived usefulness (Rese et al., 2017). Similarly, AR features app such as the responsiveness, informativeness or playfulness have also been found to play an important role (Hsuan-Yu et al., 2021; Park & Yoo, 2020; Qin et al., 2021a). In relation to these studies, it is worth noting that some research has highlighted that responsiveness is not key in AR technology adoption (Park & Yoo, 2020). Likewise, Hsuan-Yu et al. (2021) show AR attributes affects utilitarian and hedonic vale, but only hedonic value affects usage intention. A smaller number of studies have also considered the impact of individual variables (e.g. need for personal interaction, technology readiness) on technology adoption (Castillo & Bigné, 2021). In the TAM extension model proposed, this research showed that neither the need for personal interaction nor technology readiness affected perceived usefulness (Castillo & Bigné, 2021). Other studies have considered the role of socio-demographic variables in this theme (e.g. gender; Alesanco-Llorente et al., 2023). The results show that effort expectancy influences the intention to use AR only in the case of men, whereas the social influence affects the intention to use AR only in women (Alesanco-Llorente et al., 2023).

3.4.2 Media characteristics and consumer outcomes

The second prominent research theme revolves around the media characteristics and their impact on consumer outcomes related to purchase behaviour. The role of interactivity, vividness, immersion and the media richness provided by AR has been widely considered as an important predictor of purchase intentions (Sengupta & Cao, 2022; Yim et al., 2017;). In fact, research has shown that the success of the medium as an information source depends of its interactivity and vividness (Yim et al., 2017). Furthermore, immersion has a positive effect on decision-making quality. However, individual variables, such as privacy concerns negatively moderates the effect of decision-making quality on purchase intention (Sengupta & Cao, 2022). In addition, based on media richness theory, some studies explore the impact of AR on consumers' emotional and cognitive responses (de Amorin et al., 2022). Comparing media characteristics, Kowalczuk et al. (2021)

explore the relative advantage of AR over web-based product presentations. They found that cognitive and behavioural responses are higher in the web condition; and only affective responses are higher in the AR condition. In addition, it was found that AR increases consumers' attitude toward the ad, comparing AR advertisement and the traditional one (Yang et al., 2020). In relation to research that has analysed different types of AR, it has been found that perceived usefulness is the most crucial factor to use the AR branded app, while the ease of use is the key aspect that explains the intention to use a magic mirror (Xue et al., 2023).

3.4.3 Psychological factors and outcomes

The third conspicuous research theme stemming from the systematic review has to do with salient influential variables related to consumers' deeper psychological processes when exposed to AR that impact on their responses and behaviour. Researchers have focused on a variety of psychological concepts. For example, the influence of anthropomorphism on consumers' perceptions of AR has been explored, providing a theoretical mechanism to explain the improvement in brand attitude (Van Esch et al., 2019). Furthermore, based on self-determination theory, the impact of the sense of ownership in increasing the use of AR and generating brand love has been examined (Huang, 2019; Huang et al., 2019). Other theories, such as CLT, have been used to investigate the potential of AR in-store, noting how the construal level can impact on consumer attention and, consequently, increase the sales (Jäger & Weber, 2020). Other psychological concepts like flow have been used to investigate the antecedents and outcomes of consumer engagement through AR apps (Arghasi & Arsun-Yuksel, 2022).

3.4.4 Recommendations for AR implementation and its advantages

The fourth research theme is the least numerous in terms of number of articles. This theme is mainly composed of theoretical and conceptual papers that attempt to shed light on the possibilities offered by AR and its advantages in a retail context. In addition, this group also includes papers that provide a series of recommendations or guidelines for the successful implementation of AR technology. Concretely, the first articles published in 2016 provide 8

recommendations managers can use to design AR experiences that maximize consumer engagement (Scholz & Smith, 2016), and explain the success factors of companies which implemented the AR (Parise et al., 2016). Later, some researchers have investigated how to design AR-based services that enhance customer experience (Vaidyanathan & Henningsson, 2022). Furthermore, the role of AR in smart retailing has also been considered. Dacko (2017) shows how, why and to what extent AR apps contribute to smart retail creating additional value. The role of AR use in brand relationships has also been explored conceptualized. Scholz & Duffy (2018) examine what consumer-brand relationships can be facilitated through AR from a holistic approach. More recently, studies have reviewed the state of the art, identifying the antecedents, drivers and outcomes in the AR literature (Kumar, 2022).

3.5 Conclusions and main contributions

Through an exhaustive review, this chapter aims to examine the current state of the literature on AR in the retail sector. For this purpose, a systematic review of the articles published in high impact journals within the category of business and/or management in the JCR index has been carried out. This review has detected a growing interest in research on the subject. Furthermore, the review of the articles, together with the thematic analysis conducted, allow to identify the most researched areas and detecting research needs. This serves as the basis for the following 3 empirical chapters of this dissertation that explore and highlight the advantages for both retailers and consumers of using AR in online commerce compared to traditional online commerce.

After a thorough review, it is noted that a large number of publications have focused on technology adoption, using theoretical frameworks and research models related to it (e.g., TAM, U&G). Furthermore, mobile AR is the type of AR in which there is the greatest amount of research, with the sectors where VTO can be used and the furniture sector being the most explored. The AR web has also been explored through the VTO tools offered, with no research in the sample focusing on beauty products. The least researched AR types are those in which the hardware is more

expensive, which makes mass implementation difficult. Specifically, virtual mirrors and AR glasses are the least researched AR types.

This chapter has several contributions. Literature reviews can serve as useful overviews of a topic for marketing professionals seeking evidence to guide their decisions; consequently, their quality can have significant real-world implications. Furthermore, this study informs the scientific community of the current state of the art, the most and least examined research frameworks and concepts, and where future research should be focused. Therefore, it contributes to the academic literature by offering a very current view of the issue. Thus, through this chapter, researchers can clearly and concisely observe the state of AR research in the retail sector, which can serve as a basis for future contributions to the field.

Regarding managerial implications, retailers interested in introducing AR in their online shops can understand in a simple way the key elements identified in the academic research. This will allow them to know the key attributes and features, as well as the strategies to develop for the successful implementation of this technology in the customer journey. This knowledge will help AR in the retail sector to be massively implemented faster, due to the better experiences that consumers will enjoy.

3.6 Limitations and future research directions

This chapter is not without limitations. Establishing the categories of "business" and "management" in the articles search may limit the review of other papers published on the subject in journals outside these categories. For example, research focusing on the consumer decision-making process published in journals in the field of psychology may have missed out on this review (e.g., Barta et al., 2023a; Barta et al., 2023c). Therefore, future reviews could include journals from the field of psychology or could use methods employed in SLRs such as cross cited references for the inclusion of related articles published in other areas.

Furthermore, with the expected progressive increase in research on the subject, meta-analyses could be carried out in the future to complement existing SLRs in the field. With the increase in the number of publications on AR marketing, future research can gain more insights into the increased literature by using analytic techniques such as bibliometric analysis, text mining and meta-analysis. The performance of meta-analysis in the future would also make it possible to complement those that already exist (Vieira et al., 2022), making it possible to detect changes in the trend of research over time.

This systematic review has revealed that the study of AR in the retail sector is a promising area of research. The review highlights significant research gaps that require attention in the future. The main areas identified are summarised below. A more detailed future research agenda about these areas is presented in chapter section 7.4.

1. **Cognitive elements:** Research has focused on analysing how the use of AR can influence cognitive aspects. However, much of the expertise has focused on how AR enhances the positive aspects of the online shopping experience, rather than focusing on how it mitigates those negative aspects that may arise during the online shopping experience. Furthermore, previous research has shown that the use of AR can pose challenges to users due to the exposure to multiple realities, including AR and physical reality, which require mental integration (Xiet al., 2022). While some researchers argue that AR can potentially increase users' cognitive load (Tarafdar et al., 2019), others have found that AR can actually reduce cognitive load by aiding users in imagining products (Heller et al., 2019a). These studies contribute significantly to our understanding of the cognitive support and demand in AR, but further research is necessary to fully understand this phenomenon.

2. **Affective elements:** the AR experience is a multisensory experience (Heller et al., 2019a). The hedonic benefits of AR point to opportunities for research into how AR can influence affective variables. For example, AR-enabled virtual clothing and shoes

("digital skins") have become hyper-realistic to appeal as products in their own right, not just as decision aids for physical products. This leads future research to explore consumers' feelings when trying on clothes, even if virtually. The interaction between the virtual and the real anticipates the consumer experience, and can arouse emotions and affective states in the consumer. Therefore, due to the capacity of AR to influence not only cognitive processes, but also affective processes through the anticipation of the consumer experience, it is necessary to further explore this area.

3. **Social elements:** There is a lack of research focused on the social dimension that AR can provide. For example, some apps allow users to take a screenshot to share the AR experience with their family and friends. In today's hyper-connected world and with the widespread use of social media, the social elements of AR apps are of great importance. Some brands have already started to use AR in their social media marketing strategy. Apart from social media, one of the most promising areas is brand communities; as AR offers the opportunity to create and share content quickly. For example, using this technology in a social way can provide access to other users' creations to inspire new ideas (Rauschnabel et al., 2019).

4. **Dark side of AR:** Most of the literature reviewed focuses on the positive side of AR use and the positive effects of AR features. However, there are few studies that discuss the dark side of the application of AR in marketing. Some exceptions highlight how the involvement required to use AR applications can reduce engagement, compared to physical shop visits, using the theoretical framework of equity theory (Christ-Brendemuehl & Schaarschmidt, 2022). Furthermore, to provide personalized AR shopping experiences (e.g., product suggestions based on the detected features of the consumer's face), AR applications need to collect, process, store, and transmit a variety of consumer data, such as their face, body, and the space where they are located. Therefore, potential ethical issues related to privacy, surveillance, and security risk

need further research in the future (Rauschnabel, 2018). For example, consumers' privacy concerns may act as a boundary condition and strengthen/weaken the effects of AR use or AR features on their motivations, experiences, responses, and behaviours (Sengupta & Cao, 2022).

5. **Factors affecting AR experience:** Several factors such as device type, product type, user's relationship with the brand or contextual factors can affect the AR experience**.** In other contexts, the impact of the devices used or the different immersive technologies have been studied in more depth. For example, the differences between AR and VR in the engagement or intention to visit a destination have been analysed in the tourism sector (Flavián et al., 2021b; Orús et al., 2021). However, in the retail sector this field is still underexplored, with a few exceptions. For example, Hilken et al. (2021) analyse the impact of AR and VR on the fluency of mental imagery and how the order in which these technologies are used can affect the consumer experience. In addition to the analysis of different technologies, the device used can play a key role in the consumer experience (Barta et al., 2021). Due to the differences that devices present in terms of technological embodiment, presence and interactivity (Flavián et al., 2019a), it is necessary to analyse which AR devices are the most suitable for each situation and application. In addition, the user's knowledge of the product or the space where the AR is used may also affect the user's perceptions (Rauschnabel, 2018; von der Au et al., 2023). However, there is a need to further explore the understanding of more factors that influence the experience.

6. **New methodological approaches and measures:** most of the empirical research has been conducted through experiments in controlled environments or through online surveys. Therefore, there is a need to corroborate existing results in a real consumer environment. In addition, the measures used have usually been collected through surveys. Other variables to reflect the effect of this technology on actual behaviour are

needed. Furthermore, there is a predominance of the use of classical theoretical frameworks, especially focusing on technology adoption. This highlights the need to apply and contribute to the development of other theories in AR research. Therefore, there is a need to focus on theory building. Qualitative studies may be a suitable method for developing new theories in the field (Khan, 2014). Furthermore, empirical research could use neuroscientific methods to measure consumers' attention when using AR or the degree of arousal (Weder et al., 2020).

This thesis deepens in the understanding of cognitive elements in the chapters 4, 5 and 6. Nevertheless, the study of affective elements is also explored in chapters 5 and 6. Moreover, whereas chapters 4 and 5 analyse the impact of AR on the decision process in the purchase of a cosmetic product, in chapter 6 the decision they have to make is about the choice of a piece of furniture. Thus, it also contributes to the study of the fifth topic mentioned above, analysing differences between products. In addition, the decision time measure in chapter 6 allows the measurement of the actual behaviour by providing insights into the sixth area mentioned above through the use of less common measures in existing research. Specifically, this thesis contributes in the following ways:

- Analyse the impact of AR on cognitive variables exploring cognitive dissonance (chapter 4), the perceived risk of buying online (chapter 5) and the heuristic-systematic processing (chapter 6).
- Analyse the impact of AR on affective variables, concretely decision comfort (chapters 5 and 6).
- Explore the differences of AR between products. Chapter 4 and 5 analyse the impact of AR on consumer decision-making when buying beauty products, whereas in chapter 6 the effect of AR is analysed in the context of furniture.
- Explore the real behaviour through the use of new measures (chapter 6). Although conducted in a lab setting, the measurement of the time participants used to make the decision makes it possible to contribute to this field.

4. The impact of augmented reality on consumer behaviour from a cognitive load perspective

4.1 Introduction

After conducting a thorough review of the existing literature in the field, the primary objective of this chapter is to further advance the understanding of the benefits of AR in the context of online shopping in an empirical way. In light of the limited number of articles available on Web AR, this study focuses specifically on this type of AR. Although previous research has explored the impact of AR on products such as glasses or clothing, no studies have been found on Web AR in the context of beauty products in the sample of articles reviewed. Focusing on this context, this chapter aims to gain insight into the underlying cognitive mechanisms through which AR enhances the decision-making process by adopting a theoretical perspective that considers cognitive load. From this theoretical perspective, the current study seeks to investigate the potential of AR implementation to increase the sales and enhance margins for retailers. Consequently, this study focuses on purchase intention and willingness to pay more for the product as consumer responses.

The research focusing on the use of AR in the context of purchasing decisions and willingness to pay more has demonstrated that AR can enhance various aspects of the consumer experience, including usefulness, ease of use, satisfaction, engagement, and attitude (see Table 4.1). Nevertheless, negative aspects that may arise during the decision-making process warrant closer attention. For instance, recent studies have suggested that AR might decrease uncertainty by addressing concerns regarding product quality and fit, which can affect consumers' attitudes towards products, though they did not explore its effects on purchase intentions (Sun et al., 2022). Additionally, research has examined factors that decrease prepurchase cognitive dissonance, such as decision confidence (Kowalczuk et al., 2021), decision comfort (Heller et al., 2019a; Hilken et al., 2017; Wang et al., 2021), and product risk (Bonnin, 2020; Zhang et al., 2019). The present chapter seeks to investigate an unexplored area of research to understand how AR affects to perceived similarity and confusion by overchoice, which can lead to prepurchase dissonance when consumers evaluate a large range of online options (e.g. cosmetic products). Although some qualitative studies suggest that AR can lead to higher cognitive dissonance because of the greater ease with which products can be tested and the enjoyment derived from using AR apps (Romano et

al., 2021), quantitative research has generally shown that prepurchase cognitive dissonance-related variables are reduced due to the greater ease of viewing products through the filters provided by AR (Lavoye et al., 2021). To address this controversy, this chapter aims to quantitatively explore how AR affects the perceived similarity of alternatives, confusion by overchoice, and prepurchase dissonance. As described in chapter 1, several cosmetics vendors have already implemented AR technologies, such as L'Oreal, which allows virtual product testing through its website (via its online browsers) on desktop and laptop computers. These VTOs can enhance consumers' confidence in their decisions and generate purchase-related behavioural intentions (Qin et al., 2021a).

Some AR-based research into consumer behaviour has been conducted through quantitative studies in which participants were shown screenshots of examples of AR functioning in online retail. However, they did not use the AR apps. Furthermore, research has examined mobile apps rather than computer-based web environments (see Table 4.1). Recent literature has highlighted that the device type can affect consumers' psychological states related to their evaluation of their shopping experience and their subsequent behaviours (Barta et al., 2021). Additionally, many previous studies on AR and online shopping have only allowed participants to try one or a few products, which limits the generalizability of the findings. Thus, this chapter seeks to also contribute by exploring the role of AR in less-studied online environments and shopping scenarios, using a wider assortment of products to provide more realistic insights.

Drawing on the SOR model and the cognitive load theory, this chapter aims to make a contribution to the existing literature by developing a mechanism that explains how the stimulus of AR can influence consumer states related to perceived similarity, confusion caused by overchoice, and prepurchase dissonance (organism variables), which may arise during the product choice process and ultimately affect behavioural intentions, such as purchase intention and willingness to pay more (response variables). The study addresses the lack of knowledge about the effects of AR on consumers' perceptions of large online choices, where consumers often experience high levels of product similarity and confusion caused by overchoice.

Table 4.1. Summary of AR studies in retailing examining purchase intentions and willingness to pay more

Source	Context/devices	Independent variables	Mediators / moderators variables	Dependent variables
Javornik et al., 2016	Beauty products; AR in-store	Augmentation	Playfulness, convenience	Purchase intention, return intention, intention to recommend
Yim et al., 2017	Clothes and accessories; Web AR	Interactivity, vividness, previous media experience	Immersion, media novelty, attitude toward the medium	Purchase intention
Beck & Crié, 2018	Clothes and accessories; AR in-store	Presence of virtual fitting room	Perceptual specific curiosity about the product, patronage intention	Purchase intention
Brengman et al., 2019	Furniture and decoration; Mobile AR	Media (laptop, mobile phone and AR apps), geometric or material product	Perceived ownership	Product attitude, purchase intention
Heller et al., 2019a	Furniture and decoration; AR glasses	Sensory control modalities	Assessment, sensory feedback, mental intangibility, decision comfort	Willingness to pay more
Smink et al., 2019	Beauty products; Mobile AR	Online product presentation (AR, non-AR self, non-AR model)	Informativeness, enjoyment, intrusiveness	Brand attitude, purchase intention, willingness to share personal data
Bonnin, 2020	Clothes and accessories; Web AR (screenshots)	Presence/absence of AR	Utilitarian evaluation, hedonic evaluation, perceived product risk, attractiveness of the online store	Purchase intention
Park & Yoo, 2020	Beauty products; Mobile AR	Controllability, responsiveness, playfulness	Elaboration, quality, attitudes	Purchase intention, return intention, intention to recommend
Kowalczuk et al., 2021	Furniture and decoration; Mobile AR	Interactivity, system quality, product informativeness, reality congruence	Immersion, enjoyment, product liking, media usefulness, choice confidence	Reuse intention, purchase intention
Nikhashemi et al., 2021	Furniture and decoration; Mobile AR	Novelty, quality, interactivity, vividness.	Utilitarian benefits, hedonic benefits, brand engagement, psychological inspiration, customisation	Continuous use intention, willingness to pay a price premium
Qin et al., 2021a	Furniture and decoration; Mobile AR	Virtual presence, experiential value, shopping benefits, perceived value	Attitude, satisfaction	Continuous use intention, purchase intention
Wang et al., 2021	Beauty products; Mobile AR	Interactivity, vividness, augmentation, aesthetics	Spatial presence, flow experience, decision comfort, individualism, fashion innovativeness	Purchase intention
Whang et al., 2021	Beauty products; Mobile AR	Vividness, interactivity	Behavioural control, cognitive control, brand awareness, product involvement	Purchase intention
Tan et al., 2022	Beauty products, Mobile AR	AR usage	Brand popularity, product appeal, product rating, product price, new to channel, new to category	Sales
This study	Beauty products; Web AR	Presence/absence of AR	Perceived similarity, confusion by overchoice, prepurchase dissonance	Purchase intention, willingness to pay more for the product

Source: Own elaboration

In addition, this chapter offers valuable insights for online retailers. Specifically, the research findings highlight the significant role that AR technology can play in increasing sales and profit margins. Additionally, understanding the mechanisms through which AR reduces prepurchase dissonance can lead to a better consumer shopping experience and consequently an increased willingness to purchase. For retailers, this means that reducing consumer indecision, which is responsible for 60% of lost sales opportunities in online stores (Edelen, 2018), they can improve their overall performance. Understanding the most salient factors that influence consumers' purchase decision-making process can help online stores convert lost sales into actual sales, leading to better business outcomes.

4.2 Theoretical framework and hypotheses development

The theoretical bases of the study are the SOR model and cognitive load theory. As noted in chapter 3, the SOR model has been one of the most widely used models in AR research. On the other hand, cognitive load theory is a theoretical foundation that explains how cognitive variables, such as confusion by overchoice and cognitive dissonance, impact purchase behavioural responses. The following sections provide a brief overview of these theoretical concepts.

4.2.1 S-O-R Model

The SOR paradigm originates in the classic stimulus-response theory, which postulates that subjects perform a paired response after being shown a specific stimulus (Pavlov, 1902). The classic stimulus-response theory was extended by Mehrabian and Russell (1974) and Donovan and Rossiter (1982) to arrive at the SOR paradigm. Stimuli are the specific factors that arouse organismic processes in the individual (Eroglu et al., 2001). By processing these stimuli, internal (organism) processes are generated. Ultimately, this leads to responses, such as approach or avoidance behaviours (Donovan & Rossiter, 1982). Thus, the SOR model proposes that stimuli provoke organismic reactions that lead to specific actions. The organism mediates the influence of a given stimulus on the response. The SOR model has been previously applied to online shopping

environments (e.g., Eroglu et al., 2001; Ettis, 2017) and is the most widely used theoretical foundation for immersion-based research (Loureiro et al., 2019).

Recent technological developments have altered the buying process. Some beauty industry e-commerce sites integrate technologies that allow product testing using facial filters through VTO. Other e-commerce sites still need to provide this option, and products can be evaluated only through descriptions, images and videos. The technology used during the purchase process is the stimulus proposed to affect the organism components (perceived similarity, confusion by overchoice and prepurchase cognitive dissonance) and responses (purchase intention and willingness to pay more).

4.2.2 Cognitive load

In online shopping, customers often face the challenge of mentally picturing how products would look and function in their personal environments, leading to increased cognitive load. According to cognitive load theory, individuals possess limited cognitive resources. When the cognitive load becomes excessive, information processing consumes significant cognitive resources, impacting the acquisition of product information and generating negative attitudes towards products (Semin & Smith, 2013). Individuals tend to avoid cognitive efforts beyond what is necessary, and high cognitive loads can evoke negative emotions by creating conflict between the consumer's personal preferences and external demands, resulting in negative impacts on decision-making processes (Ayres, 2020).

AR can help consumers process product information by providing virtual representations of how they might look in reality; consequently, the information users have to process is more closely related to their faces/bodies and less to their imaginations (Fan et al., 2020). By superimposing 3D virtual product models onto real-world environments, AR can alleviate cognitive load during online product searches and allow consumers to make purchase decisions based on the product's appearance within their surroundings, reducing the importance of other factors such as textual product descriptions (Kim & Choo, 2021). Furthermore, VTOs offer consumers the opportunity to assess product suitability by enhancing their mental imagery capacity (Hilken et al., 2018). Therefore, the visualisation provided by AR can reduce choice overload and associated

cognitive load by enhancing mental imagery capacity, improving the consumer experience, and aiding purchase decision-making.

Virtuality plays a crucial role in eliciting cognitive and affective states among consumers. Cognitive responses refer to intellectual coping mechanisms resulting from feedback in mental processes (Qin et al., 2022). When consumers evaluate a product, they tend to imagine how it fits into their environment. This is especially important for products that need to be compatible with other elements in the environment, such as furniture or cosmetic products that enhance facial features. Thus, the enhanced mental imaging capacity provided by AR may influence the mental processes associated with cognitive states. These cognitive states, such as anxiety, confusion, and dissonance, can impede consumers' purchase decisions (Mitchell et al., 2005), and therefore, they play a significant role in consumer behaviour. Additionally, online retailers offer a wider range of products compared to physical stores, which can evoke cognitive states such as confusion by overchoice and/or prepurchase dissonance. Hence, it is essential to comprehend how the increased virtuality provided by AR in online stores influences the consumer's mental processes and, more specifically, the cognitive states that may arise during the selection process.

4.2.3 Hypotheses development

The cognitive theory of multimedia learning proposes that people have different ways of processing the information presented in visual and aural materials (Mayer, 1997). Each individual has limited resources, so a large amount of information increases the cognitive load. Cognitive load can be internal or external, depending on the source of the cognitive demand (Sepp et al., 2019). Internal cognitive load pertains to the complexity of understanding how a material or product functions, such as determining whether a component would aid in repairing an electronic device. In contrast, external cognitive load is associated with how information is presented, as illustrated by the use of AR to determine whether a particular colour suits an individual's skin tone by overlaying virtual elements onto real-world settings.

Regarding uncertainty, two types of product uncertainty exist in the online commerce literature (product performance and product-fit). Product performance uncertainty arises when

customers cannot evaluate product performance because of imperfect knowledge, whereas product fit uncertainty arises when customers cannot establish if a product is suitable for their needs (Tan et al., 2022). This study focuses on reducing the latter type of uncertainty by utilizing AR's capability to present products integrated into the real environment, specifically the consumer's face. By doing so, it becomes easier to verify if the chosen colour matches the consumer's preferences based on their skin tone. The uncertainty reduction theory suggests three methods for reducing uncertainty: active, passive, and interactive (Berger & Calabrese, 1975). Consumers can actively seek new product information to reduce uncertainty or passively receive information by reading reviews from previous customers. In this sense, AR can provide consumers with a wealth of information during their shopping journey.

By using AR, consumers can view products integrated into real-world environments, allowing them to verify if the products suit their needs. This way, AR can provide prepurchase product tests via tools such as VTO. Such information can help consumers evaluate their options and simplify their decision-making (Chylinski et al., 2020). Furthermore, the information provided on the web can offer details about product characteristics, such as their components. Similarly, other users' information can provide a deeper understanding of subjective aspects such as product quality and personal experiences. AR also reduces product fit uncertainty which cannot be reduced through active or passive uncertainty reduction methods. Thus, AR is a powerful tool to reduce uncertainty and improve the overall online shopping experience.

The AR information helps consumers evaluate their options, simplifying their decision-making (Chylinski et al., 2020). AR reduces product fit uncertainty, which cannot be reduced through active or passive uncertainty reduction methods. Due to similar shades on a white background on a 2D image requires much more effort to detect important differences (Creusen & Schoormans, 2005), the use of AR allows to detect these differences through the product visualisation in a real environment. Therefore, it is proposed:

H1: The use of AR (vs no AR) reduces the perceived similarity.

Confusion by overchoice refers to a cognitive impairment that individuals experience when confronted with numerous alternatives, leading to difficulty in making decisions (Pappas, 2017). As AR technology reduces product fit uncertainty to the consumer, it is expected to have an impact on this cognitive state. Specifically, in the cosmetics industry, the ability to test a product on the face through AR provides consumers with a clear idea of which colour shades are suitable (Do et al., 2020). This information enables consumers to eliminate options that are not appropriate, reducing uncertainty about product fit. Moreover, virtual product testing offers a more precise image of the product's appearance. Consequently, consumers' doubts about making the best choice are limited, leading to reduced confusion and dissonance during the decision-making process.

H2: The use of AR (vs no AR) reduces the (a) confusion by overchoice and (b) prepurchase dissonance.

Inconsistency among thoughts, beliefs and behaviours causes uncomfortable psychological tension (e.g., confusion and cognitive dissonance), which leads people to change one of the inconsistent elements to reduce these states or to add consonant elements to restore consonance (Festinger, 1957). To reduce confusion by overchoice, reducing the number of options offered is often the strategy employed. To this end, individuals tend to eliminate those options that do not fit their wishes (Mitchell et al., 2005). Thus, the perception that options are not similar helps to reduce the emergence of these states.

Providing consumers with the ability to view products helps them see the differences between them more clearly, facilitating purchase decisions (Gourville & Soman, 2005). Moreover, when consumers face numerous similar options, they may experience uncertainty and doubt, leading to a feeling of dissonance (Koller & Salzberger, 2007). Therefore, decreasing the perceived similarity of available options can also help alleviate consumers' anxiety. In light of these considerations, it is proposed that:

H3: Perceived similarity has a positive effect on (a) confusion by overchoice and (b) prepurchase dissonance.

Decreasing the confusion caused to the individual by the available options will also affect states that involve anxiety and nervousness, such as dissonance (Chou, 2012). When confusion is reduced, the consumer clearly knows which product to buy. As a result, consumers have few negative thoughts about whether they have made the right choice (Mitchell & Papavassiliou, 1999). As prepurchase cognitive dissonance is a psychological state that evokes emotions such as anxiety, a low level of confusion will reduce these emotions. Conversely, increased confusion by overchoice will favour the evocation of dissonance. When the consumer suffers increased confusion, greater doubts arise, which encourages the emergence of dissonance.

H4: Confusion by overchoice has a positive effect on prepurchase dissonance.

Purchase intention involves the desire to purchase a product. This intention usually originates from the consumer's perceptions and evaluation of available options (Wu et al., 2012). When consumers experience fatigue or confusion, it reduces their motivation to purchase (Mitchell et al., 2005). In these states, the process of evaluating each option is difficult. Consequently, there is a decrease in the perceived value of the options, reducing the likelihood of making a purchase (Pappas, 2017). Furthermore, the cognitive effort experienced due to the confusion may affect the price consumers are willing to pay for the product. The confusion by overchoice decreases the motivation to engage in complex decision-making processes (Alavi et al., 2016). As a result, consumers may become less willing to pay more for a product due to the perceived effort required to make the decision.

H5: Confusion by overchoice has a negative effect on (a) purchase intentions and (b) willingness to pay more.

Cognitive dissonance is one of the main consequences of the decision-making process in AR research (Mishra et al., 2021). This anxiety may cause consumers to suffer an information overload, reducing their purchase intention at that moment. Experiencing this dissonance during product choice may result in customers choosing to delay their purchase decisions (Menasco & Hawkins, 1978), and in some cases, may even lead to not buying the product (Hasan, 2012). On the other hand, a lack of dissonance can make consumers feel calm and relaxed, which can reinforce

their purchase decisions. In addition, consumers who feel more in control of their cognitive processes are more likely to complete tasks (Kim et al., 2020).

Moreover, when consumers feel uncertain and doubtful, they are less willing to pay higher prices for products. The shopping experience is a key determinant of consumers' willingness to pay more for products (Li et al., 2012), and those who do not have a positive shopping experience are less willing to pay more for products (Huang, 2021). Therefore, it is suggested that dissonance can have a negative impact on shopping behaviour.

H6: Prepurchase dissonance has a negative effect on (a) purchase intentions and (b) willingness to pay more.

Consumers who possess a strong desire to purchase a product are typically more willing to pay a higher price. This intense desire to acquire and enjoy a product generates a greater purchase intention, ultimately affecting the price the consumer is willing to pay (Heller et al., 2019a). Therefore, the greater is the consumers' intention to buy a product, the higher will be the price they will be willing to pay for it. Thus:

H7: Purchase intention has a positive effect on willingness to pay more.

For the shake of completeness, aspects relating to the product and the individuals were controlled. Product knowledge and preference for consistency of the participant's thoughts were measured because of their possible impact on the cognitive variables and behavioural intentions in line with previous research (Cakici & Shukla, 2017; Li et al., 2019).

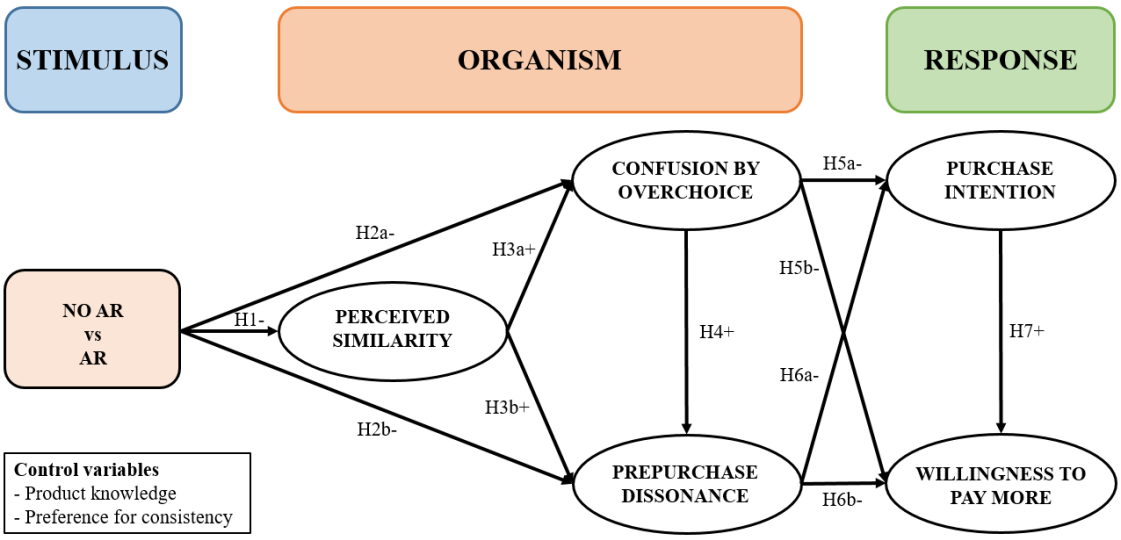
The research model proposed is shown in Figure 4.1.

4.3 Methodology

Data was collected through online surveys and analysed through Structural Equation Modeling (SEM) based on variances using Partial Least Squares (PLS) software. This method is used in the remaining empirical chapters of this thesis (chapters 5 and 6). PLS software is particularly appropriate for exploratory research and predicts relationships between variables for

theory development (Hair et al., 2019). In this regard, as noted in chapter 3, the number of AR research articles starts to emerge in 2021. Therefore, due to the novelty of the topic and the need to develop theory on it, the use of PLS software is appropriate. Furthermore, a concrete reason for using this software in this chapter is that traditional PLS is appropriate when categorical variables have five or more categories (Jakobowicz & Derquenne, 2007).

Figure 4.1. Research model



4.3.1 Data collection and sample

An online between-subjects experimental design was used in the research. Prior to the study, participants were screened for the necessary equipment, including access to a desktop or laptop computer and a webcam. The participants were then briefed on the shopping situation and asked to imagine that they were in search of nude lipstick for a special event such as an anniversary or family celebration. Due to the much higher prevalence of this product in the female gender, the study only targeted women. They were then directed to the e-commerce site (https://www.lorealparisusa.com/) where they could view the available nude shade options (14 shades, see Picture 4.1). This website was chosen because the conclusion of the pre-test study was that the colour options might create confusion among the participants. In addition, as the study was targeted at people living in the United States, a familiar and easily accessible website was used.

Picture 4.1. Nude shades

Source: L'Oreal Paris USA (n.d.)

The participants were recruited through a market research agency and were economically rewarded. They were randomly assigned to one of the scenarios (no AR or AR). In the no AR group, the participants accessed the web and viewed the shades of make-up shown in Picture 4.1. They could view the photos and information displayed on the page, but they could not use the VTO function. The market research agency controlled this by ensuring that these participants did not have a webcam on their computers. In the AR scenario, the participants accessed the same website but had to use the VTO function (these participants had previously confirmed they had webcams installed on their computers). In this scenario, the participants were asked about the steps (clicking on the VTO function, giving permission to the camera in their web browser, choosing live try-on) they took to operate the VTO function; this ensured they had actually used it. Questions were also posed to check that the participants were paying attention. For example, "if you are reading this, check option four". Participants who answered these questions wrongly were excluded.

In the no AR group, after incomplete surveys and participants excluded who failed even one attention control question, 128 participants remained. Conducting the same procedure with the AR group, 128 participants remained as well. Thus, 256 predominantly young North American women participated in the study (M_{age} = 33.06; SD = 8.99). Therefore, the sample size is appropriate for the experimental design (Soper, 2023). Furthermore, this sample is representative of the US online shopping population who buy beauty products, given that 21.88% of the participants were

between 18-25 years of age, 39.84% between 26-35, 25.78% between 36-45, and 12.50% were over 45 (Statista, 2021).

4.3.2 Measures

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

To ensure content validity, previously validated scales were used to measure perceived similarity (four items adapted from Kwon et al., 2016), confusion by overchoice (four items adapted from Tarnanidis et al., 2015), prepurchase cognitive dissonance (five items adapted from Koller & Salzberger, 2007), purchase intention (three items adapted from McClure, 2020), product knowledge (three items adapted from Smith & Park, 1992) and preference for consistency (five items adapted from Gopinath & Nyer, 2009). These variables were measured using 7-point Likert scales, in which the degree of agreement was measured by statements from 1 = "Strongly disagree" to 7 = "Strongly agree". Finally, willingness to pay more was measured by asking the participants how much they would be willing to overpay for the product as a percentage (from 0 to 10%), an approach similar to that of Boccaletti & Nardella (2000). The items that did not meet the factorial loading criteria were successively eliminated (see table 4.2; Anderson & Gerbing, 1988).

Table 4.2. Scale items

Perceived similarity (Adapted from Kwon et al. 2016)
SIM1. The available alternatives were very similar to each other
SIM2. Due to the great similarity of alternatives, it was often difficult to identify different lipstick shades
SIM3. Some lipstick shades looked so similar that it was not possible to know if they were the same or not
SIM4. I could not clearly identify the lipstick shade I wanted among the available alternatives
Confusion by overchoice (Adapted from Tarnanides et al. 2015)
OVER1. There were so many products to choose from that I felt confused
OVER2. It was hard to choose which products to buy because of the wide offer
OVER3. All the information I obtained on different products confused me
OVER4. The more I look at the products, the harder it seems to choose the best

Table 4.2. Scale items (to be continued)

Prepurchase dissonance (Adapted from Koller & Salzberger, 2007)
DIS1. I am not quite sure about my decision
DIS2. When thinking of the decision, I feel uncomfortable
DIS3. I do not know whether the decision is right
DIS4. Before the choice, I felt uneasy
DIS5. I do not know whether this is the right choice
Purchase intention (Adapted from McClure & Seock, 2020)
PUR1. I am very likely to purchase the lipstick
PUR2. I intend to purchase the lipstick
PUR3. I will purchase the lipstick
Willingness to pay more (Adapted from Boccaletti & Nardella, 2000)
The lipstick costs $8.95. How much more would you be willing to pay for the lipstick?
PAY1. 0% ($8.95)
PAY2. 1-2% ($8.96-$9.13)
PAY3. 3-5% ($9.14-$9.40)
PAY4. 5-10% ($9.41-$9.85)
PAY5. More than 10% ($9.86 and above)
Product knowledge (Adapted from Smith & Park, 1992)
KNOW1. I feel very knowledgeable about the product I just examined
KNOW2. If I had to purchase the product, I would need to gather very little information to make a wise decision
KNOW3. I feel very confident about my ability to judge these products
Preference for consistency (Adapted from Gopinath & Nyer, 2009)
CONSIS1. It is important to me that my actions are consistent with my beliefs
CONSIS2. The appearance of consistency is an important part of the image I present to the world
CONSIS3. I make an effort to appear consistent to others
CONSIS4. I typically prefer to do things the same way
CONSIS5. It bothers me if my actions are inconsistent with my past behaviours.

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

4.4 Results

4.4.1 Non-response bias and common method bias assessment

Non-response bias may result from the study's use of surveys for gathering data. Early and late responses were compared to determine the absence of non-response bias. The same procedure described in section 2.6.1 was conducted. No differences between groups were statistically significant ($p > 0.05$). Therefore, non-response bias is not an issue in this study.

To minimise common method bias, the same procedures described in section 2.6.1 were conducted. Table 4.3 shows the values obtained for each model after assessing possible CMB statistically. The analyses revealed that models 2 and 4 had a significantly better fit than models 1 and 3, respectively, which implies that trait variance is present. However, some variation is due to the method employed, as models 3 and 4 fit significantly better than models 1 and 2. The variance estimation shows that the method accounts for 33.73% of the estimation, being trait factors the main source of the variance.

Table 4.3. Nested confirmatory factor analyses tests for trait and method effects

MODEL	χ2	d.f.	*p*	Model comparison	χ2 difference	d.f.	*p*
NULL	5109.655	253	<0.001	1 vs 2	4570.975	38	<0.001
TRAIT-ONLY	538.680	215	<0.001	3 vs 4	2642.607	38	<0.001
METHOD-ONLY	2990.475	230	<0.001	1 vs 3	2119.18	23	<0.001
TRAIT-METHOD	347.868	192	<0.001	2 vs 4	190.812	23	<0.001

4.4.2 Measurement model assessment

Drawing on the proposals made by Sarstedt et al. (2022), the following sections describe the indicators used to assess the validity of our reflective measurement model, the structural model's explanatory and predictive power and the path coefficients' significance and relevance (Hair et al., 2020). This method will be common to the rest of the empirical chapters of this thesis in which PLS is used (chapters 5 and 6). The reporting of the results is performed according to the guidelines of Hair et al. (2019).

Table 4.4 summarises the reliability and convergent validity of the measurement instrument. An analysis of the factorial loads showed that all items exceeded the 0.70 criterion except the first and fourth items of preference for consistency, which were removed from the analysis (Hair et al., 2011). Furthermore, the Cronbach's alphas of the variables were higher than the minimum level criterion of 0.70 (Dijkstra & Henseler, 2015). Internal consistency reliability was evaluated through two indicators. The composite reliability of the constructs was greater than 0.88, exceeding the minimum 0.70 level (Dijkstra & Henseler, 2015). Convergent validity was evaluated through the AVE indicator. This exceeded the recommended threshold of 0.50 (Fornell & Larcker, 1981).

Table 4.4. Construct reliability and convergent validity

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

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

Finally, the model's discriminant validity was assessed by verifying that the inter-construct correlations were lower than the square roots of the AVEs of each variable (Fornell & Larcker, 1981) and by an analysis of the Heterotrait-monotrait Ratio of Correlations (HTMT), which returned values below 0.85 for all variables (Kline, 2011). As all pairs of constructs met this criterion, it can be concluded that the model has an acceptable level of discriminant validity. Table 4.5 shows the values.

4.4.1 Structural model assessment

The proposed model included a dummy variable introduced as an independent variable (0 = No AR; 1 = AR). For the structural model evaluation, collinearity was assessed, and the results

confirmed that all the Variance Inflation Factors (VIFs) were below the threshold of 3.3 proposed in the literature (Hair et al., 2019).

Table 4.5. Discriminant validity of the scales

Variables	1	2	3	4	5	6	7	8
(1) No AR/AR	**N.A**	0.267	0.332	0.245	0.140	0.054	0.001	0.001
(2) Perceived similarity	-0.250	**0.873**	0.643	0.641	0.373	0.259	0.172	0.058
(3) Confusion by overchoice	-0.321	0.603	**0.912**	0.614	0.246	0.216	0.261	0.136
(4) Prepurchase dissonance	-0.238	0.598	0.572	**0.877**	0.492	0.264	0.277	0.191
(5) Purchase intention	0.137	-0.353	-0.233	-0.467	**0.960**	0.377	0.305	0.274
(6) Willingness to pay more	0.054	-0.246	-0.209	-0.253	0.370	**N.A**	0.192	0.132
(7) Product knowledge	0.001	-0.157	-0.236	-0.253	0.296	0.175	**0.863**	0.224
(8) Preference for consistency	0.001	0.009	-0.123	-0.165	0.254	0.110	0.206	**0.850**

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

The structural model's goodness-of-fit assessment returned a Standardised Residual Mean Square Root (SRMR) of 0.064, which is lower than the maximum recommended level of 0.080 (Hair et al., 2022). As a result, the research model's goodness-of-fit is satisfactory.

The R^2 values are influenced by the model's complexity and the phenomena under research. Perceived similarity ($R^2 = 0.089$) and willingness to pay more ($R^2 = 0.156$) were shown to have weak explanatory power, whereas confusion by overchoice ($R^2 = 0.426$), prepurchase dissonance ($R^2 = 0.455$) and purchase intention ($R^2 = 0.279$) were shown to have moderate explanatory power (Hair et al., 2019).

PLS predict was used to compare the predictions generated by the PLS path model with those of a naive linear benchmark model. PLS predict is a relatively new procedure and research has only recently provided guidelines on how best to use it (Shmueli et al., 2019). This method explains the predictive power of the study. PLS predict with 10 folds and one repetition was used, in line with Shmueli et al. (2019). All the indicators yielded Q2 predict values above 0 (see Table 4.6). Next, the prediction errors were analysed in greater detail to identify the relevant statistic. The visual inspection of the prediction errors suggested that the distribution is not highly non-symmetric. Hence, the predictive power assessment was based on the root mean squared error

(RMSE), as proposed Shmueli et al. (2019). In this sense, it should be noted that the mean absolute error (MAE) analysis did not produce substantially different findings. As seen in Table 4.6, for most indicators, the RMSE of linear regression model (LM) is higher than for PLS-SEM. So, it can be concluded that the model has medium predictive power (Shmueli et al., 2019).

Table 4.6. Predictive performance of the PLS Model Versus Benchmark LM

Item	PLS-SEM		LM RMSE	PLS-SEM – LM RMSE
	RMSE	Q2 predict		
SIM1	1.573	0.052	1.566	0.007
SIM2	1.712	0.049	1.727	-0.015
SIM3	1.799	0.023	1.841	-0.042
SIM4	1.805	0.054	1.821	-0.016
OVER1	1.682	0.117	1.695	-0.013
OVER2	1.655	0.098	1.672	-0.017
OVER3	1.646	0.103	1.660	-0.014
OVER4	1.809	0.123	1.839	-0.030
DIS1	1.818	0.096	1.809	0.009
DIS2	1.453	0.067	1.461	-0.008
DIS3	1.779	0.082	1.792	-0.013
DIS4	1.533	0.054	1.532	0.001
DIS5	1.749	0.085	1.759	-0.010
PUR1	1.590	0.113	1.552	0.038
PUR2	1.587	0.123	1.546	0.041
PUR3	1.647	0.114	1.607	0.040
WILLPAY	1.355	0.023	1.373	-0.018

4.4.2 Hypotheses tests

To test the model's hypotheses, a bootstrapping method using SmartPLS with 5.000 subsamples was used (Hair et al., 2011). AR (vs no AR) results in the lower perceived similarity of alternatives (β = -0.250, $p < 0.01$; H1supported), lower confusion by overchoice (β = -0.187, $p < 0.01$; H2a supported), but there is no effect on prepurchase dissonance (β = -0.48, $p = 0.370$; H2b not supported). Perceived similarity has a positive effect on confusion by overchoice (β = 0.536, $p < 0.01$; H3a supported) and on prepurchase dissonance (β = 0.406, $p < 0.01$; H3b supported). Furthermore, confusion by overchoice positively affects prepurchase dissonance (β = 0.274, $p < 0.01$; H4 supported). Concerning consumer intentions, confusion by overchoice does not affect the purchase intention (β = 0.080, $p = 0.342$; H5a not supported) nor the willingness to pay more (β = -0.105, $p = 0.104$; H5b not supported). On the other hand, prepurchase dissonance has a negative

effect on purchase intention (β = -0.443, p < 0.01; H6a supported), but it did not affect willingness to pay more (β = -0.034, p = 0.666; H6b not supported). Finally, purchase intention positively affected willingness to pay more (β = 0.315, p < 0.01; H7 supported).

Regarding the control variables, product knowledge significantly reduces perceived similarity, confusion by overchoice and prepurchase dissonance, and increased purchase intention (all ps < 0.05). However, it does not affect willingness to pay more. Preference for consistency reduces confusion by overchoice and prepurchase dissonance, and positively affects purchase intention (all ps < 0.05). Table 4.7 shows the results of the estimated parameters, including the control variables. Figure 4.2 shows visually the results of the model.

Table 4.7. Estimated parameters and significance levels

DEPENDENT VARIABLES					
	Perceived similarity	Confusion by overchoice	Prepurchase dissonance	Purchase intention	Willingness to pay more
No AR/AR	-0.250**	-0.187**	-0.048 n.s	-	-
Perceived similarity	-	0.536**	0.406**	-	-
Confusion by overchoice	-	-	0.274**	0.080 n.s	-0.105 n.s
Prepurchase dissonance	-	-	-	-0.443**	-0.034 n.s
Purchase intention	-	-	-	-	0.315**
Product knowledge	-0.166*	-0.130**	-0.101*	0.171*	0.048 n.s
Preference for consistency	0.044 n.s	-0.101*	-0.115*	0.156**	0.001 n.s

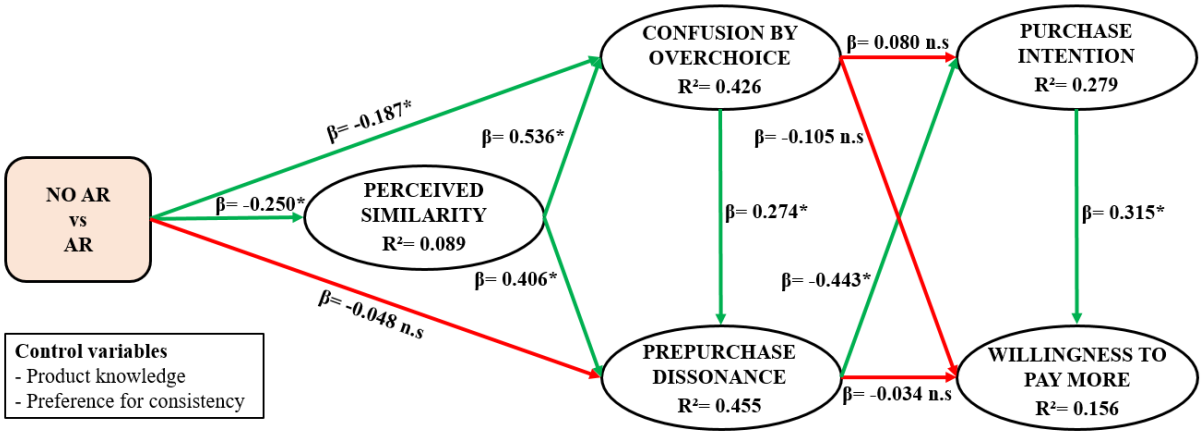
Notes: ** = p < 0.01; * = p < 0.05; n.s = not significant.

4.4.1 Robustness tests

Several robustness checks to support the stability of results were conducted in line with the guidelines proposed by Hair et al. (2019). To ensure robust results in this doctoral thesis, the inclusion of control variables in the proposed models will be supplemented by applying this procedure in the remaining empirical chapters using PLS (chapters 5 and 6). First, the absence of non-linear effects was verified. Regression equation specification error test (RESET) was applied

on the latent variable scores (Sarstedt et al., 2019). In addition, quadratic effects were included in the critical regressions (Sarstedt et al., 2020). After a bootstrapping analysis with 5000 samples, no significant non-linear effects were found. Thus, the results of the structural model are robust.

Figure 4.2 Structural model results



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

4.5 Discussion and implications

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

AR has a direct impact on some of the cognitive variables in the proposed model, particularly on perceived similarity. Thus, the use of AR is especially beneficial for products that are very similar, such as those that only differ slightly in colour, shape or detail. By reducing

perceived similarity, AR helps to alleviate confusion by overchoice, which is a common problem when consumers are faced with a wide array of product options.

However, no direct effect of AR on prepurchase dissonance has been found. Nonetheless, the use of AR significantly enhances the consumer's decision-making process and reduces cognitive dissonance by mitigating confusion by overchoice and perceived similarity. These findings are in line with previous research that has shown that the quantity and quality of information provided by online platforms improves purchase decision-making, and that AR enhances learning by reducing cognitive load (Gao et al., 2012; Thees et al., 2020). Qualitative studies have also produced similar results (Romano et al., 2021). While AR may encourage consumers to try more products, ultimately leading to increased dissonance, it can also reduce dissonance by allowing consumers to try on the product virtually and assess whether it suits them. This may be why AR does not have a direct impact on prepurchase dissonance. The key to AR's impact on consumer cognitive states is its ability to reduce perceived similarity among options.

Despite the fact that the reduction of confusion by overchoice does not have a direct impact on consumer responses, the use of AR affects these responses through prepurchase dissonance. Firstly, the reduction of cognitive dissonance during the decision-making process promotes purchase intentions. Even though reducing cognitive dissonance does not necessarily result in a greater willingness to pay more for the product, it is still essential due to the higher purchase intention generated. Secondly, AR generates a stronger desire to purchase products, leading to a greater willingness to pay a higher price. Despite extensive research on mobile AR, it is observed that Web AR in line with previous studies (Hilken et al., 2017). The use of technological tools that facilitate the consumer's decision-making process in the web environment, as in this case, offers benefits for both consumers and companies. Higher purchase intentions can assist e-commerce companies in achieving greater profits in two ways. Firstly, profits can increase based on the higher sales volumes associated with greater purchase intentions. Secondly, profits can also increase due to the higher margins that can be achieved from each sale, owing to the higher willingness to pay more that consumers develop because of their increased desire to purchase the product. These

findings align with studies that were based on data collected through AR apps in online commerce (Tan et al., 2022). Table 4.8 shows the results of the hypotheses.

Table 4.8. Results of hypotheses tests

Hypotheses	Relationship	Result
H1	No AR/AR → Perceived similarity	Supported
H2a	No AR/AR → Confusion by overchoice	Supported
H2b	No AR/AR → Prepurchase dissonance	Not supported
H3a	Perceived similarity → Confusion by overchoice	Supported
H3b	Perceived similarity → Prepurchase dissonance	Supported
H4	Confusion by overchoice → Prepurchase dissonance	Supported
H5a	Confusion by overchoice → Purchase intention	Not supported
H5b	Confusion by overchoice → Willingness to pay more	Not supported
H6a	Prepurchase dissonance → Purchase intention	Supported
H6b	Prepurchase dissonance → Willingness to pay more	Not supported
H7	Purchase intention → Willingness to pay more	Supported

4.5.1 Theoretical contributions

This chapter adds to the body of knowledge on how AR can enhance and simplify the consumer decision-making process by mitigating cognitive dissonance. Past studies have emphasized the beneficial effects of AR on positive psychological states such as flow (Barhorst et al., 2021; Javornik, 2016b) and on evaluation of experience, such as satisfaction (Poushneh, 2018; Poushneh & Vasquez-Parraga, 2017). However, this chapter contributes to understanding how AR affects states involving negative emotions, namely confusion by overchoice and prepurchase cognitive dissonance. Despite previous suggestions that AR may increase dissonance by enabling consumers to virtually try more options (Romano et al., 2021), the present study contradicts this claim. In situations where consumers face a wide range of similar options and feel uncertain, AR reduces prepurchase dissonance. This study demonstrates that AR is useful in reducing cognitive load by reducing perceived similarity and confusion by overchoice. As a result, AR affects prepurchase dissonance to a greater degree through its impact on perceived similarity, and to a lesser extent, on confusion by overchoice.

The chapter also extends the knowledge of factors that impact sales and profits in AR-based studies. Recent research has shown that increased willingness to pay more is associated with increased satisfaction and engagement (McLean & Wilson, 2019; tom-Dieck et al., 2018). This study offers a novel perspective by exploring how AR can improve decision-making in situations where consumers may experience negative emotions during their decision-making process. Previous studies have mainly focused on the positive aspects of AR, such as the comfort and confidence it provides to consumers in their decisions (Heller et al., 2019a; Hilken et al., 2017; Song et al., 2019). The present study highlights the importance of AR in situations where consumers may struggle to make a decision due to a wide range of similar product options, ultimately aiding in increasing sales and profits for retailers

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

4.5.2 Managerial implications

The results of this study highlight the relevance for retailers to offer AR web functionalities that can be accessed through computers on their e-commerce platforms. This will allow them to derive direct economic benefits by improving the customer experience. In addition to the economic benefits obtained through increased purchase intentions and increased sales margins through willingness to pay more, the customer experience improves by reducing negative aspects that may arise during the purchase process.

When there is a large selection of similar products available, incorporating AR into the web environment has been demonstrated to be particularly effective in improving the consumer's decision-making process and overall satisfaction with the customer journey (Telci et al., 2011). Therefore, it is recommended that online retailers who offer similar products include AR technology on their web platforms.

Furthermore, considering the significance of reducing perceived similarity and confusion by overchoice in alleviating cognitive dissonance, online retailers should carefully contemplate these factors. The notion of more variety not always being better applies here. Online retailers should find a balance between offering numerous products and the confusion that may arise due to overchoice, to prevent the prepurchase dissonance that can adversely impact purchasing behaviours.

4.5.3 Limitations and future research directions

This research has some limitations. First, the study was conducted only on a single e-commerce store that sells cosmetics. While the VTOs provided by such companies have similar functions, their characteristics may influence the ease or difficulty of consumer decision-making. The amount of information displayed, how it is displayed, and how VTO function operates, can have an impact. For example, VTOs have different interfaces. Sometimes, consumers can compare half of their face without the product and half with the product. In other cases, they can see only the result of the product. Therefore, future research should assess which interfaces make consumers' choices easier.

Second, future research could be carried out with other higher-cost products to explore further the effect of AR on the consumers' willingness to pay more for products. Future studies might examine what percentage benefit would be achieved by introducing AR to improve the consumer's decision-making. This would help explain to what extent the implementation of these technological tools is beneficial to the retailer. Previous research has shown that the increase in sales and economic margins derived from AR can be higher for high-cost products (Tan et al., 2022).

Third, there is a need to examine other factors that may influence the impact of AR on the purchase decision process. These factors could include risk reduction, satisfaction, confidence, and comfort, which have been identified as critical responses to the use of AR in decision-making (Chen et al., 2022a). Moreover, in addition to the cognitive aspects included in the consumer decision-making process, hedonic aspects should also be considered due to the interactivity provided by AR. Therefore, the following empirical chapter incorporates a hedonic feature to explore the impact of AR in these type of variables. Specifically, the impact of AR on decision comfort is explored.

5. The impact of augmented reality on consumer decision-making: the role of risk perception

5.1 Introduction

As demonstrated in chapter 4, AR enables better identification of differences between similar alternatives, resulting in reduced cognitive load and an improved decision-making process for consumers. Therefore, the next step is to further explore how this technology can facilitate better decision-making and increase its adoption rate. Given the positive impact of AR on the decision-making process, it is essential to understand how to effectively implement the use of this tool among consumers, which could help reduce the number of incorrect decisions and subsequently decrease product returns. Since engagement has been identified as a key factor in the adoption of new technology (Hollebeek & Belk, 2021), it plays a crucial role in understanding how AR can be more widely adopted in the context of online shopping. Thus, exploring the mechanisms by which engagement is generated through AR is essential to increase its use.

Consequently, the purpose of this chapter is to expand upon the benefits of AR in the consumer's decision-making process. Specifically, it investigates how AR affects the perceived risk associated with online purchases. In addition, it analyses the effect of the AR on decision-making through variables, such as comfort and confidence. Thus, it broadens the perspective of the previous study by including an affective variable related to decision-making. By improving decision comfort and confidence, the evaluation of the purchase process is enhanced, increasing the likelihood of engagement with AR technology.

To increase AR adoption, previous studies have focused on explaining how engagement is generated through interactivity, vividness, utilitarian and hedonic benefits, usefulness or customisation (Chen et al., 2022b; Jessen et al., 2020; McLean & Wilson, 2019; Nikhashemi et al., 2021). However, little attention has been paid to how AR may influence risk. By allowing consumers to visualise the product, AR can enhance their ability to imagine the outcome of their intended purchase, thus reducing perceived risk associated with the lack of pre-purchase testing (Choi & Boi, 2020; Heller et al., 2019b). Given that the product trail prior to purchase is one of the main aspects that increase the risk of buying online (Glover & Benbasat, 2010), including AR in an

e-commerce shop could reduce the perceived risk of buying the product online. However, if consumers virtually testing the product are unable to make a clear decision, their perception of risk in the purchase may increase.

Other research in this area has considered perceived risk with the product, analysing the indirect positive influence of AR on purchase intention through product risk and the attractiveness of the store (Bonnin, 2020). However, participants were not exposed to an AR experience, but they were shown screenshots showing the use of AR. In this sense, it is necessary to consider that human-technology interaction involves activity levels and cognitive processes that can influence the evaluation, attitudes and intentions caused by technology (Barta et al., 2021; Kuuti, 1996). Therefore, the lack of empirical studies analysing the impact of AR on risk highlights the need for further research in this direction. In addition, the above-mentioned debate on whether AR can increase or reduce the perceived risk of shopping online needs to be addressed. Additionally, the previous studies have not examined the impact of AR on decision-making evaluation, including decision comfort and decision confidence, which are crucial factors for customer satisfaction and engagement with the online shop (Hilken et al., 2018). Thus, this study seeks to investigate the effects of AR on risk reduction, decision-making, and customer satisfaction, filling a significant gap in the current literature.

The present study contributes to the current understanding of how AR affects online purchase risk and the decision-making process, expanding on the existing knowledge of the consequences it generates (Alimany et al., 2017). By examining how AR impacts risk and the mechanisms through which it affects decision-making, this research responds to the call for further exploration into how AR can generate conviction in consumer decisions (Rauschnabel et al., 2022). Furthermore, this research highlights the relative importance of decision-related factors, such as comfort and confidence, in the creation of engagement, providing valuable business insights. Understanding these key factors can guide improvements in the design of online environments that use AR and, in turn, enhance the consumer experience, satisfaction and engagement.

5.2 Research Framework and hypotheses development

5.2.1 Research framework

Previous research has been based on different theoretical frameworks to study the impact of AR on engagement. For example, research based on co-creation has shown how providing authentic experiences increases customer engagement (Alimany & Nadeem, 2021). Also, in line with equity theory, consumer participation has a negative effect on engagement (Christ-Brendemühl & Schaarshmidt, 2021). Equity theory builds on the foundations of cognitive dissonance theory (Festinger, 2022) and is applied to exchange relationships (Adams, 1965). The theory proposes that individuals consider their ratio of inputs to outcomes against the perceived ratio of inputs to outcomes of a comparable reference person, group or institution (Franke et al., 2013). Research in AR that has built on this theoretical foundation has postulated that using AR reduces engagement intention (Christ-Brendemühl & Schaarshmidt, 2021). However, this previous research compared a high consumer participation process (VTO) with a low participation process (in-store service). As this study compares online shopping experiences (no AR vs AR), consumer participation in the two scenarios is similar. Therefore, it is expected that the improved experience for decision evaluation caused by AR and the reduction of risk improve customers' outcomes of the shopping experience, leading to engagement with online commerce.

Furthermore, the model proposed in this research aligns with the theory of technology adoption, which helps to explain the potential outcomes of adopting AR. According to this theory, user evaluation of technology plays a key role in mediating the relationship between technology attributes and resulting behaviours (Davis et al., 1989). Previous studies based on technology acceptance theories have demonstrated that perceived ease of use and usefulness can have a positive impact on brand engagement (McLean & Wilson, 2019). Other attributes such as interactivity and vividness have also been identified as important factors in generating engagement (Nikhashemi et al., 2021). Table 5.1 shows a summary of the AR literature related to this research.

Table 5.1. Summary of AR literature related to the study

Source	Research framework	Independent variables	Mediators / moderators	Dependent variables	Main findings
Alimany et al. 2017	Perceived risk	No AR/AR	No mediators	Perceived risk dimensiones	It is postulated that shopping with AR decreases the perceived risk in the different dimensions.
McLean & Wilson, 2019	Customer brand engagement, TAM	Interactivity, vividness, novelty	Ease of use, usefulness, enjoyment, subjective norm, brand engagement, purpose	Satisfaction, brand usage	AR attributes and technology acceptance attributes increase brand engagement.
Bonnin, 2020	Attractiveness store, perceived risk	No AR/AR	Utilitarian and hedonic evaluation, product risk, attractiveness of the online store	Patronage intention	AR indirectly affects patronage intention through product risk and the attractiveness of the online store. This effect is reinforced when people become more familiar with AR.
Christ-Brendemühl & Schaarschmidt, 2021	Equity theory	Customer participation	Fairness perceptions	Engagement intentions, negative WOM intentions	Customer participation positively affects negative WOM and has a negative effect on engagement intentions.
Heller et al. 2021	Technology-enabled engagement process	Visual appeal, information fit-to-task	Spatial presence, cognitive engagement, emotional engagement, value-in-use	Service reuse likelihood, WOM	Framework of the technology-enabled engagement process integrates multiple stages of customer engagement, as a service-centric process.
Nikhasemi et al. 2021	SOR model, U&G, Technology continuance theory	Interactivity, quality, vividness, novelty	Utilitarian and hedonic benefit, engagement, inspiration, inspirational intention, customisation	Intention to use AR, willingness to pay a price premium	The impact of utilitarian and hedonic benefits on AR app engagement is non-linear. Customisation moderates the relationships between stimulus and organism variables.
This research	Technology adoption theory	No AR/AR	Risk of buying online, decision comfort, decision confidence, satisfaction	Engagement	AR decreases the risk of buying online, but it does not directly affect decision comfort and confidence. Instead, decision comfort increases satisfaction directly and through decision confidence.

Source: Own elaboration

5.2.2 Hypotheses Development

Perceived risk is defined as consumers' perceptions of the uncertainty and adverse consequences of purchasing a product or service (Dowling & Staelin, 1994). In other words, perceived risk is the expectation of a loss and its consequences. This aspect is an important avenue of research that can help explain technology adoption and consumer perceptions and behaviour. Understanding factors that can decrease perceived risk is crucial for online commerce (Saheb et al., 2022).

To decrease perceived risk, online retailers can use extrinsic signals, such as warranties (not directly related to web design) or intrinsic signals, such as physical surroundings (Tan & Sutherland, 2004). Among the intrinsic signals, AR is an interesting option (Bonnin, 2020). One of the main causes of perceived product risk in online shopping is that consumers cannot test the product before purchasing. The intangibility of products presented online leads to difficulties in assessing product characteristics. This fact leads to the existence of perceived risk of buying online (Verhagen et al., 2016). In the case of the cosmetics sector, AR, through virtual testing, can help reduce this risk, allowing them to see how the product looks on their face in a pretty real way.

H1: AR (vs no AR) reduces the perceived risk of buying online.

Consumers experience emotional changes when making purchase decisions. Decision comfort is the degree of psychological (and physiological) ease, satisfaction and well-being one feels about a specific decision. In other words, decision comfort reflects a person's feeling of being “good or agreeable" while making a specific decision (Parker & Lehmann, 2016). Decision comfort is an emotional response to the decisions and choices made. Interactive technologies (e.g. AR) can contribute to consumer comfort as a vital function in the service interaction. AR technology can create a space where consumers can experience virtual products in the real world and provide consumers with a sense of "being there" that promotes positive consumer perceptions and further influences their emotional reactions when making decisions (Wang et al., 2022).

Decision confidence is the clarity with which the consumers understand their preferences and the extent to which those preferences are believed to be correct (Philips et al., 2014). Consumers

use AR not only because they expect the technology provides them with an enhanced experience when shopping online, but also because they expect to reduce uncertainty when making purchases (Dacko, 2017). Decision aids such as AR can induce greater confidence in the consumers' decisions. Through the aid of AR, the consumers can observe how the product alternatives presented fit their preferences, leading to a higher degree of perceived confidence resulting from the decision made. When the consumer can appreciate the different alternatives presented, confidence in the consumer's decision can increase (Gershoff et al., 2003).

H2: AR (vs no AR) has a positive effect on (a) decision comfort and (b) decision confidence.

When faced with a purchase decision, consumers' uncertainty affects their emotions and feelings. If the consumer perceives risk when buying a product, this generates negative emotions that can affect the consumer's well-being when making the decision (Barta et al., 2022b). The feeling of discomfort that perceived risk can generate reduces the comfort with the decision made (Stone & Grønhaug, 1993). Similarly, the consumer's confidence in the decision is also affected by the risk the consumer perceives to exist. Confidence integrates elements of competence that imply that the consumer feels able to make the right decision without making a mistake (Flavián et al., 2006). Therefore, if the consumer perceives a high risk in the decision to be taken, it will reduce the existence of confidence in the decision taken.

H3: The perceived risk of buying online has a negative effect on (a) decision comfort and (b) decision confidence.

The risk associated with online shopping pertains to the perception of potential losses that may arise from purchasing decisions (Dowling & Staelin, 1994). Satisfaction, on the other hand, is the psychological or emotional state that results from the cognitive evaluation of the level of conformity between expected outcomes and actual results (Oliver, 1980). Online shopping risk is a crucial aspect that consumers highly value and commonly consider when assessing their shopping experiences. When consumers perceive online purchases as risky, they are more likely to experience negative emotions such as anxiety and uncertainty, which can lead to lower satisfaction with the product or service they ultimately choose (Omar et al., 2021). Thus, if consumers perceive risk

during their shopping experience, this is an aspect that they will rate negatively when evaluating their online shopping experience.

H4: The perceived risk of buying online has a negative effect on satisfaction.

Confidence in the decision arises when the consumers have considered the certainty with which the chosen option matches their preferences. Affective aspects such as decision comfort can affect decision confidence (Kowalczuk et al., 2021). Decision confidence can result from internal processes, inferences and intuition. According to feelings as information theory, emotional reactions can be cognitively assessed, and the resultant beliefs are influenced as a result (Schwarz, 2012). Therefore, if a consumer develops positive emotions due to decision comfort, this may influence their cognitive evaluations. In other words, positive emotional states such as decision comfort can be positively valued during cognitive processes. In line with this, it is proposed that decision comfort increases decision confidence.

H5: Decision comfort has a positive effect on decision confidence.

Customer value evaluation is derived from the shopping experience (Chepurna & Criado, 2021). Satisfaction with the online shopping experience includes everything from searching for information to receiving the product and the service offered afterwards (Vakulenko et al., 2019). Decision comfort implies a state of well-being and peace of mind for the consumer. This well-being will help the consumers be satisfied with the shopping experience they have enjoyed. Confidence in the decision implies that the consumers feel sure about the decision they have finally made during the search phase and evaluate alternatives throughout the customer journey. Therefore, this confidence that the consumer feels will cause them to be satisfied with the shopping experience they have had by evaluating it positively.

H6: Decision comfort (a) and decision confidence (b) has a positive effect on satisfaction.

When interacting with a digital system, engagement is a quality of user experience characterised by the depth of an actor's cognitive, temporal, affective, and behavioural investment (O'Brien et al., 2018). Thus, determining which aspects of users' interactions with digital applications indicate user engagement is key. Previous research has shown how AR's inspiration

may lead to engagement behaviours (Hinsch et al., 2020). This inspiration is linked to exploratory behaviour, which increases web usage (Rauschnabel et al., 2022). Concerning the web experience, satisfaction involves the overall evaluation of the shopping experience on a website (Casaló et al., 2017). This evaluation includes both cognitive and affective aspects. Therefore, if consumers are satisfied with the online experience, they will likely develop engagement behaviours towards the online shop.

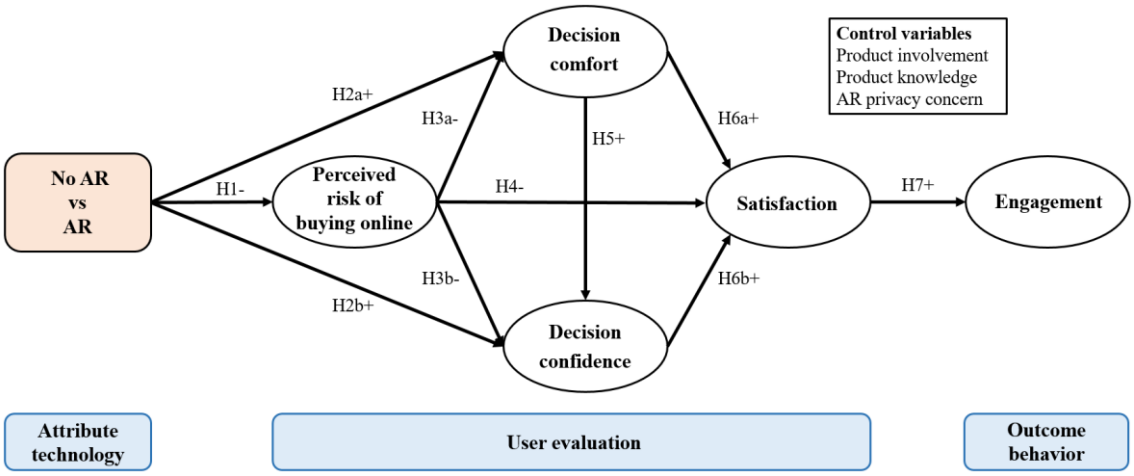
H7: Satisfaction has a positive effect on engagement.

In the research model, the presence or not of AR is a technology attribute of the system that affects user evaluation of the shopping experience. This study considers perceived risk, decision comfort, decision confidence and satisfaction mediate the relationship between technology attributes and outcome behaviour. The effect of AR on user evaluations leads to behaviours closely related to technology adoption, such as engagement with the online shop.

For the shake of completeness, some control variables related to the product (product involvement and product knowledge) and the consumer (AR privacy concern) were asked. Product involvement reflects a person's perceived relevance of a consumption object based on needs, values, and interests (Zaichkowsky, 1985). Moreover, product knowledge is the information the consumer holds to clearly know a product (Mourali et al., 2005). These variables were included due to their possible relationship with variables linked to the decision evaluation based on the results of previous studies (Behe et al., 2015; Mittal & Lee, 1989). Finally, the consumer's AR privacy concern refers to the worry that others may use personal data in unpredictable ways when using AR. This aspect was also included as a control variable due to the effect that this aspect could have on the evaluation of experience (satisfaction) and engagement (Harborth & Pape, 2021).

Consequently, the research model proposed is shown in Figure 5.1.

Figure 5.1. Research model

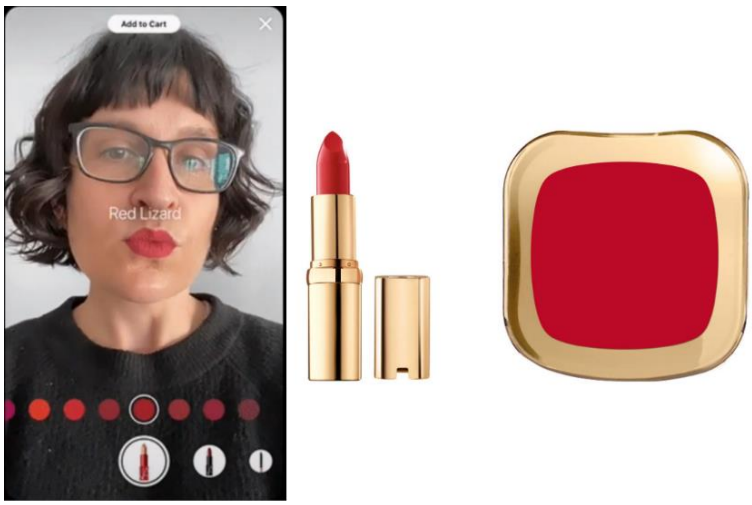


5.3 Methodology

5.3.1 Data collection and sample

To collect data, the participants of the study carried out in chapter 4 of this doctoral thesis were contacted again. Similar to the previous study, they were randomly assigned to one scenario (No AR vs AR). Participants were economically rewarded for their participation. The procedure for data collection was similar to the one described in section. Picture 5.1 shows examples of the conditions. The sample characteristics are described in section 4.3.1.

Picture 5.1. Examples of experimental conditions



Source: L'Oreal Paris USA (n.d.)

5.3.2 Measures and data validity

Online questionnaires were created for data collection. Similar to previous chapter, two academics specialising in immersive technologies reviewed the survey. A pre-test with 11 volunteers was conducted to check for any potential misunderstandings. This reinforced translational and content validity (Drost, 2011).

Previously validated scales were used to measure perceived risk (three items adapted from Stone & Grønhaug, 1993), decision comfort (four items adapted from Parker et al., 2016), decision confidence (three items adapted from Tan et al., 2012), satisfaction (four items adapted from Flavián et al., 2006), engagement (four items adapted from O'Brien et al., 2018), product involvement (three items adapted from Zaichkowsky, 1985), product knowledge (three items adapted from Smith & Park, 1992) and AR privacy concern (four items adapted from Rauschnabel et al., 2018). All scale items were measured on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The scale items and the sources are presented in Table 5.2.

Table 5.2. Scale items

Perceived risk of buying online (Adapted from Stone & Grønhaug, 1993)
RISK1. Buying this product on this website makes me concerned that I will experience some kind of loss if I buy it
RISK2. If I buy the product on this website, I will think I made a mistake when I use it.
RISK3. Buying this product on this website could cause me problems not knowing how it will fit me
Decision comfort (Adapted from Parker et al., 2016)
COMF1. I am comfortable with choosing this product
COMF2. I feel good about choosing this product
COMF3. Although I do not know if this product is the best, I feel comfortable with the choice
COMF4. I am experiencing negative emotions about choosing this product (r)
Decision confidence (Adapted from Tan et al., 2012)
CONFID1. I am confident that the decision made is indeed the best for me
CONFID2. I am certain that I have made the best choice for me
CONFID3. I am positively sure that the decision made is really the best choice for me
Satisfaction (Adapted from Flavián et al., 2006)
SAT1. Using this website to purchase the product is a correct decision
SAT2. The experience that I have had with this website has been satisfactory
SAT3. In general terms, I am satisfied with the information that this website shows me
SAT4. In general, I am satisfied with the information I have received from the website

Table 5.2. Scale items (to be continued)

Engagement (Adapted from O'Brien et al., 2018)
ENG1. I was absorbed in the shopping experience
ENG2. The shopping experience was rewarding
ENG3. The time I spent using the app just slipped away
ENG4. I felt interested in this shopping experience
Product involvement (Adapted from Zaichkowsky, 1985)
INV1. I am interested in this product
INV2. This product is important for me
INV3. This product is relevant to me
Product knowledge (Adapted from Smith & Park, 1992)
KNOW1. I feel very knowledgeable about the product I just examined
KNOW2. If I had to purchase the product, I would need to gather very little information in order to make
KNOW3. I feel very confident about my ability to judge these products
AR privacy concern (Adapted from Rauschnabel et al., 2018)
PRIV1. I am concerned about my privacy when using AR
PRIV2. I have doubts about how well my privacy is protected while using AR
PRIV3. My personal information would be misused when the camera is running
PRIV4. AR would collect too much information about the user

Note: item in italics was removed during the validation process; (r): reverse item.

5.4 Results

5.4.1 Non-response bias and common method bias assessment

The data collection method through surveys used in the study may cause non-response bias. To check the absence of non-response bias, the responses of early and late respondents were compared. The same procedure described in section 2.6.1 was conducted. No significant differences were found between groups ($p > 0.05$). Therefore, non-response bias is not an issue in this study.

To minimise common method bias, the same procedures described in section 2.6.1 were conducted. The statistical analyses show trait variance is present. The variance estimations reveal that the method accounts for 3.82% of the variance. Therefore, method bias is not an issue in this study. Table 5.3 shows the values obtained for each model.

Table 5.3. Nested confirmatory factor analyses tests for trait and method effects

MODEL	$\chi 2$	d.f.	*p*	Model comparison	$\chi 2$ difference	d.f.	*p*
NULL	7228.866	351	<0.001	1 vs 2	6530.758	55	<0.001
TRAIT-ONLY	698.108	296	<0.001	3 vs 4	4665.171	55	<0.001
METHOD-ONLY	5195.099	324	<0.001	1 vs 3	1166.901	27	<0.001
TRAIT-METHOD	529.928	269	<0.001	2 vs 4	168.18	27	<0.001

5.4.2 Measurement model assessment

To check the reliability and validity of the measurement model, the same described in section 4.4.2 was conducted. The Cronbach's alphas for all the variables were higher than the minimum level criterion of 0.70 (Nunnally, 1978). An analysis of the factorial loads showed that each item exceeded the 0.70 criterion (Hair et al., 2011). Also, the composite reliability of the constructs was greater than 0.86 (Nunnally, 1978). AVE exceeded the recommended threshold of 0.50 (Fornell & Larcker, 1981). Table 5.4 shows these values.

Table 5.4. Construct reliability and convergent validity

CONSTRUCT	ITEM	INDICATOR LOADINGS	CRONBACH'S ALPHA	COMPOSITE RELIABILITY	AVE
Risk of buying online	RISK1	0.903	0.918	0.948	0.858
	RISK2	0.934			
	RISK3	0.941			
Decision comfort	COMF1	0.951	0.923	0.952	0.868
	COMF2	0.943			
	COMF3	0.898			
	COMF4	*0.621*			
Decision confidence	CONFID1	0.960	0.961	0.975	0.928
	CONFID2	0.962			
	CONFID3	0.967			
Satisfaction	SAT1	0.881	0.950	0.964	0.869
	SAT2	0.949			
	SAT3	0.944			
	SAT4	0.953			
Engagement	ENG1	0.909	0.932	0.952	0.832
	ENG2	0.888			
	ENG3	0.921			
	ENG4	0.929			
Product involvement	INV1	0.813	0.762	0.863	0.678
	INV2	0.843			
	INV3	0.814			
Product knowledge	KNOW1	0.851	0.830	0.897	0.747
	KNOW2	0.791			
	KNOW3	0.943			
AR privacy concern	PRIV1	0.965	0.968	0.976	0.913
	PRIV2	0.954			
	PRIV3	0.953			
	PRIV4	0.950			

Finally, the model's discriminant validity was assessed with the same procedures described in section 4.4.2. After these checks, it can be concluded that the variables in the model have adequate discriminant validity. Table 5.5 shows the values.

Table 5.5. Discriminant validity

Variables	1	2	3	4	5	6	7	8	9
(1) No AR/AR	**N.A**	0.508	0.321	0.307	0.167	0.256	0.001	0.001	0.001
(2) Perceived risk of buying online	-0.487	**0.927**	0.421	0.368	0.088	0.051	0.255	0.307	0.102
(3) Decision comfort	0.309	-0.389	**0.931**	0.769	0.470	0.335	0.053	0.150	0.062
(4) Decision confidence	0.301	-0.348	0.725	**0.963**	0.450	0.332	0.048	0.128	0.073
(5) Satisfaction	0.163	-0.079	0.441	0.431	**0.932**	0.677	0.308	0.394	0.092
(6) Engagement	0.246	-0.047	0.312	0.317	0.640	**0.912**	0.430	0.322	0.041
(7) Product involvement	0.001	0.212	0.016	0.033	0.263	0.366	**0.823**	0.503	0.113
(8) Product knowledge	0.001	0.270	0.135	0.124	0.361	0.305	0.418	**0.863**	0.242
(9) AR privacy concern	0.001	0.100	-0.062	-0.082	-0.088	-0.038	-0.100	-0.217	**0.954**

Notes: The diagonal elements (in bold) are the square roots of the AVEs. Above the diagonal elements are the HTMT values. Values below the diagonal elements are the inter-construct correlations.

5.4.3 Structural model assessment

Collinearity was assessed, and the results confirmed that all the VIFs were below the 3.3 thresholds proposed in the literature (Hair et al., 2019). Regarding model fit, the SRMR was 0.075, less than 0.080, indicating a good level of fit based on the previous literature (Hu & Bentler, 1998).

Decision comfort is shown to have weak explanatory power ($R^2 = 0.224$), while the risk of buying online ($R^2 = 0.349$), decision confidence ($R^2 = 0.537$), satisfaction ($R^2 = 0.362$) and engagement ($R^2 = 0.453$) have moderate explanatory power (Chin, 1998).

To assess the predictive validity of the structural model PLS predict was used (same procedure that section 4.4.3). Similar to the previous chapter, the model was found to have medium predictive power (Shmueli et al., 2019). Table 5.6 shows the indicators.

5.4.1 Hypotheses test

Similar to the previous chapter, a dummy variable was created as an independent variable (0 = No AR; 1 = AR). The hypothesis testing was carried out in the same way as in section 4.4.4.

Table 5.6. Predictive performance of the PLS Model Versus Benchmark LM

Item	PLS-SEM		LM RMSE	PLS-SEM – LM RMSE
	RMSE	Q2 predict		
No AR/AR	0.509	-0.023	0.524	-0.015
RISK1	1.449	0.084	1.475	-0.026
RISK2	1.578	0.053	1.596	-0.018
RISK3	1.552	0.053	1.574	-0.022
COMF1	1.494	0.013	1.496	-0.002
COMF2	1.499	0.011	1.500	-0.001
COMF3	1.485	0.001	1.509	-0.024
CONFID1	1.486	-0.001	1.505	-0.019
CONFID2	1.560	-0.007	1.571	-0.011
CONFID3	1.575	-0.006	1.602	-0.027
SAT1	1.263	0.092	1.300	-0.037
SAT2	1.300	0.095	1.324	-0.024
SAT3	1.253	0.116	1.279	-0.026
SAT4	1.222	0.131	1.254	-0.032
ENG1	1.341	0.104	1.335	0.006
ENG2	1.445	0.100	1.422	0.023
ENG3	1.495	0.147	1.456	0.039
ENG4	1.303	0.162	1.311	-0.008

The results show that AR (vs no AR) reduces the risk of buying online (β = -0.487, $p < 0.001$; H1 supported). However, the use of AR does not significantly affect decision-related variables, such as decision comfort (β = 0.112, p = 0.107; H2a not supported) and decision confidence (β = 0.059, p = 0.286; H2b not supported). The risk of buying online negatively affects decision comfort (β = -0.406, $p < 0.001$; H3a supported), but not decision confidence (β = -0.070, p = 0.222; H3b not supported). In addition, the risk of buying online directly affects satisfaction (β = -0.218, $p < 0.01$; H4 supported). The decision comfort positively affects decision confidence (β = 0.672, $p < 0.001$; H5 supported) and satisfaction (β = 0.319, $p < 0.001$; H6a supported). Furthermore, the decision confidence also positively affects satisfaction (β = 0.249, $p < 0.01$; H6b supported). Finally, satisfaction positively affects engagement (β = 0.582, $p < 0.01$; H7 supported). Figure 5.2 shows the results of the structural model.

Regarding control variables, product involvement positively affects satisfaction and engagement. Product knowledge affects the risk of buying online, decision confidence and satisfaction. Moreover, the AR privacy concern increases the risk of buying online. These results are shown in Table 5.7.

Figure 5.2. Structural model results

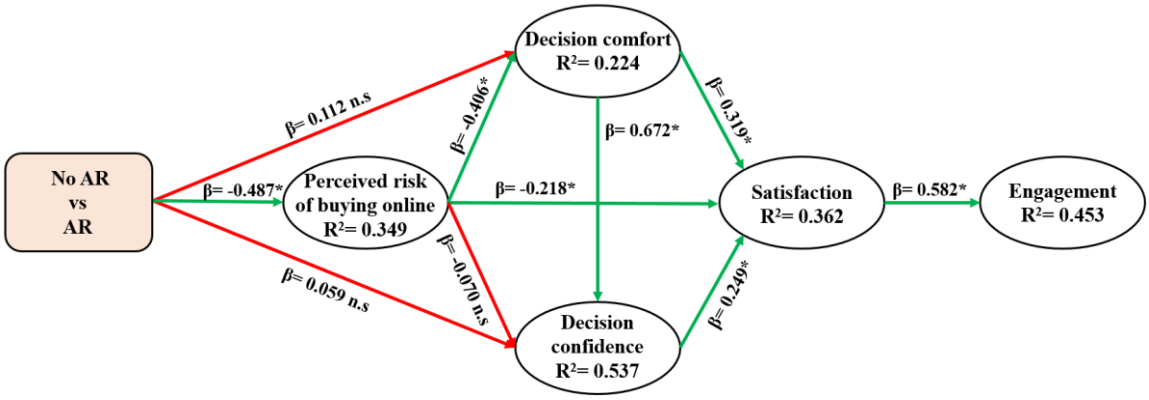


Table 5.7. Estimated parameters and significance levels

DEPENDENT VARIABLES					
	Perceived risk of buying online	Decision comfort	Decision confidence	Satisfaction	Engagement
No AR/AR	-0.487*	0.112 n.s	0.059 n.s	-	-
Perceived risk of buying online	-	-0.406*	-0.070 n.s	-0.218*	-
Decision comfort	-	-	0.672*	0.319*	-
Decision confidence	-	-	-	0.249*	-
Satisfaction	-	-	-	-	0.582*
Product involvement	0.123 n.s	0.001 n.s	0.018 n.s	0.130*	0.211*
Product knowledge	0.255*	0.252*	0.040 n.s	0.169*	0.015 n.s
AR privacy concern	0.167*	0.033 n.s	-0.023 n.s	-0.020 n.s	0.038 n.s

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

5.4.2 Robustness tests

Additional robustness tests were performed despite the inclusion of control variables in the research model to achieve robust results. The procedure conducted is described in section 4.4.5. No significant non-linear effects were found. Thus, the results are robust.

5.5 Discussion and implications

AR improves the shopping experience during the product choice through risk reduction. This risk reduction generates a higher degree of comfort and confidence, resulting in a satisfactory

experience during the search and evaluation of alternatives, which leads to engagement. The engagement generated likely increases the use and adoption of AR (Chen et al., 2022b; Christ-Brendemühl & Schaarschmidt, 2021). Furthermore, the greater product knowledge increases risk perception when buying online. Due to the type of product it may be the case that higher product knowledge implies the perception of greater risk because the colours shown either in the pictures or through the VTO do not resemble reality.

The results show AR does not directly impact variables related to the decision, such as the degree of comfort or confidence, but it does so by reducing risk. First, the consumers have to perceive that they are buying a product in a process where there is little risk to generate positive impressions or sensations during the product choice. Next, consumers evaluate the advantages and disadvantages of their online shopping experience. When consumers perceive a low level of risk in online purchases, they enjoy a satisfactory experience, as one of the negative aspects of the experience has been reduced. Being comfortable and relaxed with the decision is essential to provide satisfactory experiences. In this sense, decision comfort increases satisfaction in a direct way and also positively affects to the decision confidence, in line with previous research (Barta et al., 2023a; Kowalczuk et al., 2021). If the consumers are comfortable with the decision, it indicates confidence in the decision made (Parker & Lehmann, 2016). Table 5.8 shows the results of the hypotheses.

Table 5.8. Results of hypotheses tests

Hypotheses	Relationship	Result
H1	No AR/AR → Risk of buying online	Supported
H2a	No AR/AR → Decision comfort	Not supported
H2b	No AR/AR → Decision confidence	Not supported
H3a	Perceived risk of buying online → Decision comfort	Supported
H3b	Perceived risk of buying online → Decision confidence	Not supported
H4	Perceived risk of buying online → Satisfaction	Supported
H5	Decision comfort → Decision confidence	Supported
H6a	Decision comfort → Satisfaction	Supported
H6b	Decision confidence → Satisfaction	Supported
H7	Satisfaction → Engagement	Supported

5.5.1 Theoretical contributions

The research makes several theoretical contributions to the AR literature. Firstly, it has been discovered that virtual consumption via AR has a direct effect on consumers' perceptions, specifically the perceived risk associated with purchasing products online. However, it does not appear to have a significant effect on consumers' evaluations of their decision-making process, namely their comfort and confidence with the decision. Instead, reducing the perceived risk of online shopping for these products is shown to enhance the evaluation of the decision process, primarily by increasing consumers' comfort levels with the decision. Thus, the risk reduction is a key element to generate AR shopping experiences that generate engagement. Thus, this study sheds light on AR's effect on perceived risk and its consequences, providing an empirical response to propositions formulated in previous research (Alimany et al., 2017). In addition, it provides an answer to the question of whether it might even increase perceived risk. Although participants were faced with a purchase where they had to choose a colour from a wide range of quite similar colours, the use of AR reduce perceived risk. Therefore, the study supports the basis that the use of AR improves the online purchase decision process by focusing on the perceived risk in online shopping.

Secondly, reducing the perceived risk of buying online has been identified as a key aspect. It directly improves the evaluation of the experience by generating satisfaction. Likewise, the other key aspect identified is decision comfort. Decision comfort affects satisfaction both directly and indirectly through decision confidence. Therefore, it is found that affective variables (comfort) affect cognitive variables (confidence). These findings contribute to feelings as information theory (Schwarz, 2012), which suggests that affective states play a role in influencing cognitive variables. This result highlights the relevance of considering the study of affective variables because the affective variables may impact the cognitive processes during the decision (Kowalczuk et al., 2021).

Finally, past research on equity theory has indicated that (AR may not be as engaging as in-person (Christ-Brendemühl & Schaarschmidt, 2021). However, the current study, which focuses on an online shopping context, challenges this assumption by showing that AR can be an effective tool for generating engagement despite previous research suggesting otherwise. Consequently, this

study makes a theoretical contribution to the literature on engagement. Comparing two different situations of online shopping (no AR vs AR), this research explains how reducing perceived risk can increase consumer satisfaction directly as well as by improving the decision-making process (via decision comfort). Then, decision comfort increases satisfaction directly and indirectly through improved decision confidence. Finally, improving the evaluation of the purchase through satisfaction leads the consumer to generate engagement towards the online shop. This highlights the relevance of perceived risk in AR shopping experiences, which is in line with studies on online behaviour (Currás-Pérez et al., 2013; Masoud, 2013).

5.5.2 Managerial implications

Online retailers should consider incorporating tools to provide virtual consumption experiences for both web and mobile applications. Within the beauty industry, integrating this technology could lead to a greater number of shop visits, resulting in higher sales (Tan et al., 2022). Furthermore, consumers are likely to perceive low risk, making their decision-making process easier and improving their well-being by increasing their comfort and confidence. Therefore, including AR in online shop environments could benefit both consumers and the retailer. Consumers may derive greater value from their shopping experiences and, as a result, become more engaged with the online store, increasing their likelihood of returning for future purchases. Meanwhile, companies could achieve higher sales due to the increased number of visits. Moreover, increased engagement towards their website could result in online retailers generating additional revenue. Specifically, as the number of website visitors increases, the value of their advertising space will rise, enabling them to earn more advertising revenue by extending the reach of their advertisements.

In addition to incorporating virtual consumption experiences, there are other strategies that online retailers can implement to increase consumer comfort and confidence in their purchasing decisions. One such strategy is to provide relevant information in a clear and concise manner on the online shop, as studies have shown that this can contribute to increased comfort and confidence (Choi, 2019; Parker et al., 2016). Another effective tactic is to include product comparators,

particularly for objective product attributes, as this can make the shopping experience more enjoyable and increase decision confidence.

Finally, it is important to note that the successful integration of AR in an online shop requires careful consideration of AR-related concerns, as previous research has shown (Rauschnabel et al., 2018). This aspect has even more relevance in the context studied. The companies have to convey security and confidence in handling the facial information collected through AR in this context. For this purpose, displaying how the collected information is handled before using AR can help build trust and transparency with consumers (Barta et al., 2022a).

5.5.3 Limitations and future research directions

This chapter has several limitations. The current study has focused on a single e-commerce site, thus limiting the generalizability of the findings to other online stores with different web designs or mobile applications. Future research should explore the impact of AR on consumers' perceptions of online shopping for other products and assess the decision-making process. Specifically, products where the importance of attributes cannot be tested through AR, such as the comfort of furniture items like sofas or chairs, could be examined to evaluate the effectiveness of AR in enhancing consumer experience.

Furthermore, this study has found that AR's impact on decision comfort and confidence is not direct but rather is mediated by the reduction of perceived risks. By reducing uncertainties associated with product characteristics and features, AR technology can enhance decision comfort, leading to increased customer confidence. Future studies should explore other potential mediators between the effect of AR on decision related variables to gain a better understanding of how AR technology can be effectively used in online shopping to improve the decision-making process.

In addition, some control variables, such as product knowledge, show a surprising preliminary effect on the perceived risk of buying the product online. Although knowledge of the product may make the consumer more aware of the risks involved in buying this type of product online, future research could examine this identified effect. A more comprehensive analysis of its

underlying causes could be conducted, exploring whether this effect is for all products or whether there are specific attributes that trigger a higher risk perception only in some cases.

Finally, although the PLS predict analyses suggest that the model has medium predictive power, the Q predict values for the items of decision confidence are less than 0. While this is not a significant concern since decision confidence is not the final dependent variable of the model (Shmueli et al., 2019), it would be beneficial to replicate the study in the future to enhance the generalisability of the results.

6. The impact of augmented reality on consumer information processing and decision-making

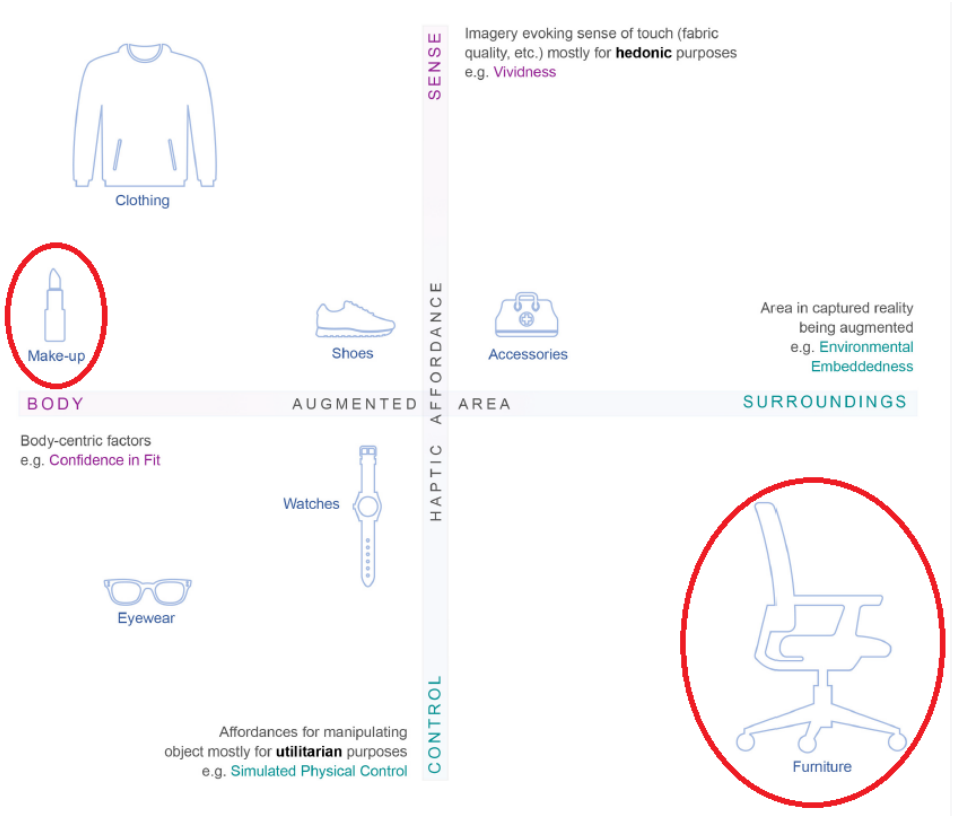
6.1 Introduction

To further explore the consequences that AR can have on purchase decision-making, this chapter aims to provide an in-depth understanding of its impact on information processing. The way information is processed influences the way consumers make decisions (Fu et al., 2020). Therefore, the impact of AR on the decision-making process is also analysed. In line with the second future research line mentioned in section 5.5.3, this study explores other potential mediators between the effect of AR on decision related variables to gain a better understanding of how AR affects the decision-making process. Similar to chapter 5, this study analyses the impact of AR on decision comfort and confidence. However, in addition to measuring decision comfort and confidence as decision-related variables, this study introduces a new variable. Due to the need to investigate actual behaviour identified in chapter 3, decision time is included in this study. In contrast to the data collection method used in the previous two empirical studies (chapters 4 and 5), which involved online experiments, a lab experiment was conducted in this chapter. This allowed for a greater internal validity (Viglia & Dolnicar, 2020), allowing for a more reliable measurement of the time participants spent making a decision.

In addition, to further generalise the results obtained in chapters 4 and 5, a new context, that is, the furniture sector, is explored. In the furniture industry, AR technologies can address the limitation that, while customers can physically examine products in-store, they cannot visualize them integrated with other elements of their homes. Thus, in this context the AR features could instil confidence and comfort in customers during the purchase decision-making process (Hilken et al., 2017). Therefore, it is expected that using AR will influence the decision-making process by providing the consumer with more data, which will modify his/her decision-related information processing. In line with previous research, it is argued that make-up products and furniture are completely different in the terms of the area augmented (Ivanov et al., 2022). In the first group of products, body-centric factors are key for the success of the AR experience. For furniture, the key for a successful AR experience is environmental embeddedness. Thus, in these two contexts, the most important elements of the AR experience are completely different (see Figure 6.1; Ivanov et

al., 2022). Furthermore, to shed light on other mediating variables that may explain the relationship between the use of AR (vs not using AR) and decision-related variables (decision comfort and decision confidence), the impact of AR on Heuristic-Systematic Model (HSM) processing is explored.

Figure 6.1. AR categories mapped on an augmentation/haptics framework



Source: Ivanov et al. (2022)

In general, the dual-process model of persuasion refers to the two popular models, the Elaboration Likelihood Model (ELM; Petty & Caccioppo, 1986) and the HSM (Chaiken, 1980). The ELM proposes that persuasion operates through two different forms of information processing, that is, central and peripheral route processing. On the other hand, the HSM proposes that information can be processed through heuristic and/or systematic processing. The two different modes of information processing, that is, central and peripheral route processing, are assumed to be conceptually mutually exclusive (Todorov et al., 2022). However, the HSM proposes that the two modes of processing, that is, systematic and heuristic, might independently, or interdependently, influence appraisals.

CLT posits that individuals construct different representations of stimuli in their environments, which vary in terms of degree of abstraction (Trope & Liberman, 2003). CLT shares an important conceptual commonality with the systematic and heuristic processing constructs in the dual-process model. When a high level of mental construal is activated, people tend to focus on the central features of the information provided (Trope & Liberman, 2010). Conversely, in low-level mental construal activation, people tend to focus on peripheral information. Interestingly, the dual-process model, similarly, postulates that systematic processing is likely to lead people to focus on central cues, while heuristic processing makes it more likely that people will focus on peripheral cues. Although CLT and the dual-process model appear to have important commonalities, surprisingly little research has examined the relationship between construal levels and mode of information processing (Stapel & Koomen, 2021). Previous research has shown the applicability of CLT to research into immersive technologies. Previous research has suggested that the visual representations provided by VR induce lower construal levels than do computers; however, no differences in mental states were observed in the process (Cahalane et al., 2022). In AR research, CLT has been used as a theoretical basis to explain the technology's adoption (Chiang et al., 2022), behavioural intentions toward using face filters (Cowan et al., 2021) and purchase intentions (Uhm et al., 2022). However, there is still a need to explain how the use of AR affects information processing from the theoretical perspective of CLT.

In recent years, academic research has examined the effectiveness of AR in terms of the consumer’s experience, observing how some features affect information processing. For example, AR improves the viewer’s mental image of the viewed object (Park & Yoo, 2020; Hilken et al., 2022a; Hilken et al., 2022b), reduces his/her cognitive load (Fan et al., 2020; Barta et al., 2023b) and facilitates flow states (Arghasi & Yuksel, 2022; Barhorst et al., 2022). In this sense, it has been observed that psychological states, such as flow, favoured by AR technologies, cause information to be processed through the central route (Barhorst et al., 2021). While these studies have provided valuable contributions, there is still a need to investigate how AR affects information processing from the perspective of a more traditional dual-process model (Qin et al., 2021b).

Consequently, this chapter aims to explain how AR may affect heuristic-systematic information processing through the theoretical lens of CLT. Following this, an exploration is made of the effect that processing type has on the decisions made by the consumer, specifically on decision comfort, time and confidence. The results of the study shed light on the effect of AR on the consumer's decision-making process and the enhancements that AR can provide (at this stage) in online shopping. Moreover, measuring decision time answers calls for AR-based research based proxy or actual behaviour variables (Pamuru et al., 2021; Tan et al., 2022). These theoretical contributions add knowledge about the impact of AR on actual consumer behaviours, beyond increases in sales (Tan et al., 2022). They also provide managerial contributions, illustrating for online retailers the impact of AR on their online shops, by its altering of consumers' information processing and enhancing the decision-making in specific aspects.

6.2 Research framework

In this chapter the theories examined in this thesis dissertation are extended, by going deeper into AR relationships by using CLT which may influence the heuristic-systematic processing of information. By reducing the psychological distance to the object which AR brings through the virtual representation in the environment, it is proposed that this will affect the construal level, which affects information processing. In the following sections, the theoretical foundation of each concept is explained. In addition, an explanation is provided of how CLT and heuristic-systematic processing are related.

6.2.1 CLT and psychological distance

CLT posits that individuals construct different representations of stimuli in their environments, which vary in terms of degree of abstraction (Trope & Liberman, 2003). Low-level construal is more concrete, descriptive and informed by contextual detail, while high-level construal is more abstract and generic (Cahalane et al., 2022). Psychological distance is conceptualized as the individual's cognitive separation from a subject (Trope & Liberman, 2010). There are four

dimensions in which an individual can be distant from a subject: spatial (how far away in the physical space), temporal (the time distance between the present and the event), social (how familiar the person or persons are) and hypothetical (how likely an event is).

A considerable body of research has demonstrated that construal levels influence judgments and choices. Studies of psychological distance as a determinant of construal level have found that differences in construal level cause differences in the ways that individuals make judgments and decisions about psychologically distant, as opposed to near, events (Fujita et al., 2008; Trope & Liberman, 2000). Previous research has postulated also that temporal distance influences construal levels (Kah et al., 2016). For example, in holiday planning. When a large temporal distance exists, individuals focus on general aspects, and think about a few possible destinations and dates. When the time distance becomes shorter, individuals focus on much more concrete aspects, such as the activities they will undertake at the destination, planning each day in detail and mapping out their itinerary.

AR allows consumers to "place" a piece of furniture in a room in their homes, thus, this study focuses on spatial distance. At greater distances, individuals tend to generically interpret information, as high-level interpretation is more useful for capturing information that will not change as distance reduces. On the other hand, with a low spatial distance, individuals focus on specific aspects, that is, concrete details that may be important in a particular situation (Cahalane et al., 2022). In other words, when consumers view a piece of furniture in a photo, they perceive a higher degree of information abstraction than they do when viewing a 3D model of the location where they plan to place the item. In the first case, consumers gather generic information available on the web, such as the dimensions of the piece of furniture and the material of which it is made, but they will find it difficult to imagine how the piece of furniture will fit into their homes, which will generate high construal levels. However, when the consumer can "visualize" a 3D representation in his/her home, (s)he can quickly judge if the product will fit and can be integrated with the surrounding elements of the room; thus, they can easily imagine how the product will look (Park & Yoo, 2020), which creates low construal levels.

Thus, AR allows products to be displayed virtually in a real consumer situation. In the context of home furniture, the projection of graphic representations of objects through 3D models makes it possible to position them in the consumer's own environment (Kang et al., 2020). This helps the consumer to imagine how the product will appear when integrated with the other environmental elements, and to perceive the product as being very close to them, in the same room. Therefore, it is expected that AR will increase spatial presence, thus reducing the psychological spatial distance between the viewer and the object and, consequently, the associated abstraction.

6.2.2 Construal level theory and heuristic-systematic processing

Construal level is conceptually distinct from dual process models because it is a cognitive construct that people can automatically access without cognitive effort and because people are sensitive to argument strength when the object is temporally more distant than close (Fujita et al., 2008). In addition, other studies have found that the temporal distance between the individual and an event is not related to the number of thoughts (s)he has about it, which highlights that these concepts are different (Ledgerwood et al., 2008). This suggests that construal level, represented by psychological distance, may be an antecedent of dual processing. The constructive level set by psychological distance could lead people to easily, but unconsciously, use their mental state (i.e., abstract or concrete thinking) in information processing.

The theoretical model proposed in this study postulates that the psychological distance at which the object (the piece of furniture) is perceived, will determine the level of interpretation carried out by the viewer, that is, the amount and type of thinking (s)he undertakes. Therefore, it is predicted that the attention paid to peripheral cues (i.e., low construal level) will accompany heuristic processing. Thus, it is proposed that psychological distance influences the way people process information, that is, the degree (high/low) of construal level. In conclusion, this framework posits that dual information processing is a key factor that mediates the effects of psychological distance on evaluations.

6.2.3 AR and information processing

Previous research has called for further explorations into how AR affects cognitive styles, using broad samples, rather than student samples (Fan et al., 2020). Despite the growing body of research into AR in the field of consumer behaviour, further investigations are needed into the associated decision-making process (Qin et al., 2021b). Other recent research has analysed how AR features influence cognitive and affective variables (Qin et al., 2021a). For example, it has been shown that reality congruence affects aspects such as choice confidence, and that interactivity affects enjoyment (Kowalkzuc et al., 2021). Much of the research has analysed the influence of AR on cognitive and affective variables, but not in the context of an established information processing model (Fan et al., 2020). In this sense, research has examined some of the traditional models of information processing. For example, by linking psychological concepts, such as flow, with the ELM, it has been shown that AR increases degree of information processing due to the immersion and motivation it generates (Barhorst et al., 2020). Other ELM-based research has shown that attitudes toward commercial advertising can improve because of the higher degree of information elaboration and the greater involvement associated with interactivity (Mauroner et al., 2016). In the present study it is proposed that no explanations have yet been offered of the impact of the various information processing forms on consumers' decision-making.

The HSM model is used in this research for several reasons. First, while the two models are conceptually very similar, they have differences. HSM is conceptually more suitable for research involving the concept of presence (Xiao et al., 2018). ELM, in comparison to HSM, is inherently more descriptive, and is conceptually too broad to guide persuasion studies. In the presence literature, the HSM perspective has often been accepted as convincing by researchers, which has led them to adopt the model (as opposed to the ELM) to explain the relationship between presence and persuasion (Skalski & Tamborini, 2007; Son et al., 2020).

Second, the assumption in HSM that the two modes of information processing can occur simultaneously has led researchers to adopt that model over ELM. HSM was originally developed by Chaiken & Eagly (1983) to make up for the conceptual limitations of the ELM. In the ELM, the

two modes of information processing are assumed to be mutually exclusive. However, the HSM recognizes the potential that the two processing modes (i.e., systematic and heuristic) may influence judgements independently or interdependently.

Third, social psychology research accepts that affective influence is more important in persuasion than cognition (Edwards, 1990; Petty & Briñol, 2015). This phenomenon can be explained by the peripheral persuasion process described in the HSM. Thus, while AR research has largely used the ELM, recent studies have recognized the importance of affective aspects, which points toward the advisability of using the HSM (Kowalski et al., 2021; Barta et al., 2023a; chapter 5 of this thesis dissertation). These results, explained from the perspective of affect as information theory, highlight the importance of affective factors in the consumer decision-making process (Schwarz, 2012). Therefore, given the reasons mentioned, it makes sense to use the HSM in AR research.

6.2.4 Hypotheses development

Spatial presence is a psychological state in which people feel that they are sharing a physical space with an object and can interact with it (Hilken et al., 2017). Research has shown that spatial presence is a potential mediating variable between AR and cognitive variables (Chen et al., 2022a). Heuristic processing involves the use of mental shortcuts, or rules of thumb, to make decisions quickly and efficiently (Chaiken & Maheswaran, 1994). This form of processing is often associated with low levels of cognitive effort and is known to be influenced by factors such as emotions and intuition. AR enhances intuition by providing individuals with real-time, interactive and immersive experiences through overlaying digital information onto the physical world (Flavián & Barta, 2022). Consequently, AR improves heuristic processing by providing individuals with quick and efficient access to information, which can lead to faster and more intuitive decision-making. Furthermore, through AR a product can be collocated in a space with the consumer, thereby increasing its spatial presence (Smink et al., 2020). A heightened sense of spatial presence will lead people to adopt a low level of interpretation and, in turn, promote heuristic processing. Therefore it is proposed:

H1: High spatial presence (vs low spatial presence) generates a higher level of heuristic processing.

Systematic processing involves the use of analytical thinking and logical reasoning to evaluate the pros and cons of different options (Chaiken & Maheswaran, 1994). It is often associated with high levels of cognitive effort. The individual's psychological distance from objects or events can affect the level of abstraction at which (s)he construes them (Trope et al., 2007). CLT proposes that individuals tend to construe abstract, distant objects and events at a higher level of abstraction, while concrete, proximal objects and events are construed at a lower level of abstraction. This variation in construal level can have implications for the type of processing engaged in by individuals (Trope & Liberman, 2010). When consumers feel a low spatial presence, they perceive objects as distant, and with a high level of abstraction. Accordingly, when they evaluate these objects, they analyse their features in depth, engaging in systematic processing. Thus:

H2: High spatial presence (vs low spatial presence) generates a lower level of systematic processing.

The consumer's affective sense of feeling at ease when making a choice, conceptualized as decision comfort, has been shown to be an important aspect in retailing experiences (Heller et al., 2019a). Decision comfort is particularly meaningful in the context of frontline AR-based technologies. Vividly generated and transformable AR content offers a processing style more closely linked to the final consumption experience than is offered by traditional media (Heller et al., 2019b). Due to the high spatial presence it creates, AR generates immersive environments for consumers, allowing them to interact with virtual products within a real-world context. This technological advancement instils a sense of presence, of "being there," thus fosters favourable consumer attitudes and, subsequently, enhances their emotional responses during decision-making processes. Furthermore, AR provides a more intuitive and visually rich representation of products, which may lead consumers to follow a more effective decision-making process and increase their comfort with the decisions they make (Javornik et al., 2021).

Consumers develop confidence in their decisions when they believe that the option chosen matches their preferences (Barta et al., 2023a). The high spatial presence provided by AR can increase decision confidence for several reasons. First, the possibility of manipulating, and interacting with, the product in ways not possible with traditional 2D representations allows consumers to view its details better, thereby increasing their confidence in their decisions (Kowalczuk et al., 2021). Second, in the furniture sector, high spatial presence makes it possible for consumers to view objects integrated with other elements in their homes (Kumar & Srivastava, 2022); this realistic visual representation generates confidence. Finally, high spatial presence, by giving them a more tangible and verifiable experience of the product, increases consumers' perceptions of the credibility of the product information provided (Breves, 2021). This tangibility may reduce consumers' scepticism and doubts, leading them to have higher confidence in their decisions. Thus, in line with previous research in the beauty sector (Barta et al., 2023a), and with chapter 6 of this thesis dissertation, the following hypotheses are proposed:

H3: High spatial presence (vs low spatial presence) increases (a) decision comfort and (b) decision confidence.

The relationship between heuristic processing and decision comfort can be explained by reduction in cognitive load (Renkl et al., 2009; Plass et al., 2010). Heuristic processing is fast and automatic, relying on mental shortcuts/rules of thumb. Research has shown that when people use heuristic processing, they expend less mental effort (Pittman & Haley, 2023). This is because heuristics simplify the decision-making process by reducing the number of factors taken into consideration. This reduction in cognitive load can lead consumers to feel a greater sense of comfort with their decisions, as they do not experience the stress and anxiety associated with prolonged decision-making. Moreover, when people rely on heuristics, they may feel that they have made decisions consistent with their beliefs and values (Vega-Zamora et al., 2014), which can increase their sense of comfort with their decisions. In addition, heuristics can simplify complex decision-making processes by breaking them down into manageable parts. This can make consumers'

decision-making processes feel more manageable and less overwhelming, which can increase their comfort with their decisions. Thus:

H4a: Heuristic processing has a positive effect on decision comfort.

The use of heuristics can have a significant impact on the amount of time it takes individuals to make decisions (Gigerenzer & Gaissmaier, 2011). Heuristics allow individuals to make decisions quickly and with minimal effort (Shah & Oppenheimer, 2008), and allow individuals to bypass the need for a detailed analysis of all available information and, instead, rely on a limited set of cues/factors to make a decision. This reduction in the amount of information that needs to be processed can significantly decrease the time it takes to make a decision. Thus:

H4b: Heuristic processing has a negative effect on decision time.

By simplifying the decision-making process, and by drawing on past experiences, heuristics can increase the sense of confidence people feel in their decisions. In heuristic processing, people draw on their past experiences and their knowledge to make decisions, which can create a sense of confidence in the decision-making process (Park & Lessig, 1981). Moreover, heuristic processing can lead to more automatic and/or intuitive decisions, which can increase decision confidence. By relying on mental shortcuts/rules of thumb, individuals may feel that they have made an intuitive decision that aligns with their instincts and/or personal preferences. In addition, heuristic processing can increase decision confidence by reducing the need for complex analysis or information gathering. Individuals may feel more confident in their ability to make decisions when they do not need to invest a significant amount of time or effort in the decision-making process (Yeung & Summerfield, 2012).

H4c: Heuristic processing has a positive effect on decision confidence.

Systematic processing, also known as analytic processing, involves a thorough and deliberate analysis of all available information before making a decision. This type of processing can increase decision comfort by providing individuals with a greater sense of control in the decision-making process. Moreover, it can lead to more informed and well-reasoned decisions,

which can also increase decision comfort (Parker et al., 2016). By taking time to carefully analyse all the available information, individuals are less likely to overlook important factors, or make decisions based on incomplete or biased information. This can increase the likelihood that the decision will be successful, which will further increase comfort with the decision. In addition, systematic processing can increase decision comfort by reducing the potential for regret or uncertainty (Joseph-Williams et al., 2011). When individuals engage in thorough analyses, and consider all the available information, they are more likely to feel that they have made an informed, well-reasoned decision. This can reduce the likelihood of regret and/or second-guessing and increase one's sense of comfort with the decision.

H5a: Systematic processing has a positive effect on decision comfort.

Systematic processing can be time-consuming and requires greater mental effort. This processing is associated with a deliberate and thorough analysis of all available information before making a decision. It may increase decision quality, but it can also increase decision-making time. When individuals engage in systematic processing, they carefully consider all the available information, weigh the pros and cons of each option, and use logical reasoning to arrive at a decision (Lee & Lin, 2022). This thorough analysis can take time and effort, especially when the issue is complex, or the information available is ambiguous or incomplete. Furthermore, it can lengthen decision time by increasing the need for information gathering and analysis (Chen & Chaiken, 1999). Individuals may need to conduct extensive research, and/or consult with experts to gather all the relevant information, and may need to use complex analytical tools to process and interpret it. This can be time-consuming and may delay the decision-making process.

H5b: Systematic processing has a positive effect on decision-making time.

The thorough analysis associated with systematic processing can help individuals feel more confident in their decision-making abilities and increase their sense of control over the outcome. In addition, by taking the time to carefully analyse all available information, individuals are less likely to overlook important factors or make decisions based on incomplete or biased information, which can increase their confidence in the decision. Furthermore, systematic processing can help

individuals understand the decision-making process and the factors that influence outcomes (Meyers-Levy & Maheswaran, 2004). This can increase their sense of mastery over the decision-making process and their ability to make effective decisions, increasing their confidence.

H5c: Systematic processing has a positive effect on decision confidence.

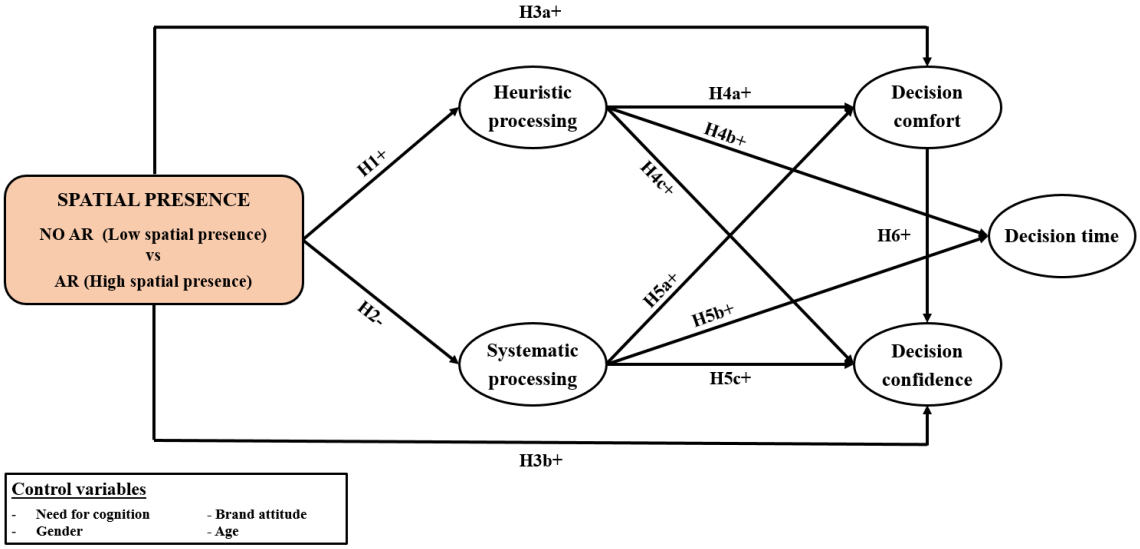
The affect as information theory proposes that emotions and affective states are strong determinants of cognitive evaluations (Schwarz, 2012). Specifically, individuals regard their affective states as an important information source, and automatically integrate them into their decision-making processes (Schwarz & Clore, 2003). Consumers evaluate experiences based on how they feel about them. The theory has been successfully applied to users' experiences with immersive technologies (Zanger et al., 2022).

Consequently, affective aspects, such as decision comfort, can affect decision confidence (Kowalczuk et al., 2021). Decision confidence can result from internal processes, inferences and intuition. Therefore, if consumers develop positive emotions due to decision comfort, this may influence their cognitive evaluations. In other words, positive emotional states, such as decision comfort, may be positively evaluated during cognitive processes. In line with previous research into AR-based technologies (Kowalczuk et al., 2021; Barta et al., 2023a), it is proposed:

H6. Decision comfort has a positive effect on decision confidence.

Similar to previous empirical chapters, for the shake of comprehensiveness some control variables were included. Need for cognition was included because of its importance in information processing (Todorov et al., 2002; Ruiter et al., 2004; Kim, 2019). The participants' attitudes toward the Ikea brand were also controlled because they could influence their heuristic-systematic processing, comfort and confidence with their decisions (Batra & Stayman, 1990; Bohner et al., 2003; Harris & Gupta, 2008). Finally, socio-demographic information was also controlled (e.g. gender and age). The research model is shown in Figure 6.2.

Figure 6.2. Research model



6.3 Methodology

6.3.1 Data collection and sample

A between-subjects lab experimental design with two different scenarios (no AR and AR) was conducted over four days at a European university. The participants were rewarded with a course credit. The sample size was 235 (134 no AR group; 101 AR group). For the proposed model, a medium effect size, with a power level of 0.80 and a significance level of 0.05, the sample size required is 177 (Soper, 2023). Thus, the sample size is appropriate.

The sample was predominantly young and female (M_{age} = 23.57; SD_{age} = 1.83; Female = 62.98%). Due to the location of the experiment, there was a high percentage of participants from northern/central Europe (74.04% of the participants were from Germany, The Netherlands and Belgium). Using students to analyse users' experiences with immersive/innovative technologies is an established procedure (Kowalczuk et al., 2021). Students are considered as the leading group of AR technology users (Rauschnabel, 2018). In addition, using a valid and homogeneous group, in terms of age and education levels, increases the internal validity of lab experiments (Flavián et al., 2016).

6.3.2 Research protocol and measures

An internal protocol was developed to standardize the participants' experiences in the different experimental conditions. First, when the participants entered the lab, they were randomly assigned either to the no AR group or the AR group. They were then each assigned a seat with an iPad. The iPad presented the participants with a questionnaire (designed with Qualtrics) which featured instructions in the first section. They were told that in a shopping-based scenario they had to imagine they were interested in buying a sofa-bed for their home. They were provided with a wish list of sofa-beds, one of which they had to choose. The no-AR group were told to search for sofa-beds on the Ikea website, while the AR group were told to carry out the same search, but using the Ikea-Place app, which gave them access to the AR function. Both groups then made their choices. Thereafter, the participants completed the questionnaire. Next, the participants were asked to evaluate (most of) the variables under study on a 7-point Likert scale (from 1 strongly disagree, to 7 strongly agree). As a manipulation check, spatial presence was measured using 4 items adopted from Hilken et al. (2017). For example: "I felt like the sofa-bed was actually there in the real world". For the variables in the research, previously validated scales were used to measure heuristic and systematic processing (both using four items adopted from Griffin et al., 2014), decision comfort (four items adopted from Heller et al., 2019), decision confidence (three items adopted from Tan et al., 2012), need for cognition (six items adopted from Lins de Holanda Coelho et al., 2020), brand attitude (four items adopted from Lee et al., 2009). To measure decision-making time, using Qualtrics a measurement was made of the time the participants spent in the section of the questionnaire where the models were evaluated/decisions were made. Table 6.1 shows the items.

6.4 Results

6.4.1 Common-method bias assessment

Lab experiments are distinguished by a high degree of internal validity because the experimental environment can be controlled (Viglia & Dolnicar, 2020). As the researcher could

ensure that the participants performed the experiment properly, and were not distracted, it is not necessary to control for early and late respondent bias in this chapter. However, because the data were collected in a survey, an examination of the possible presence of CMB was undertaken.

Table 6.1. Scale items

Heuristic processing (Adapted from Griffin et al. 2004)
HEU1. I have not spent much time reading information about the models.
HEU2. There was far more information available than I needed to make the decision.
HEU3. From all the information available, I focused on only a few key points.
HEU4. If I had to decide now, the information collected so far would be enough for me.
Systematic processing (Adapted from Griffin et al. 2004)
SYST1. After this search, I will probably stop and think about my choice.
SYST2. After this search I believe that the more information I can obtain to decide, the better.
SYST3. After this search, I have a much broader perspective of the desk I could choose from.
SYST4. I have read the information about the different models carefully.
Decision comfort (Adapted from Heller et al. 2019)
COMF1. I would feel good about choosing it.
COMF2. I would experience negative emotions about choosing it (r).
COMF3. Whether or not it is the best choice, I would be okay with choosing this product.
COMF4. Although I do not know if this product is the best, I would feel perfectly comfortable with the choice I made.
Decision confidence (Adapted from Tan et al. 2012)
CONFID1. I would feel confident that the decision made is indeed the best for me.
CONFID2. I would be certain that I have made the best choice for me.
CONFID3. I would be positively sure that the decision made is really the best choice for me.
Need for cognition (Adapted from Lins de Holanda Coelho et al. 2020)
NFC1. I prefer complex to simple problems.
NFC2. I would rather do something that requires little thought than something that is sure to challenge my thinking abilities (r).
NFC3. I really enjoy a task that involves coming up with new solutions to problems.
NFC4. I prefer a task that is intellectual, difficult and important to one that is somewhat important but does not require much thought.
NFC5. *I like to have the responsibility of handling a situation that requires a lot of thinking.*
Brand attitude (Adapted from Lee et al. 2009)
I have an opinion about the Ikea brand…
ATT1. very favourable
ATT2. very positive
ATT3. very good
ATT4. I like Ikea very much
Gender
Age

Notes: Items in italics were deleted during the validation process; (r) = reverse items.

To check CMB the procedure described in section 2.6.1 was conducted. The variance estimation showed that the method accounted for 17.93% of the estimation, trait factors being the main source of the variance. The results are shown in Table 6.2.

Table 6.2. Nested confirmatory factor analyses tests for trait and method effects

MODEL	χ2	d.f.	*p*	Model comparison	χ2 difference	d.f.	*p*
NULL	3942.100	276	<0.001	1 vs 2	3493.078	52	<0.001
TRAIT-ONLY	449.022	224	<0.001	3 vs 4	1535.541	52	<0.001
METHOD-ONLY	2359.456	252	<0.001	1 vs 3	1582.644	24	<0.001
TRAIT-METHOD	367.459	200	<0.001	2 vs 4	81.563	24	<0.001

6.4.2 Measurement model assessment

To check the reliability and validity of the measurement model, the same described in section 5.4.2 was conducted. The Cronbach's alphas for all the variables were higher than the minimum level criterion of 0.70 (Nunnally, 1978). An analysis of the factorial loads showed that each item exceeded the 0.70 criterion (Hair et al., 2011). Also, the composite reliability of the constructs was greater than 0.85 (Nunnally, 1978). AVE exceeded the recommended threshold of 0.50 (Fornell & Larcker, 1981). Table 6.3 shows these values.

Table 6.3. Construct reliability and convergent validity

CONSTRUCT	ITEM	INDICATOR LOADINGS	CRONBACH'S ALPHA	COMPOSITE RELIABILITY	AVE
Heuristic processing	HEU1	0.874	0.766	0.859	0.672
	HEU2	0.740			
	HEU3	0.839			
Systematic processing	SYST1	0.774	0.815	0.877	0.641
	SYST2	0.811			
	SYST3	0.802			
	SYST4	0.813			
Decision comfort	COMF1	0.869	0.876	0.915	0.729
	COMF2	0.820			
	COMF3	0.833			
	COMF4	0.891			
Decision confidence	CONFID1	0.960	0.966	0.978	0.936
	CONFID2	0.966			
	CONFID3	0.975			

Table 6.3. Construct reliability and convergent validity (to be continued)

CONSTRUCT	ITEM	INDICATOR LOADINGS	CRONBACH'S ALPHA	COMPOSITE RELIABILITY	AVE
Need for cognition	NFC1	0.843	0.870	0.897	0.686
	NFC2	0.907			
	NFC3	0.754			
	NFC4	0.802			
Brand attitude	ATT1	0.948	0.940	0.957	0.848
	ATT2	0.939			
	ATT3	0.823			
	ATT4	0.871			

Finally, the model's discriminant validity was assessed with the same procedures described in section 4.4.2. After these checks, it can be concluded that the variables in the model have adequate discriminant validity. Table 6.4 shows the values.

Table 6.4. Discriminant validity of the scales

Variables	1	2	3	4	5	6	7	8	9	10
(1) No AR/AR	**N.A**	0.431	0.547	0.154	0.185	0.806	0.054	0.037	0.064	0.052
(2) Heuristic processing	0.401	**0.819**	0.377	0.085	0.096	0.386	0.073	0.118	0.047	0.042
(3) Systematic processing	-0.514	-0.323	**0.800**	0.389	0.343	0.464	0.088	0.233	0.147	0.033
(4) Decision comfort	-0.145	0.067	0.328	**0.854**	0.844	0.144	0.063	0.294	0.123	0.053
(5) Decision confidence	-0.181	-0.044	0.313	0.781	**0.967**	0.155	0.070	0.207	0.064	0.036
(6) Decision time	-0.806	-0.362	0.436	0.136	0.152	**N.A**	0.076	0.057	0.049	0.034
(7) Need for cognition	0.051	-0.063	0.017	-0.063	-0.088	-0.076	**0.828**	0.076	0.056	0.055
(8) Brand attitude	-0.034	0.109	0.187	0.270	0.198	-0.053	0.042	**0.921**	0.125	0.022
(9) Gender	-0.064	-0.045	0.131	0.113	0.063	0.049	-0.031	0.118	**N.A**	0.024
(10) Age	-0.052	-0.006	-0.026	-0.049	-0.036	0.034	-0.055	-0.005	-0.024	**N.A**

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

6.4.3 Structural model assessment

A dummy variable was introduced into the proposed model as an independent variable (0 = No AR; 1 = AR). First, to ensure that the scenarios differed in the degree of spatial presence the participants perceived with the product, a manipulation check was carried out. A t-test for independent samples showed that the manipulation was properly perceived by the participants (M_{no-}

$_{AR}$= 3.73; M_{AR}= 4.40; T(233) = 3.671; p < 0.001). A subsequent evaluation of the structural model assessed collinearity, and the results confirmed that all the VIFs were below the threshold of 3.3 proposed in the literature (Hair et al., 2019). Regarding model fit, the SRMR was 0.062 which shows a good level of fit (Hu & Bentler, 1998).

Heuristic processing (R^2 = 0.185) and decision comfort (R^2 = 0.184) were shown to have weak explanatory power, whereas decision time (R^2 = 0.264) and systematic processing (R^2 = 0.303) were shown to have moderate explanatory power. Decision confidence (R^2 = 0.624) was shown to have substantial explanatory power (Hair et al., 2019).

To assess the predictive validity of the structural model PLS predict was used (same procedure that section 4.4.3). The model was found to have almost high predictive power (in only one indicator RMSE is higher with PLS than with LM; Shmueli et al., 2019). Table 6.5 shows the indicators.

Table 6.5. Predictive performance of the PLS Model Versus Benchmark LM

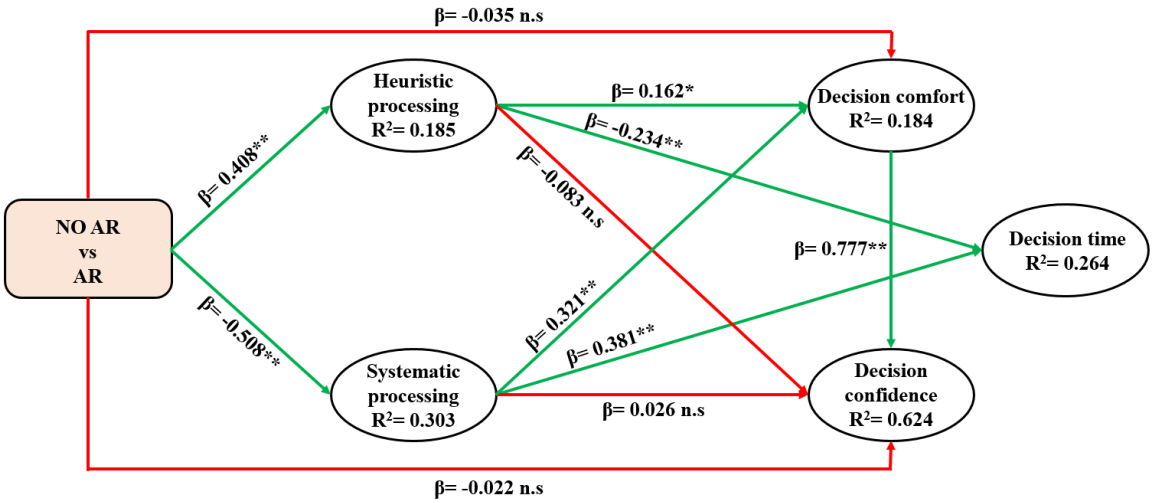
Item	PLS-SEM		LM RMSE	PLS-SEM – LM RMSE
	RMSE	Q2 predict		
HEU1	1.270	0.145	1.308	-0.038
HEU2	1.382	0.009	1.416	-0.034
HEU3	1.029	0.118	1.038	-0.009
SYST1	1.211	0.125	1.224	-0.013
SYST2	1.136	0.135	1.160	-0.024
SYST3	1.216	0.094	1.232	-0.016
SYST4	1.235	0.290	1.215	0.020
COMF1	1.312	0.029	1.351	-0.039
COMF2	1.243	0.094	1.279	-0.036
COMF3	1.382	0.031	1.416	-0.034
COMF4	1.557	0.043	1.591	-0.034
CONFID1	1.574	0.031	1.605	-0.031
CONFID2	1.598	0.027	1.652	-0.054
CONFID3	1.594	0.044	1.639	-0.045

6.4.4 Hypotheses tests

The model's hypotheses were tested using a bootstrapping method with SmartPLS, with 5.000 subsamples (Hair et al., 2011). AR (vs no AR) results in higher heuristic processing (β =

0.408, p < 0.01; H1 supported), and lower systematic processing (β = -0.508, p < 0.01; H2 supported). As to the decision variables, the use of AR (vs no AR) did not affect decision comfort (β = -0.035, p = 0.607; H3a not supported) or decision confidence (β = -0.022, p = 0.643; H3b not supported). Heuristic processing increased decision comfort (β = 0.162, p < 0.05; H4a supported), reduced decision time (β = -0.234, p < 0.01; H4b supported), but did not have a statistically significant effect on decision confidence (β = -0.083, p = 0.089; H4c not supported). On the other hand, systematic processing increased decision comfort (β = 0.321, p < 0.01; H5a supported) and decision time (β = 0.381, p < 0.01; H5b supported), but did not have a statistically significant effect on decision confidence (β = 0.026, p = 0.662; H5c not supported). Finally, decision comfort increased decision confidence (β = 0.777, p < 0.01; H6 supported). Figure 6.3 shows the structural model results of the hypotheses testing.

Figure 6.3. Structural model results



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

Regarding control variables, the need for cognition did not affect the dependent variables (all ps > 0.05). However, brand attitude positively affected both heuristic and systematic processing, and decision comfort (ps < 0.05). Finally, the sociodemographic factors (age and gender) did not have statistically significant effects on the dependent variables. Table 6.6 shows the results of the estimated parameters.

Table 6.6. Estimated parameters and significance levels

DEPENDENT VARIABLES					
	Heuristic processing	Systematic processing	Decision comfort	Decision confidence	Decision time
No AR/AR	0.408**	-0.508**	-0.035 n.s	-0.022 n.s	-
Heuristic processing	-	-	0.162*	-0.083 n.s	-0.234**
Systematic processing	-	-	0.321**	0.026 n.s	0.381**
Decision comfort	-	-	-	0.777**	-
Need for cognition	-0.090 n.s	0.036 n.s	-0.065 n.s	-0.045 n.s	-0.091 n.s
Brand attitude	0.131*	0.159*	0.188**	-0.003 n.s	-0.095 n.s
Age	0.010 n.s	-0.048 n.s	-0.043 n.s	-0.002 n.s	0.037 n.s
Gender	-0.037 n.s	0.080 n.s	0.051 n.s	-0.035 n.s	-0.002 n.s

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

6.4.5 Post-hoc analysis: indirect effects

Since this chapter proposes an information processing model that has two complementary routes, as opposed to the ELM which are exclusive, the indirect effects on decision-related variables are analysed below. In this way, it will be possible to determine the relative importance of AR in the decision-making process through the heuristic and the systematic route.

The analysis of these indirect effects reveals interesting findings. While it is observed through the specific indirect effects that AR increases decision comfort through the heuristic route, the reduced systematic processing that AR generates plays a more important role. Consequently, by looking at the total effect of AR on decision comfort, it is found that the use of AR results in a reduction of comfort.

In relation to decision time, in this case the two routes have a complementary role. Both the increased heuristic processing and the reduction of systematic processing lead to a reduction of time in which the consumer makes the decision.

Finally, the results pertaining to decision confidence align with those of decision comfort. Although AR in the heuristic route generates decision confidence through decision comfort, the effect of the systematic route plays a more important role in confidence. Thus, the total effect of

AR through the two information processing routes explored decreases the decision confidence. The results of these analyses are shown in Table 6.7.

Table 6.7. Specific and total indirect effects

Effects	Type of effect	Estimates	Bias-corrected confidence interval
No AR/AR → Heuristic processing → Decision comfort	Specific indirect	0.066*	(0.011, 0.126)
No AR/AR → Systematic processing → Decision comfort	Specific indirect	-0.163**	(-0.246, -0.084)
No AR/AR → Heuristic processing → Decision time	Specific indirect	-0.095**	(-0.164, -0.040)
No AR/AR → Systematic processing → Decision time	Specific indirect	-0.194**	(-0.284, -0.113)
No AR/AR → Heuristic processing → Decision confidence	Specific indirect	-0.034 n.s	(-0.082, 0.005)
No AR/AR → Systematic processing → Decision confidence	Specific indirect	-0.013 n.s	(-0.078, 0.047)
No AR/AR → Heuristic processing → Decision comfort → Decision confidence	Specific indirect	0.051*	(0.009, 0.101)
No AR/AR → Systematic processing → Decision comfort → Decision confidence	Specific indirect	-0.126**	(-0.196, -0.066)
No AR/AR → Decision comfort	Total indirect	-0.132*	(-0.256, -0.010)
No AR/AR → Decision time	Total indirect	-0.289**	(-0.370, -0.210)
No AR/AR → Decision confidence	Total indirect	-0.171**	(-0.297, -0.044)

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

6.4.6 Robustness tests

As in previous chapters (chapters 4 and 5), the absence of non-linear effects was verified. The procedure conducted is described in section 4.4.5. In this case, no significant non-linear effects were found. Thus, it can be concluded that the results of the model are robust.

6.5 Discussion and implications

This study shows that the higher degree of spatial presence provided by AR affects the consumer's heuristic-systematic processing. That is, AR increases heuristic processing, and decreases systematic processing. Exploring a new product, the results show AR has no direct effect

on decision comfort and decision confidence. Therefore, the absence of direct effects between the use of AR and decision-making process supports the results found in chapter 5. In the furniture sector, the use of AR does not increase decision comfort and confidence in a direct way. Furthermore, it is noteworthy the absence of direct effects between the type of processing and the decision confidence. Despite the direct influence of HSM on the decision-making process in variables such as decision comfort and time to decision, this does not occur with confidence. This aspect supports the results found in chapter 5 of this thesis dissertation, and in previous research (Kowalckzuk et al., 2021; Barta et al., 2023a).

Table 6.8 shows a summary of the results of the hypotheses developed.

Table 6.8. Summary of the results

Hypotheses	Relationship	Result
H1	AR (vs no AR) → Heuristic processing	Supported
H2	AR (vs no AR) → Systematic processing	Supported
H3a	AR (vs no AR) → Decision comfort	Not supported
H3b	AR (vs no AR) → Decision confidence	Not supported
H4a	Heuristic processing → Decision comfort	Supported
H4b	Heuristic processing → Decision time	Supported
H4c	Heuristic processing → Decision confidence	Not supported
H5a	Systematic processing → Decision comfort	Supported
H5b	Systematic processing → Decision time	Supported
H5c	Systematic processing → Decision confidence	Not supported
H6	Decision comfort → Decision confidence	Supported

As in this study two complementary routes that generate responses in the decision-making process are analysed, the analyses of the mediating effects are particularly interesting. In this chapter it is observed how the heuristic and systematic route complement each other on the time to make the decision. Thus, both the higher degree of heuristic processing and the lower degree of systematic processing generated using AR lead to a very significant reduction in the time spent to make a decision.

On the contrary, the effects of AR on decision confidence and decision comfort through the two processing routes are confronted, with the systematic route having a greater weight. This means

that the greater importance of systematic processing, compared to heuristic processing, leads to a reduction of comfort and confidence in the consumer's decision-making process when faced with the choice of a piece of furniture.

Therefore, the heuristic processing can be a helpful tool in making decisions, particularly when time and effort are limited. By providing shortcuts to complex decision-making processes, heuristics can help individuals make decisions quickly and confidently. However, it is important to recognize the limitations and potential drawbacks of relying solely on heuristic processing. While heuristic processing can be a useful tool for making decisions quickly and efficiently, it is important to recognize its limitations (and potential drawbacks) for making comfortable and confidence decisions.

6.5.1 Theoretical contributions

This research answers calls for further examinations to be made of the impact of AR on information processing (Fan et al., 2020; Qin et al., 2021b). Consequently, the study contributes to several theories and research topics. First, the research contributes to CLT by showing that AR increases heuristic information processing through the increased spatial presence the viewer experiences with a product. On the other hand, it was shown that using AR (vs no AR) reduces the systematic processing of information.

Second, this study extends the knowledge of the impact of AR in dual-process models of information. Previous research had found that the flow state and immersion that AR provides facilitates cognitive processing (Barhorst et al., 2020). In addition, attitudes toward commercial advertising can improve due to the higher degree of information elaboration and greater involvement associated with interactivity (Mauroner et al., 2016). However, few studies have focused on how AR affects heuristic-systematic processing. Thus, this chapter sheds light on this issue by explaining AR’s impact through the different levels of spatial presence viewers experience with a product. In this sense, it explains how the AR reduces the time to make the decision. However, in relation to other aspects of the decision process, the use of AR can be detrimental in

some cases. In the case of products where systematic processing is the main route to purchase decisions, the reduction that AR can generate may affect comfort and confidence with the decision.

Third, based on affect as information theory, the present study confirms that affect has a strong influence on cognitive aspects (e.g. confidence) in the decision-making processes for purchasing other product types, in this instance, a piece of furniture. By exploring this relationship using other product types, we can generalize the results obtained, and highlight the importance of affective elements in online shopping using immersive technologies, particularly AR. Moreover, in this chapter PLS predict showed that the proposed model had almost high predictive power, which allows for further generalization of this aspect to the AR research (Kowalczuk et al. 2021; Barta et al., 2023a). Through using a methodology with greater control of internal validity (lab experiment) and examining a different product, it was shown that affect has a very important role in the cognitive components of the decision-making process.

Fourth, in addition, the understanding of the consequences of using AR are extended by the analysis of the impact it has on the consumer's decision time. Using this non-self-reported/objective measure shed light on the impact of AR on actual consumer behaviours, extending current knowledge (Tan et al., 2022).

6.5.2 Managerial implications

The results of the research make important managerial contributions that can be used by online retailers. The implementation of AR has one main advantage from a consumer perspective. Through increased heuristic processing, it reduces the time consumers take to make decisions. Furthermore, the reduction of systematic processing in AR experiences strengthens this effect on the way consumers behave in their decision-making process.

Due to the faster decision-making the implementation of AR for online retailers could be interesting in some cases. Heuristic processing has been widely linked to impulse buying (Chan et al., 2017). Therefore, the implementation of AR could increase impulse purchases, especially in the context of low-involvement products, which are more associated with impulse buying

(Muruganantham & Bhakat, 2013). However, although retailers may benefit from this because of the increased number of sales, they should consider the ethical implications this may have.

In addition, retailers should also understand that the relationship between heuristic processing and decision time is not always straightforward (Rand, 2016). In some cases, using heuristics can increase decision time. This can occur when the heuristics used are not well-suited to the decision at hand, leading to increased uncertainty and the need to search out additional information and/or undertake further analysis. Moreover, when individuals are presented with a large amount of information that is inconsistent with their heuristics, they may need to switch to systematic processing, which can increase decision time (Jain & Maheswaran, 2000). Furthermore, when encouraging heuristic, rather than systematic processing, there are other aspects to consider. Systematic processing usually leads to more informed decision-making. Due to the significant amount of time and cognitive effort consumers spend in the process, they have greater knowledge of the aspects of the product on which to make a decision. In addition, systematic processing can also reduce risk in the consumer's decision-making by collecting accurate and detailed product information.

It should also be noted that using AR reduces systematic processing. Systematic processing has been shown to have positive effects on decision comfort and confidence. Therefore, the advantages and disadvantages of using one processing mode over another should be considered. To properly consider the impact of AR on decision-making, online retailers should consider the type of processing that consumers tend to employ when evaluating the products offered (Zuckerman & Chaiken, 1998). In cases where consumers tend to rely on heuristic processing, the incorporation of AR may facilitate quicker and more efficient decision-making. However, if consumers tend to employ a more systematic approach, relying heavily on detailed analysis, the time saved through the use of AR may confront with less informed decisions, ultimately undermining decision comfort and confidence. As such, a nuanced understanding of the relationship between AR and decision-making requires consideration of the product type and the processing strategies typically employed by consumers in evaluating the product.

6.5.3 Limitations and future research lines

The results of this study present limitations that need to be addressed in order to deepen the understanding of the effects found and provide greater generalization. First, the results are limited in that a convenience sample of college students was used. While this young sample has been shown to be appropriate for studying AR, because students are often attracted to new technologies early (Rauschnabel, 2018), using a student sample limits the generalizability of the findings. Although a homogeneous sample increases internal validity (Flavián et al., 2016), differences between age groups might cause external validity issues (Bracht & Glass, 1968). Thus, future research should investigate age-related differences in the decision-making process in terms of the use of systematic or heuristic processing. In addition, other methods might provide the results with greater external validity. While in this chapter care was taken to use variables that could be appropriate proxies for real behaviours, future studies might carry out field experiments and data analyses using actual AR apps to understand more accurately the impact of AR on decision-making time.

The overall effect found between AR use and decision comfort and confidence through the HSM processing deserves special attention. Based on the augmentation/haptics framework (Ivanov et al., 2022), future research could investigate the relationships found using other product types. This chapter looked at the furniture sector. Based on this framework, this is a context in which the augmented area is the object's surroundings. Therefore, observing the product integrated with the rest of the elements of the room is very important. The lab experiment provided participants with a dedicated space for using AR that resembled a home environment. Despite this, not using AR in their home may explain the lack of direct effects between AR and decision comfort and confidence, as well as the impact of each HSM route on these variables. Consequently, to further validate the effects found, it is crucial to conduct future studies with this product where participants can visualize the product in a real-use environment (von der Au et al., 2023).

In addition, future studies could examine sectors with different characteristics. For example, with clothing it is important to evoke the sensation of touch using affordances for manipulation objects mostly associated with hedonic purposes (e.g., vividness; Ivanov et al., 2022).

Moreover, AR-based clothing experiences are associated with body-centric factors. Thus, examinations could be undertaken to test for common results and differences that may exist between these sectors.

7. Conclusions, implications, limitations and future research agenda

7.1 Overview and summary of the results

The main purpose of this thesis is to understand the causes of the shopping experience that explain product returns, and then to analyse how AR can help to solve this problem. This thesis examines the role that AR can play in the shopping experience, and more specifically, in the decision-making process, after exploring how aspects of the shopping experience (e.g. flow states) can influence the product returns. For this main objective, several specific objectives were stated.

In the first empirical study (chapter 2), the aim is to analyse the impact of flow and flow consciousness on product returns when consumers are not satisfied with their purchase decision. The study highlights that consumers who recognize being in the flow state perceive it as a negative aspect of the shopping experience when they regret their purchase decision. These consumers tend to feel more regretful about the shopping process they went through, leading to outcome regret and ultimately resulting in the product return.

Some features provided by AR generate a high degree of interactivity and immersion and can generate flow experiences. Therefore, it is important to know how AR can improve the purchase decision-making process. The findings from the first empirical study reveal that flow is considered a negative element when purchase decision is unsatisfactory. Hence, it is vital to investigate how AR can aid in the decision-making process, leading to better choices and ultimately reducing the problem of returns in online shopping. Apart from the high degree of interactivity and immersion, AR has great applicability in the retail sector due to the virtual testing of products that it allows by integrating virtual elements into the real world (Flavián & Barta, 2022; Heller et al., 2021). Due to its potential to enhance the online purchasing decision-making process, the subsequent chapters investigate the impact of this technology on improving purchasing decisions.

The aim of the third chapter is to examine the state of the art of research focused on AR and consumer behaviour. This enables the identification of research gaps and needs to contribute in the knowledge of the effect of AR on decision-making in the following three chapters. To examine the current state of the literature, a SLR and a thematic analysis are conducted, resulting

in the identification of four major themes in the existing research: (1) AR app features and technology adoption, (2) media characteristics and consumer outcomes, (3) psychological factors and outcomes and (4) recommendations for AR implementation and its advantages. This thematic analysis, combined with the examination of variables studied in empirical research, results in the identification of six main areas for future research: (1) cognitive elements, (2) affective elements, (3) social elements, (4) dark side of AR, (5) factors affecting AR experiences and (6) new methodological approaches and measures. Based on the existing literature and the identified research gaps, the following three chapters (chapters 4, 5 and 6) aim to empirically investigate the impact of AR on the consumer decision-making process.

Chapter 4 analyses the effect of AR on the decision-making process from a cognitive perspective, focusing on cognitive load and dissonance theory. The findings of this study indicate that the use of AR in online shopping reduces the level of prepurchase dissonance, as it leads to a lower degree of perceived similarity of alternatives and confusion by overchoice. The reduction in dissonance positively influences purchase intentions, ultimately resulting in a higher willingness to pay for the product. Therefore, this study supports the notion that AR enhances the consumer's decision-making process by reducing cognitive load. Additionally, AR provides benefits for online retailers, as the decreased dissonance in the choice process promotes purchase intentions, which results in a greater willingness to pay for the product.

Once the benefits of using AR in online shopping for retailers are understood in terms of increased sales and margins, the next chapter aims to explore how the improvement of the consumer's decision-making process can lead to greater engagement. Understanding the factors that contribute to engagement is crucial given its importance for explain the AR adoption by consumers (Jessen et al., 2020).

Consequently, chapter 5 analyses the effect of AR on the consumer's decision considering the role of perceived risk in online shopping. The findings of this chapter show that AR reduces the perceived risk of online shopping, leading to decision comfort, but the perceived risk of online shopping don not affect decision confidence. The decision confidence is generated through the

decision comfort. Reducing the perceived risk of online shopping, as well as increasing decision comfort and confidence, leads to greater satisfaction with shopping experience, ultimately generating consumer engagement with the online shop.

Finally, to deepen the understanding of the effect of AR on the decision process, the last empirical study (chapter 6) is analysed through the theoretical perspective of the HSM processing. HSM and CLT are related in order to explain how AR can increase heuristic processing of information, while reducing the systematic one. This chapter presents intriguing findings that warrant further validation through future studies, which may involve conducting experiments in real-world settings and exploring the effects of AR on decision making across a wider range of product categories. The results confirm the hypotheses developed that AR increases heuristic processing and reduces systematic processing. Concerning the effect of the type of information processing on the decision-making process, it is found that the two information processing routes affect decision comfort and decision time, but not decision confidence. More concretely, it is observed that AR through more heuristic processing and less systematic processing complement each other, which significantly reduces the time to make a decision. However, the effects of AR through the two processing routes are confronted on decision comfort and confidence. In this sense, the results show AR reduces decision comfort and confidence due to the greater emphasis on systematic processing, compared to heuristic processing in the context studied.

Therefore, as conclusion, the last three empirical studies (chapters 4, 5 and 6) suggest that AR is an adequate tool which facilitate the consumer's decision-making process, which can help to mitigate the number of product returns. Moreover, based on the HSM model, AR allows making faster decisions. However, based on the two information processing routes, AR will improve confidence and comfort with the decision in those products in which the consumer relies on heuristic indicators and, therefore, this information processing route predominates to a large extent. Nonetheless, further research is needed to fully understand the extent of these effects and their applicability to other products and contexts.

7.2 Summary of theoretical implications

This doctoral thesis presents a series of theoretical contributions to the literature focusing on product returns and to the literature focused on the effect of AR on consumer behaviour. In addition, this doctoral thesis makes more specific contributions to the various theoretical frameworks on which the studies are based.

Firstly, through chapter 2 this doctoral thesis contributes to the literature on product returns and to flow theory. From a consumer perspective, it contributes to the understanding of the psychological causes explaining product returns. In addition to the CLT and dissonance theory (Chen et al., 2020; Janakiram & Ordóñez, 2012), this thesis also contributes to the literature by exploring how flow states can explain returns. This provides a new perspective to understand the underlying psychological processes that lead to returns, and can inform strategies to reduce them. Furthermore, the existing literature on flow generally considers it as a positive element of the shopping experience (Hsu et al., 2012; Lee et al., 2019). However, in chapter 2, it is shown that when the consumer is dissatisfied with the purchase decision made, the state of flow can be considered as a negative aspect. Moreover, by distinguishing between flow and flow consciousness in the study (Barta et al., 2022b, Herrando et al., 2018), this chapter contributes to the understanding of the impact of flow consciousness on consumer regret.

Subsequently, chapter 3 through a SLR offers a general vision to researchers interested in the field of AR and its effect on consumer behaviour. This thesis makes a valuable contribution to the literature by providing a comprehensive overview of the main issues addressed in the field. In addition, the use of tables helps to summarize the most relevant information. Table 3.1 shows the objective, research framework, methodology, AR device used, context, and main findings of each study. Table 3.2 presents the variables studied in the quantitative studies. These tables provide a clear and concise way for researchers to gain a quick understanding of the research topic and its findings, improving the efficiency of the research process.

Chapters 4, 5, and 6 contribute to expanding the understanding of the effects of AR on decision-making. These chapters address variables related to the decision-making process that had been proposed in theoretical papers (Chen et al., 2022a).

Chapter 4 makes a contribution to the literature by exploring how AR impacts cognitive load, specifically in relation to cognitive dissonance. The convenience, speed, and ease of trying on products using AR may lead consumers to evaluate more options, potentially increasing their cognitive dissonance (Romano et al., 2021). However, the greater ease of imagining the actual product appearance through VTO may reduce dissonance (Barta et al., 2023c). Thus, this study sheds light on the effects of AR on cognitive dissonance and offers insights into its potential to alleviate this variable related to cognitive load in online shopping.

Concerning to chapter 5, previous research on equity theory suggested that AR may not be as engaging as in-person shopping (Christ-Brendemühl & Schaarschmidt, 2021). However, this chapter challenges that assumption by demonstrating that AR can effectively generate engagement in an online shopping context. The study makes a theoretical contribution to the literature on engagement by comparing online shopping with and without AR, and explaining how reducing perceived risk can increase consumer satisfaction directly and indirectly through the improved decision-making process.

Furthermore, affect as information theory proposes that affect is a critical component of the decision-making process (Schwarz, 2012). According to this theory, when individuals are faced with a decision, they not only consider the factual information available but also the emotional response or feeling associated with each option. This emotional response, or affect, can influence their decision-making process and ultimately their purchasing behavior. Chapter 5 supports this theory in the purchase decision-making process with AR. Specifically, it is observed how decision comfort influences confidence, as well as the evaluation of the shopping experience through satisfaction.

Finally, chapter 6 presents several theoretical contributions. First, the research contributes to CLT by showing that AR increases heuristic information processing through the increased spatial

presence the viewer experiences with a product. On the other hand, it was shown that using AR (vs no AR) reduces the systematic processing of information.

Second, this chapter significantly contributes to the understanding of the impact of AR on dual-process models of information. While previous research has focused on how AR enhances cognitive processing through flow and immersion (Barhorst et al., 2020), and improves attitudes toward commercial advertising due to greater interactivity and information elaboration (Mauroner et al., 2016), little is known about how AR affects heuristic-systematic processing. Chapter 6 addresses this gap by examining the impact of AR on heuristic and systematic processing through the varying levels of spatial presence experienced by viewers when interacting with a product. Therefore, this study provides valuable insights into the role of AR in the decision-making process, particularly in relation to heuristic and systematic processing.

Finally, this chapter also contributes to affect as information theory in a similar way that chapter 5. In this case, the findings show that affect has a significant role in the cognitive components of the decision-making process. This adds knowledge to the growing body of literature on the impact of affective elements in online shopping experiences and emphasizes the importance of considering these factors in the research focused on immersive technologies (Kowalczuk et al., 2021).

7.3 Summary of managerial implications

The findings of this doctoral thesis presents several managerial contributions.

Chapter 2 reveals that online retailers should consider all aspects of the flow state when designing their sales strategies. While flow has many positive aspects for businesses and consumers (Hsu et al., 2012), it can also lead to negative outcomes, such as regret and returns. Proper management of this aspect can increase customer satisfaction and reduce returns, leading to savings in logistics and repackaging and contributing to sustainability.

Furthermore, process regret is essential to generate outcome regret. Therefore, providing a pleasant and intuitive shopping experience, with tools such as 360º photos and VTOs, can help reduce process regret. In this sense, companies should not only consider integrating new technology tools, but also develop the appropriate methods to measure how they affect consumer behaviour in different aspects, such as increasing the rate of sales, reducing the rate of returns or improving the decision-making process (Buhalis & Volchek, 2021).

The SLR conducted in chapter 3 presents provides valuable insights and evidence for marketers and managers in the retail sector on the potential of AR technology in enhancing the shopping experience of customers. By using AR, customers can visualize products in a virtual environment, view 3D models, and even try-on products virtually, providing them with a more realistic sense of the product before purchasing it. These aspects improve the decision-making process, result in higher customer satisfaction and, ultimately, increased sales. Furthermore, as proposed in this doctoral thesis, enhanced decision making through the integration of advanced technologies like AR could potentially mitigate the issue of high online return rates.

Furthermore, in chapter 3, the thematic analysis revealed a topic that could be particularly relevant to managers. Specifically, it refers to the last block entitled: “Recommendations for AR implementation and its advantages”. Thus, the knowledge of the scientific articles published in high-impact journals on this specific topic can enable managers with a business-oriented perspective to find and read these articles that can provide them with interesting management insights.

Concerning to the impact of AR on the decision-making process, chapter 4 shows that incorporating AR into online shopping experiences can reduce cognitive load. The AR technology implementation in online shops can positively impact consumers' decision-making process, satisfaction, and willingness to pay more. Therefore, online retailers should consider implementing AR functionalities for their similar products and carefully balance the number of products offered to avoid overchoice and cognitive dissonance. These strategies can enhance the customer experience and lead to increased sales and profits for online retailers.

Furthermore, chapter 5 shows that using AR can also reduce the perceived risk for consumers, making their decision-making process easier and improving their comfort and confidence. By providing these experiences, retailers can create more engaged customers who are more likely to return for future purchases. This engagement can also lead to increased advertising revenue as the number of website visitors increase.

Based on the findings of chapter 6, AR technology can benefit consumers by reducing the time required for decision-making through increased heuristic processing. While systematic processing requires more time and effort, it can lead to more informed decision-making and reduce risk. Thus, the decision to use AR should be based on an understanding of the processing strategies typically employed by consumers in evaluating the product. If consumers tend to rely on heuristic processing, AR can facilitate quicker and more efficient decision-making. However, if consumers tend to use a more systematic approach, the use of AR may lead to less informed decisions, ultimately reducing decision comfort and confidence. Therefore, retailers should consider the product type and processing strategies when evaluating the impact of AR on their online shops.

Furthermore, the chapter 6 also sheds light on the varying degrees of spatial presence that viewers can experience when using AR to view a product. This information can be valuable for AR application developers, who can use it to design customized experiences that align with specific product types and the decision-making processes of consumers.

In conclusion, the adoption of AR technology in online shops presents a promising strategy for enhancing consumer decision-making. With improved decision-making, consumers can make more confident and informed choices, ultimately reducing the number of product returns. Thus, based on the findings of this doctoral thesis, implementing AR in online shopping platforms is a recommended strategy for retailers. Moreover, as demonstrated in chapter 6, this strategy is particularly relevant for sellers offering products that rely heavily on heuristic information processing in the decision-making process.

Table 7.1 summarizes the research objectives, the results obtained across this thesis as well as the theoretical and practical implications.

Table 7.1. Summary of results and implications

Chapters	Research objectives	Main results	Theoretical contributions	Practical implications
Chapter 2	**Objective 1.** *Analyse the mechanism through the flow state generates the product return.*	- Flow states generate flow consciousness. - Flow consciousness increases process regret. - No significant effect of flow consciousness on outcome regret. - Process regret increases outcome regret and this outcome regret is the predictor of the return intention.	- From a consumer perspective, the study expands the knowledge of the effect of psychological states (flow) on product returns. - Flow is considered a negative aspect of the shopping experience when the consumers are dissatisfied with their choice. - The decision-making process is key. The process regret is the predictor of outcome regret which is the factor that explains the return intention.	- Avoiding the wrong choices of consumers is essential. - Special attention should be paid to encouraging flow states in online shopping, If the consumer regrets the decision made, it is considered a negative aspect of the shopping experience. - Online retailers should adopt tools that facilitates the consumers to make the right choice. This aspect could avoid choices where the consumer regrets the product purchase. Thus, the issue of product returns could be mitigated.
Chapter 3	**Objective 2.** *Analyse the current state of the literature in AR and consumer behaviour to establish research gaps about its role in decision-making process.*	- 4 main thematic blocks have been examined in the literature of AR and consumer behaviour, which has become highly relevant since 2021: (1) AR app features and technology adoption, (2) Media characteristics and consumer outcomes, (3) Psychological factors and outcomes and (4) Recommendations for AR implementation and its advantages. - Identify 6 main areas for further research: (1) cognitive elements, (2) affective elements, (3) social elements, (4) dark side of AR, (5) factors affecting AR experiences and (6) new methodological approaches and measures.	- It shows an overview of the literature in the field by highlighting the main topics addressed. - Provides a future research agenda for researchers on the main issues to be addressed in future research.	- To present evidence for marketers and managers in the retail sector of the possibilities that AR offers.

Chapters	Research objectives	Main results	Theoretical contributions	Practical implications
Chapter 4	**Objective 3.** *Analyse the effect of AR on purchase behaviour and its impact on cognitive dissonance.*	The use of AR (vs no AR) reduces the perceived similarity and the confusion by overchoice, but it does not affect prepurchase dissonance in a direct way. Prepurchase dissonance is key for explaining the consumer buying behaviour, affecting the purchase intention. This purchase intention positively affects the willingness to pay more for the product.	- Contributes to cognitive load theory by explaining how AR affects cognitive variables. - It clarifies the controversy about the effect of AR on cognitive dissonance in an empirical way. - Shows how improving the decision-making process by reducing cognitive load influences consumers' purchasing behaviour.	Retailers can obtain direct benefits of the AR implementation in their online shops. When consumers face to a large selection of similar products, the use of AR is particularly effective. Online retailers should find a balance between offering numerous products and the confusion that may arise due to overchoice.
Chapter 5	**Objective 4.** *Analyse the effect of AR on consumer decision-making process through the role of risk perception.*	The use of AR (vs no AR) reduces the perceived risk of buying online, but there is not direct effect on decision-making variables (decision comfort and decision confidence). Engagement is generated through the increased satisfaction generated as a consequence of the reduced perceived risk of buying online.	- The perceived risk of shopping online is a key aspect to explain the AR adoption through the engagement. - The theoretical foundation of affect as information theory is applicable to AR research, considering how decision comfort (affective) affects decision confidence (cognitive).	Reducing the perceived risk is essential to generate engagement with the online shop. The implementation of AR with the possibilities it offers, such as the use of VTOs, should be considered.
Chapter 6	**Objective 5.** *Analyse the effect of AR on consumer information processing and decision-making.*	AR (vs no AR) increases the heuristic and reduces the systematic processing. The two ways of information processing complement each other to reduce the time taken to make decisions. However, the effect of AR on these two routes conflicts with decision comfort and decision confidence, having greater importance on the systematic route.	- Contributes to the understanding of how AR affects HSM processing. - The advantages of AR across the two information processing routes in terms of time may be balanced by the disadvantages it provides in other elements of the purchase decision process due to the greater weight of the effect of the reduction in systematic processing it causes. - Measuring decision time shed light on the impact of AR on actual consumer behaviours.	- Online retailers should consider the predominant route of information processing for the purchase of their products. For those products where heuristic indicators are more important, the implementation of AR could be particularly interesting. - AR could be a very suitable tool for the promotion of impulse purchases due to the faster decision-making resulting from the complementarity of the effect of AR on the two information processing routes.

Source: Own elaboration

7.4 Limitations and future research agenda

Despite this doctoral thesis offers intriguing theoretical and practical implications, it is not without limitations that could serve as opportunities for further research. While the limitations of each study were discussed in detail in their respective chapters, this section will briefly highlight the most significant ones. Additionally, potential future research directions will be suggested. The section ends providing an agenda for future research in the field of AR and consumer behaviour. This agenda is organized thematically, in line with the topics mentioned in section 3.6.

First, in chapter 2, the data collection through a survey may limit the generalizability of the results due to cross-sectional data. Although the recommendations to minimize this potential bias have been taken into account (Maier et al., 2023), future studies could analyse the effect of flow on product returns from a different perspective. For instance, qualitative methodologies could be used to delve deeper into the causes and mechanisms that make flow perceived as a negative aspect of the shopping experience after a wrong decision. In addition, future research could also adopt mixed method approaches. By conducting several studies and using different methodologies, results can be confirmed, providing greater generalization (Doyle et al., 2009). Furthermore, in addition to the aforementioned need to continue exploring the causes that explain product returns from a consumer perspective, future studies could incorporate characteristics of the purchase or the individual that may have a moderating effect on the relationship between flow and regret. Just as previous studies have observed how the effect of flow on process regret is different depending on whether a consumer is a maximizer or a satisficer (Barta et al., 2023b), future research could consider other aspects. For instance, the utilitarian or hedonic motivation shopping of the consumer could be a relevant variable to study. As the hedonic motivation refers to seeking pleasurable experiences, it is possible that in such purchases, consumers may not be seeking the best choice, but rather simply enjoying themselves (Arnold & Reynolds, 2003). On the other hand, utilitarian motivation towards the purchase involves seeking useful and relevant information to make a good decision. Therefore, it could happen that consumers with hedonic motivation value the flow as an element of the

shopping experience that allows them to reduce the regret they may feel after making a wrong choice. On the other hand, since flow has been linked to exploratory behaviour (Guo & Poole, 2009), consumers with utilitarian motivation may consider flow as a negative element of the shopping experience that has distracted them from seeking useful information, leading to a bad decision.

Second, in chapter 3, one of the main themes identified in the thematic analysis conducted in section 3.4 includes the analysis of psychological factors and outcomes. Due to the exclusive focus on the areas of business and management in the SLR carried out, it is possible that studies related to this topic published in psychology journals have been excluded from this analysis. Therefore, future reviews could focus on the inclusion of articles from journals in this area that analyse the impact of AR on consumer behaviour. Recently, journals in this area have published special issues on this topic (Mahr et al., 2023). Therefore, the insights offered in chapter 3 should be complemented with a review of articles focused on the consumer in high-impact psychology journals.

Third, the empirical studies in chapters 4 and 5 were conducted through online experiments. Despite being a common method in AR research, as noted in chapter 3, it has its advantages and disadvantages. On the one hand, in the literature focused on AR in consumer behaviour, it allows participants to perform the task in a familiar environment, such as their home, thus simulating a realistic online shopping experience. However, despite the inclusion of questions to check the participants' attention and experience, some aspects are much harder to control. In the studies conducted, sing Web AR, the individual's screen resolution and internet connection latency could potentially affect their online shopping experience (Barta et al., 2021). Therefore, future studies could complement the results obtained so far by using other data collection methods that provide a higher degree of internal validity.

Fourth, to explore the effect of AR on the decision-making process from a broad perspective, chapter 5 includes the implementation of a lab experiment simulating a furniture purchasing experience. This method can overcome most of the limitations of one-off cross-sectional

data from survey research with no randomization, and lab experiments ensure a higher degree of control and internal validity than online experiments (Viglia & Dolnicar, 2020). However, given the importance of the surroundings in the AR shopping experience for a piece a furniture (Ivanov et al., 2022), future studies should analyse the effect of AR on the decision-making process through the HSM collecting data in real environments. Recent research has shown how the congruent or incongruent context in which AR is used plays a fundamental role, especially in the case of evaluating a sofa (von der Au et al., 2023). Therefore, the greater weight found for the effect of systemic processing on the decision-making process in chapter 5 needs to be further explored both with the use of AR in a congruent use environment, and with other types of products where environmental aspects are not as important in the AR shopping experience. In this sense, field experiments, natural experiments and quasi-experiments out in real settings with actual (or prospective) consumers have the could increase the external validity of the effects found in this study. Furthermore, although commonly used, student samples tend to limit the generalisability of findings and may not reflect the target consumer for certain product categories, such as furniture (Kim et al., 2020). Thus, future research should seek a broader demographic of research participants or conduct field research with actual consumers.

The research topics identified from the SLR in section 3.6 are described in more detail below.

1. **Cognitive elements:** the impact of AR on other types of fluency, such as perception fluency and perceptual fluency, presents an interesting avenue for future research. Perception fluency refers to the ease with which a person can perceive and interpret sensory information, while perceptual fluency refers to the ease with which a person can recognize and process familiar stimuli (Hilken et al., 2022a). These types of fluency can be influenced by factors such as the level of visual detail, colour, and contrast in AR experiences. Future research could explore how AR can be used to enhance these types of fluency and how they might impact affective responses and decision-making processes.

Additionally, further research could explore the role of other factors that may influence cognitive load in AR experiences, such as the level of realism of the AR content and the level of control that users have over the AR environment. This will provide insights into how to design AR experiences that optimize cognitive processing and reduce the cognitive load of consumers.

2. **Affective elements:** future research on the impact of AR on affective responses can explore the role of sensory cues in creating these responses. Specifically, researchers can investigate how different sensory cues, such as visual, auditory, and haptic cues, can influence affective responses to AR. For example, researchers can investigate the impact of adding sound effects to AR experiences on consumers' emotional responses. Similar to research conducted in web environments (Flavián et al., 2017), research can also investigate how the timing and duration of sensory cues increase or reduce affective responses to AR.

   Furthermore, nostalgia is a concept studied in games literature, but not explored in the field of consumer behavior (Rauschnabel et al., 2017). As AR allow consumers to engage with virtual representations of the products, it may evoke feelings of nostalgia. The anticipated virtual consumption of a product that the consumer may not have later can arouse this kind of affective response after the AR experience. Future research can analyse how the nostalgia created by the AR experience influences affective responses.

3. **Social elements:** AR can enable consumers to try-on virtual outfits or accessories and share their augmented appearance on social media. This creates opportunities for social comparison, which can affect well-being in terms of self-esteem. In addition, social influence is an important aspect of consumer decision-making (Kim & Sirvastava, 2007). Therefore, future studies could analyse how the opinions of others to make a decision influence to a greater or lesser extent by the use of AR. Given the anticipatory nature of the consumption experience, it is predictable that the impact of social influence on decision-making with AR would be comparatively less significant. In addition, future research could

explore how social presence influences purchase decisions in AR shopping contexts. In this sense, research could analyse how AR-based social interactions are more or less persuasive than those that occur in face-to-face contexts.

Furthermore, there is a lack of research on shared or adaptive AR experiences, which enhance embodied interactions, despite their practical use in brand strategies to recreate social experiences (Papagiannis, 2020). Future studies could investigate the value co-creation and word-of-mouth implications of synchronous and asynchronous shared AR experiences, as well as user-to-user communication, and how these factors influence consumer behaviour. Such research could inform effective marketing strategies that take advantage of the potential benefits of shared AR experiences.

4. **Dark side of AR:** As AR becomes increasingly integrated into our daily lives, it is important to consider its potential negative effects on individuals and society as a whole. Apart from the privacy issues that AR can raise through the collection of personal information such as face or rooms in the home, the use of this technology in consumer behaviour can also raise another issues (Wang et al., 2023).

One important area for future research regarding the dark side of AR is the ethical considerations of using AR to manipulate consumer emotions. Future research could explore the ethical implications of using AR in this way and identify guidelines or best practices for using AR in a responsible and transparent manner. For example, research could examine how consumers perceive the use of AR to manipulate emotions, and whether there are certain types of emotional manipulation that are considered more or less acceptable by consumers.

Furthermore, the use of AR technology to increase impulse purchases can be seen as a potential dark side of this technology (Zheng & Li, 2023). Future research could explore the ethical implications of using AR to create a sense of urgency or impulse in consumers, such as through the use of gamification or other persuasive techniques. Studies could examine the potential harms of increased impulse purchases, such as consumer regret

or financial harm, and investigate ways to mitigate these risks. Additionally, research could explore the responsibility of companies and marketers in using AR to promote impulse purchases and the need for transparency and ethical guidelines in these practices.

5. **Factors affecting AR experiences:** different types of factors can affect the consumer's experience with AR. The available devices for AR have specific characteristics that impacts the user experience. For example, users can move around while using mobile AR, but not when using Web AR. Also, the use of AR glasses allows the user to free their hands during the experience, a possibility that does not exist with the other devices previously mentioned. Therefore, due to these characteristics and the different degrees of embodiment they generate (Flavián et al., 2019a), future research is needed in this field to know the most suitable devices for each situation.

   Moreover, other aspects like the type of product can affect the evaluation of the AR experiences. The effect of AR on familiar or unfamiliar products is an interesting area for future research. Studies could examine how AR influences consumer behaviour and decision-making for products that are familiar versus those that are unfamiliar to them. For instance, research could investigate how AR affects consumers' perceptions of product quality, trust, and overall satisfaction for both familiar and unfamiliar products. Additionally, future research could explore whether AR enhances consumers' product knowledge and understanding, and whether this effect is stronger for unfamiliar products. Furthermore, future studies could investigate the role of the familiarity with the product. Research could examine whether individuals who are less familiar with a product category are more likely to use AR to learn about the product and make purchasing decisions compared to those who are more familiar. In addition, given that the success of the AR retail experience depends on the product category (Tan et al., 2022), future research could investigate the most significant attributes in different product categories and market positions, such as mass market and luxury.

Concerning to the relationship with the brands, future research could analyse how AR impacts consumers' perception and evaluation of local versus global brands. For example, consumers could perceive local brands as more authentic and trustworthy when experiencing them through AR, compared to global brands.

Contextual factors can also affect the AR experiences (Rauschnabel, 2018; von der Au et al., 2023). In this sense, one factor to consider is the setting where the AR experience takes place, such as at home or in-store. This could affect the consumer's level of immersion and engagement with the product, as well as their perception of the product's fit with their personal environment.

6. **New methodological approaches and measures:** A large number of the empirical articles reviewed collect data through subjective measures, mainly surveys. Although subjective measures are adequate for measuring user experiences, it is necessary to use other data collection methods to gain a more specific understanding of some user responses, or to contribute to the theory development. For this reason, the use of different measures is suggested.

Qualitative studies, such as focus groups, may be appropriate for gaining in-depth knowledge of users' perceptions of these technologies. Based on these data, empirical studies can be carried out to corroborate the results obtained. Furthermore, with the exception of a few articles that use eye-tracking devices to measure attention (Yang et al., 2020), the use of measures collected by neuroscientific tools is very scarce. The measurement of heart rate or arousal could be used to understand, through biometric responses, the responses of users when they have an experience with AR.

In addition, longitudinal studies could provide insights into how the habit to this technology affects consumers' perceptions. In this sense, it is possible that consumers are becoming increasingly confident in their use of technology in line with UTAUT (Venkatesh et al., 2003). Therefore, future studies could learn how perceptions and responses to the use of AR change with increasing consumer use of the technology.

Table 7.2 shows a summary of the future research avenues.

Table 7.2 Future research avenues

Research themes	Possible research topics
Cognitive elements	- The impact of AR on other types of fluency apart from cognitive fluency (e.g., perception fluency, perceptual fluency). - The role of different types of AR content (e.g. informational vs. interactive) on cognitive load and mental workload in consumers. - Examine the role of different types of AR content (e.g. informational vs. interactive) on cognitive load and mental workload in consumers. - Investigating the impact of different types of AR content (e.g. informational vs. interactive) on cognitive variables. - Further examine the impact of AR on HSM processing (relevance of the context and the product type). - Integration and development of other theories (embodied cognition theory).
Affective elements	- Role of sensory cues in creating affective responses to AR. - Consumer perceptions and emotions over time. - The impact of gamification on affective responses in AR. - The role of nostalgia in affective responses to AR experiences. - Further examine the role of affective aspects on cognitive aspects, in line with affect as information theory.
Social elements	- Adopt social theories the explain the influence of social factors (e.g. social cognitive theory). - The role of social presence in enhancing engagement to AR experiences. - The role of social influence in decision-making (no AR vs AR). - Study consumer well-being when exposed to AR social experiences. - To investigate the influence of AR content-based social media marketing strategies.
Dark side of AR	- Ethical considerations of using AR to manipulate consumer emotions. - AR as a tool to increase impulse purchases. - AR and privacy concern. - Disruptive effects on social interaction.

Table 7.2. Future research avenues (to be continued)

Research themes	Possible research topics
Factors affecting AR experience	- Devices • Mobile vs computers • Mobile vs glasses • Investigate the impact of the control modalities (sensory controls) • Extend the knowledge about the impact of Virtual Mirrors and AR glasses on consumer perceptions and behaviour. - Product types • Familiar vs. unfamiliar. • High, medium and low risk product. • Augmentation/haptics framework (body vs surroundings; sense vs. control). - Brands • Local vs. global. • Familiar vs. unfamiliar. • Well-known vs unknown. - Environment • Congruent vs. incongruent space. • At home or in-store. • Public vs. private space.
New methodological approaches	- Conduct longitudinal research to compare differences over time. - Increase the generalisation of the results identifying paths through other methodologies (e.g. QCAs). - Develop studies with more ecologically validation (avoid student samples). - Use of natural environments to increase external validity. - Use of physiological measures through neuroscience instruments (e.g. attention, emotion, arousal). - Collect measures of actual behaviour (product purchase, product return rate). - Qualitative studies. - Cross-cultural studies.

Source: Own elaboration

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ANEXO: Resumen y conclusiones

Resumen

El principal objetivo de esta tesis doctoral es comprender las causas de la experiencia de compra que explican las devoluciones de productos y, en consecuencia, analizar cómo la Realidad Aumentada (RA) puede ayudar a resolver este problema. Para este objetivo, esta tesis examina el papel que la RA puede desempeñar en la experiencia de compra y, más concretamente, en el proceso de toma de decisiones, después de haber analizado cómo los aspectos de la experiencia de compra (por ejemplo, los estados de flujo) pueden influir en las devoluciones de productos. Para este objetivo principal, se plantearon varios objetivos específicos.

En el primer estudio empírico (capítulo 2), el objetivo es analizar el impacto del flujo y la conciencia de flujo en las devoluciones de productos cuando los consumidores no están satisfechos con su decisión de compra. El estudio destaca que los consumidores que reconocen estar en estado de flujo lo perciben como un aspecto negativo de la experiencia de compra cuando se arrepienten de su decisión. Estos consumidores tienden a sentirse más arrepentidos con el proceso de compra que han realizado, lo que genera un arrepentimiento con el producto y, en consecuencia, se realiza la devolución del producto.

Algunas funciones que ofrece la RA generan un alto grado de interactividad e inmersión y pueden generar experiencias de flujo. Por lo tanto, es importante saber cómo la RA puede mejorar el proceso de decisión de compra. Las conclusiones del primer estudio empírico revelan que el flujo se considera un elemento negativo cuando la decisión de compra es insatisfactoria. Por lo tanto, es vital investigar cómo la RA puede ayudar en el proceso de toma de decisiones, dando lugar a mejores decisiones de compra y, por tanto, a reducir la problemática actual de las devoluciones en las compras online. Además de su alto grado de interactividad e inmersión, la RA tiene una gran aplicabilidad en el sector del comercio online debido a la prueba virtual de productos que permite al integrar elementos virtuales en el mundo real (Flavián & Barta, 2022; Heller et al., 2021). Dado su potencial para mejorar el proceso de toma de decisiones de compra online, los siguientes capítulos investigan el impacto de esta tecnología en la mejora de la toma de decisiones de compra.

El objetivo del tercer capítulo es examinar el estado actual de la investigación centrada en la RA y el comportamiento del consumidor. Esto permite identificar las necesidades de investigación para contribuir al conocimiento del efecto de la RA en la toma de decisiones en los tres capítulos posteriores.

Para examinar el estado actual de la literatura, se llevó a cabo una revisión sistemática de la literatura y un análisis temático, que dan como resultado la identificación de cuatro temas principales en la investigación existente: (1) características de las aplicaciones de RA y adopción de la tecnología, (2) atributos de la RA y las respuestas del consumidor, (3) factores psicológicos y comportamientos y (4) recomendaciones para la implantación de la RA y sus ventajas. Este análisis temático, combinado con el examen de las variables estudiadas en la investigación empírica, da como resultado la identificación de seis áreas principales para futuras investigaciones: (1) elementos cognitivos, (2) elementos afectivos, (3) elementos sociales, (4) el lado oscuro de la RA, (5) factores que afectan a las experiencias de RA y (6) nuevos enfoques metodológicos y uso de distintas medidas. Basándose en la literatura existente y en las necesidades de investigación identificadas, los tres capítulos siguientes (capítulos 4, 5 y 6) pretenden investigar empíricamente el impacto de la RA en el proceso de toma de decisiones del consumidor.

El capítulo 4 analiza el efecto de la RA en el proceso de toma de decisiones desde una perspectiva cognitiva, centrándose en la carga cognitiva y la teoría de la disonancia. Las conclusiones de este estudio indican que el uso de la RA en las compras online reduce el nivel de disonancia previa a la compra, ya que conduce a un menor grado de similitud percibida de las alternativas y de confusión por exceso de alternativas. La reducción de la disonancia influye positivamente en las intenciones de compra, lo que en última instancia se traduce en una mayor disposición a pagar por el producto. Por lo tanto, este estudio apoya la idea de que la RA mejora el proceso de toma de decisiones del consumidor al reducir la carga cognitiva. Además, la RA proporciona beneficios a las tiendas online, ya que la disminución de la disonancia en el proceso de elección fomenta las intenciones de compra, lo que se traduce en una mayor disposición a pagar por el producto.

Una vez comprendidos los beneficios del uso de la RA en las compras online para los comercios en términos de aumento de las ventas y los márgenes, el siguiente capítulo pretende explorar cómo la mejora del proceso de toma de decisiones del consumidor puede conducir a un mayor engagement. Comprender los factores que contribuyen al engagement es crucial dada su importancia para explicar la adopción de la RA por parte de los consumidores (Jessen et al., 2020).

Para ello, el capítulo 5 analiza el efecto de la RA en la decisión del consumidor teniendo en cuenta el papel del riesgo percibido en las compras online. Los resultados de este capítulo muestran que la RA reduce el riesgo percibido de las compras online, lo que conduce a un mayor confort con la decisión. Sin embargo, el riesgo percibido de las compras online no afecta a la confianza en la decisión. La confianza en la decisión es generada a través del confort con la decisión. La reducción del riesgo percibido en las compras online, así como el aumento del confort y la confianza en la decisión, conducen a una mayor satisfacción con la experiencia de compra, generando en última instancia un mayor engagement del consumidor con la tienda online.

Por último, para profundizar en la comprensión del efecto de la RA en el proceso de decisión de compra, el último estudio empírico (capítulo 6) analiza cómo la RA influye en el procesamiento heurístico-sistemático. El procesamiento heurístico-sistemático y la "Constural Level Theory" (CLT) se relacionan para explicar cómo la RA puede aumentar el procesamiento heurístico de la información, al tiempo que reduce el sistemático. Este capítulo presenta resultados interesantes que necesitan de una mayor validación a través de futuros estudios, que pueden implicar la realización de experimentos en entornos reales y la exploración de los efectos de la RA en la toma de decisiones en una gama más amplia de productos. Los resultados confirman las hipótesis desarrolladas que explican cómo la RA aumenta el procesamiento heurístico y reduce el sistemático. En cuanto al efecto del tipo de procesamiento de la información en el proceso de toma de decisiones, se constata que las dos vías de procesamiento de la información afectan al confort con la decisión y al tiempo empleado para ella, pero no a la confianza en la decisión. Más concretamente, se observa que el efecto de RA sobre las dos vías del procesamiento heurístico-sistemático se complementan para reducir el tiempo empleado en la decisión. Sin embargo, los

efectos de la RA a través de las dos vías de procesamiento se enfrentan en su efecto sobre el confort y la confianza con la decisión. En este sentido, los resultados muestran que la RA reduce el confort y la confianza debido al mayor efecto que tiene en el contexto estudiado sobre la reducción del procesamiento sistemático, en comparación con el procesamiento heurístico.

Por tanto, como conclusión, los tres últimos estudios empíricos (capítulos 4, 5 y 6) sugieren que la RA es una herramienta adecuada que facilita el proceso de toma de decisiones del consumidor, lo que puede ayudar a mitigar el número de devoluciones de productos. Además, según el modelo de procesamiento heurístico-sistemático, la RA permite tomar decisiones más rápidamente. Sin embargo, basándonos en las dos rutas de procesamiento de la información, la RA mejorará la confianza y el confort con la decisión solo en aquellos productos en los que el consumidor se basa en indicadores heurísticos y, por tanto, predomina en gran medida esta ruta de procesamiento de la información. No obstante, es necesario seguir investigando para comprender plenamente el alcance de estos efectos y su aplicabilidad a otros productos y contextos.

Conclusiones teóricas

Esta tesis doctoral presenta una serie de aportaciones teóricas a la literatura centrada en las devoluciones de producto y a la literatura centrada en el efecto de la RA sobre el comportamiento del consumidor. Además, esta tesis doctoral realiza aportaciones más específicas a los distintos marcos teóricos en los que se basan los estudios.

En primer lugar, a través del capítulo 2, esta tesis doctoral contribuye a la literatura sobre las devoluciones de productos y a la teoría del flujo. Desde la perspectiva del consumidor, contribuye a la comprensión de las causas psicológicas que explican las devoluciones de productos. Además de teorías psicológicas ya exploradas en este campo, como la CLT y la teoría de la disonancia (Chen et al., 2020; Janakiram & Ordóñez, 2012), este capítulo contribuye a la literatura explorando cómo los estados de flujo pueden explicar las devoluciones. Esto proporciona una nueva perspectiva para comprender los procesos psicológicos subyacentes que conducen a la devolución de productos, lo cual permite establecer estrategias para reducirlas. Además, la literatura existente

sobre el flujo generalmente lo considera un elemento positivo de la experiencia de compra (Hsu et al., 2012; Lee et al., 2019). Sin embargo, el capítulo 2 muestra que cuando el consumidor está insatisfecho con la decisión de compra tomada, el estado de flujo puede considerarse un aspecto negativo. Además, al distinguir entre flujo y consciencia de flujo en el estudio (Barta et al., 2022b, Herrando et al., 2018), este capítulo contribuye a la comprensión del impacto de la consciencia de flujo en el arrepentimiento del consumidor.

Posteriormente, el capítulo 3, a través de una revisión sistemática de literatura, ofrece una visión general a los investigadores interesados en el campo de la RA y su efecto en el comportamiento de los consumidores. Este capítulo supone una importante contribución a la literatura al ofrecer una visión general de las principales cuestiones abordadas en este campo. Esto permite a los investigadores interesados en la temática comprender de una forma clara y concisa el estado actual la investigación y los hallazgos ya existentes.

Los capítulos 4, 5 y 6 contribuyen a ampliar la comprensión de los efectos de la RA en la toma de decisiones. Estos capítulos abordan variables relacionadas con el proceso de toma de decisiones que se habían propuesto en trabajos teóricos (Chen et al., 2022a).

El capítulo 4 contribuye a la literatura explorando cómo la RA afecta a la carga cognitiva, concretamente a la disonancia cognitiva. La comodidad, rapidez y facilidad de probarse productos mediante RA puede llevar a los consumidores a evaluar más opciones, aumentando potencialmente su disonancia cognitiva (Romano et al., 2021). Sin embargo, la mayor facilidad para imaginar el aspecto real del producto a través de los probadores virtuales puede reducirla (Barta et al., 2023c). En consecuencia, este estudio arroja luz sobre los efectos de la RA en la disonancia cognitiva y demuestra el potencial de la RA para aliviar esta variable relacionada con la carga cognitiva en las compras online.

En relación con el capítulo 5, investigaciones anteriores sobre la teoría de la equidad sugerían que la RA podría no ser tan atractiva como las compras en tienda física (Christ-Brendemühl y Schaarschmidt, 2021). Este capítulo examina cómo la RA puede generar engagement en un contexto de compra online. El estudio aporta una contribución teórica a la literatura sobre el

engagement comparando las compras online con y sin RA, y explicando cómo la reducción del riesgo percibido puede aumentar la satisfacción del consumidor directa e indirectamente a través de la mejora del proceso de toma de decisiones.

Además, "affect as information theory" propone que el afecto es un componente crítico del proceso de toma de decisiones (Schwarz, 2012). Según esta teoría, cuando los individuos se enfrentan a una decisión, no solo tienen en cuenta la información objetiva disponible, sino también la respuesta emocional o el sentimiento asociado a cada opción. Esta respuesta emocional, o afecto, puede influir en su proceso de toma de decisiones y, en última instancia, en su comportamiento de compra. El capítulo 5 apoya esta teoría en el proceso de toma de decisiones de compra con RA. En concreto, se observa cómo el confort con la decisión influye en la confianza, así como en la evaluación de la experiencia de compra a través de la satisfacción.

Por último, el capítulo 6 presenta varias contribuciones teóricas. En primer lugar, la investigación contribuye al CLT al demostrar que la RA aumenta el procesamiento heurístico de la información a través de la mayor presencia espacial que el consumidor experimenta con un producto. Por otro lado, se demostró que el uso de la RA (frente a la ausencia de RA) reduce el procesamiento sistemático de la información.

En segundo lugar, este capítulo contribuye significativamente a la comprensión del impacto de la RA en los modelos de procesamiento dual de la información. Mientras que investigaciones anteriores se han centrado en cómo la RA mejora el procesamiento cognitivo a través del flujo y la inmersión (Barhorst et al., 2020), ha sido menos explorado cómo la RA afecta al procesamiento heurístico-sistemático. El capítulo 6 aborda esta temática examinando el impacto de la RA en el procesamiento heurístico y sistemático a través de los distintos niveles de presencia espacial que experimentan los consumidores al interactuar con un producto. Por lo tanto, este estudio contribuye al conocimiento sobre el papel de la RA en el proceso de toma de decisiones, especialmente en relación con el procesamiento heurístico y sistemático.

Por último, este capítulo también contribuye a "affect as information theory" de forma similar al capítulo 5. En este caso, los resultados muestran que el afecto desempeña un papel

importante en los componentes cognitivos del proceso de toma de decisiones. Esto añade conocimiento al creciente cuerpo de literatura sobre el impacto de los elementos afectivos en las experiencias de compra online y destaca la importancia de considerar los elementos afectivos en la investigación centrada en las tecnologías inmersivas (Kowalczuk et al., 2021).

Implicaciones para la gestión empresarial

Los resultados de esta tesis doctoral presentan varias contribuciones para la gestión.

El capítulo 2 revela que las tiendas online deben tener en cuenta todos los aspectos del estado de flujo a la hora de diseñar sus estrategias de venta. Aunque el flujo tiene muchos aspectos positivos para las empresas y los consumidores (Hsu et al., 2012), también puede provocar resultados negativos, como arrepentimiento y devoluciones. Una gestión adecuada de este aspecto puede aumentar la satisfacción del cliente y reducir las devoluciones, lo que supone un ahorro en logística y embalaje que contribuye a la sostenibilidad.

Además, el arrepentimiento con el proceso de compra genera un arrepentimiento con la compra del producto. Por lo tanto, ofrecer una experiencia de compra agradable e intuitiva, con herramientas como fotos de 360º y probadores virtuales, puede ayudar a reducir el arrepentimiento de proceso. En este sentido, las empresas no sólo deben considerar la integración de nuevas herramientas tecnológicas, sino también desarrollar los métodos adecuados para medir cómo afectan al comportamiento del consumidor en diferentes aspectos, como el aumento de la tasa de ventas, la reducción de la tasa de devoluciones o la mejora del proceso de toma de decisiones (Buhalis & Volchek, 2021).

La revisión sistemática de literatura realizada en el capítulo 3 proporciona una gran cantidad de información relevante para los responsables de marketing y los gerentes de tiendas online sobre el potencial de la tecnología de RA para mejorar la experiencia de compra de los clientes. Gracias a la RA, los clientes pueden visualizar los productos en un entorno virtual e incluso probárselos virtualmente, lo que les proporciona una visión más realista del producto antes de comprarlo. Estos

aspectos mejoran el proceso de toma de decisiones, redundan en una mayor satisfacción del cliente y, en definitiva, en un aumento de las ventas. Además, como se propone en esta tesis doctoral, la mejora de la toma de decisiones mediante la integración de tecnologías avanzadas como la RA podría mitigar potencialmente el problema de las elevadas tasas de devolución online a las que se enfrentan actualmente las tiendas online.

Además, en el capítulo 3, el análisis temático reveló un tema que podría ser especialmente relevante para los directivos de empresas. En concreto, se refiere al último bloque denominado: "Recomendaciones para la implantación de la RA y sus ventajas". El conocimiento de los artículos científicos publicados en revistas de alto impacto sobre este tema específico puede permitir a los directivos con una perspectiva orientada a los negocios conocer y acceder a estos artículos que pueden proporcionarles interesantes perspectivas para la correcta gestión empresarial, especialmente en materia de digitalización de la empresa.

En cuanto al impacto de la RA en el proceso de toma de decisiones, el capítulo 4 muestra que la incorporación de la RA a las experiencias de compra online puede reducir la carga cognitiva. La implantación de la tecnología de RA en las tiendas en línea puede influir positivamente en el proceso de toma de decisiones de los consumidores, en su satisfacción y en su disposición a pagar más. Por lo tanto, las tiendas online deberían considerar la posibilidad de implementar funcionalidades de RA. La integración de RA en el proceso de compra online es especialmente adecuada para aquellas empresas que ofrecen productos muy similares. Además, debido al impacto que tiene la confusión por exceso de alternativas en la disonancia cognitiva se debe valorar el ofrecer un número adecuado de productos, ya que un amplio catálogo de productos facilita la aparición de la confusión por exceso de alternativas en el consumidor.

Además, el capítulo 5 muestra que el uso de la RA también puede reducir el riesgo percibido por los consumidores, facilitando su proceso de toma de decisiones y mejorando su confort y confianza. Al proporcionar experiencias de RA, los minoristas pueden generar engagement con los clientes, haciéndoles más propensos a volver a visitar la tienda online para futuras compras. Este

engagement también puede traducirse en un aumento de los ingresos publicitarios al aumentar el número de visitantes del sitio web.

Según las conclusiones del capítulo 6, la tecnología de RA puede beneficiar a los consumidores reduciendo el tiempo necesario para la toma de decisiones mediante un mayor procesamiento heurístico. Si bien, cabe destacar también que el procesamiento heurístico al requerir de menor tiempo, puede conducir a una toma de decisiones con menos información. Por tanto, la decisión de utilizar la RA debe basarse en la comprensión de las estrategias de procesamiento que suelen emplear los consumidores para evaluar los productos ofrecidos en la tienda online. Si los consumidores tienden a utilizar el procesamiento heurístico para esos productos, la RA puede facilitar una toma de decisiones más rápida y eficaz. Sin embargo, si los consumidores tienden a utilizar un procesamiento más sistemático, el uso de la RA puede dar lugar a decisiones con una menor información, reduciendo el confort y la confianza con la decisión. A la vista de estos resultados, las empresas online deberían tener en cuenta el tipo de producto y las estrategias de procesamiento empleadas por los consumidores a la hora de evaluar el impacto de la implementación de la RA en el proceso de toma de decisiones.

Además, el capítulo 6 también muestras la importancia de los diferentes niveles de presencia espacial que pueden experimentar los consumidores al utilizar la RA para ver un producto. Esta información puede ser valiosa para los desarrolladores de aplicaciones de RA. Considerar este aspecto puede ser importante para el correcto diseño de experiencias personalizadas que se ajusten a los procesos de toma de decisiones de los consumidores. Debido a la relación encontrada entre el grado de presencia espacial del producto y el tipo de procesamiento realizado, si se quiere fomentar un procesamiento heurístico será necesario el desarrollar experiencias de RA en las que el consumidor perciba un alto grado de presencia espacial con el objeto.

En conclusión, la adopción de la tecnología de RA en las tiendas online presenta una estrategia prometedora para mejorar la toma de decisiones de los consumidores. A través de una mejor toma de decisiones, los consumidores pueden tomar decisiones de compra con una mayor confianza y tranquilidad, reduciendo en última instancia el número de devoluciones de productos.

Por tanto, en base a los resultados obtenidos en esta tesis doctoral, la implantación de la RA en las tiendas de compra online se trata de una acción prometedora para combatir el alto número de devoluciones de producto recibidas. Además, como se demuestra en el capítulo 6, la implementación de la RA en la tienda online puede ser especialmente interesante para los vendedores que ofrecen productos que dependen en gran medida del procesamiento heurístico de la información en el proceso de toma de decisiones.