Methodology to carry out MRT experiments

DELIVERABLE

2.2

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ABBREVIATIONS

ESR: Early Stage Researcher

CDP: Career Development Plan

VR: virtual reality

HBT: Human Behaviour Tracking

VE: virtual environments

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Content

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1 Executive summary

This document describes the theoretical framework, hypothesis and methodology of the mediator's experiments as described in deliverable 2.1 (D2.1):

In D2.1, the following information about MRT experiments was detailed:

- General experimental methodology – RHUMBO experiments classification
- Theoretical models of shopper characterization and customer experience
- Description of VE contents for shopper classifier and shopper dimensions experiments
- Signals to be used for implicit measures
- Experimental design with fMRI
- Experimental platform description for MRT experiments

Based on the above-mentioned information and following the naming convention used in D2.1 for the different experiments, the present document (D2.2) provides:

- Scientific rationale for mediator experiments
- Description of mediator experiments

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2 Introduction to mediator experiments

2.1. Aim of the study

The general objective is to analyze the influence of different mediators on the shopper behavior. Each subject will be classified using the Shopper Classifier Experiments outputs. After that, the subject will interact in a 3D virtual environment (VE) by means of a VR headset-based interfaces coupled with 3D touch controllers for navigation/interaction. The VE will be used to modulate one class of mediators and analyzing the influence of mediators on shopper dimensions defined by SD experiments.

In this document, **we define "mediator" as an independent variable that has a potential influence on the shopper Behaviour and decisions taken as well as dimensions (SD) described in D2.1 when one subject is facing either a buyer-product or a buyer-seller relationship.**

Although there is a high number of independent variables (mediators) that can influence SD, in this project, we will restrict the types of mediators according to the following classification:

Mixed Reality Mediators (MRM)

This group of mediators refers to several aspects related to digitalization of the experience in marketing (VEM) employing mixed realities as defined in (Alcañiz, Bigné & Guixeres, 2019). In more detail, we refer to the interactive visual and audio information provided to the subject when he/she is using either an augmented reality or augmented virtuality interface according to the classification of VEM described in (Alcañiz et al., 2019).

Environmental Mediators (EM):

This group of mediators refers to the facility-based environmental cues, or "atmospherics", that can influence buyer behavior. In more detail, we refer to the cues described in the following groups of the classification proposed by (Turley & Milliman, 2000): exterior, general interior, store layout, and interior displays.

Social Mediators (SM):

This group of mediators refers to the social cues described in "human variables" group of the classification proposed by (Turley & Milliman, 2000).

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3 State of the art about mediators

3.1 Mixed Reality Mediators

Imagine if you go walk into a store intending to buy a toy. An unassembled 3D puzzle catches your eye, but you are not quite sure what the final assembly will look like. Then, you are told about augmented reality (AR), a collection of viewing features that helps shoppers visualize the assembled toy in three dimensions (3D), which enables you to observe the puzzle from every angle. This example illustrates how AR helps shoppers/users make purchase decisions (Poushneh & Vasquez-Parraga, 2017). AR is a series of technologies that integrate real world and virtual information, thereby enhancing a specific reality (Lamantia, 2009). Some customers do not make online purchase because such deficiencies make the process risky (J. Kim & Forsythe, 2008a). AR can produce meaningful experiences for online shoppers (MacIntyre, Bolter, Moreno, & Hannigan, 2001) by providing sufficient product information (Lu & Smith, 2007) that enables them to evaluate the targeted products (J. Kim & Forsythe, 2008a) and make decisions with more certainty (Oh, Yoon, & Shyu, 2008).

Goldsmith & Flynn (2005) highlighted earlier that consumers have found the traditional checklist-based and two-dimensional (2D) display of merchandise on Web-based shopping practices are insufficient to provide them with a hedonic shopping experience. Apparently, Pantano & Laria (2012) had also been taking advantage of the traditional limitations of brick-and-mortar shops setting, delivering unlimited selections of merchandise along with various powerful recommendation systems. Obviously, compared to brick-and-mortar shops, all virtual channels offer wider collections and are not confined to limited shelf space. Likewise, as the expectations of consumers on online shopping platform have been raised currently due to the emergence of diverse digital shopping channels such as VR, AR and mobile technologies (MT), these platforms are more focused on enriching the consumers' hedonic shopping experiences (Ben-Ur, Mai, & Yang, 2015) instead of the following traditional consumers' attributes, namely convenience and discount prices that online shopping platform provided.

AR is a form of stimulus and the level of interactivity reflects AR. Interactivity refers to the "extent to which users can participate in modifying the form and content of a mediated environment in real time" (Steuer, 1992). Interactivity entertains users and enables them to personalize information in a 3D virtual model (Fiore, Kim, & Lee, 2005), and they enjoy interacting with virtual objects more than they do handling or looking at physical objects (H. Li, Daugherty, & Biocca, 2001).

User Experience (UX) is holistic and subjective (McCarthy & Wright, 2004), and varies across time (Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009). UX is a complex construct that encompasses a user's inner state, product characteristics, and the context of use (Hassenzahl & Tractinsky, 2006). AR enhances UX by revealing more product information than products without AR, which results in higher UX at the time of purchase, reduces users' anxiety (Huang & Liu, 2014), and facilitates decision-making (J. Kim & Forsythe, 2008a, 2008b). AR facilitates user involvement and thereby enhances the hedonic value of experience (J. Kim & Forsythe, 2008b), which

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provides users the ability to share personalized experiences on social networks, thus enhancing playfulness (Huang & Liu, 2014). AR generates user satisfaction (US) through experiential value (Yuan & Wu, 2008). Additionally, AR is also able to influence US before the buying process (Bulearca & Tamarjan, 2010). User Willingness to Buy (UWB) is also impacted by an AR-enriched UX. Virtual objects and the information contributed by AR may heighten user's enjoyment and mental imagery (Schlosser, 2003), which in turn may stimulate UWB (Huang & Liu, 2014; J. Kim & Forsythe, 2008a).

AR has been studied and applied in various contexts, such as tourism (Jung, Chung, & Leue, 2015), museums (tom Dieck & Jung, 2018), retailing (Rese, Baier, Geyer-Schulz, & Schreiber, 2017; Spreer & Kallweit, 2014) and others (Javornik, 2016a, b; Stockinger, 2016). AR represents an innovative media format that integrates virtual information into a user's perception of the real-world. The 'Pokémon Go' mobile app is a well-known example where users catch virtual creatures projected over the real-world as viewed through a smartphone (Rauschnabel, Rossmann, & tom Dieck, 2017). Applications such as virtual mirrors (screens where consumers can see themselves wearing virtual clothes (Beck & Crié, 2018), furniture planners (apps that allow you to see furniture in your home (Rese et al., 2017; Rese, Schreiber, & Baier, 2014), and virtual make-up trials are examples of AR in marketing applications.

The literature on AR has emphasized the technological aspects of AR, but it has neglected the end user's needs and problems (Swan II, Gabbard, & Hall, 2005). Yet, AR is increasingly employed in designing and delivering products, even though research has not been able to catch up with the trend from a marketing perspective (Kozick & Gettliffe, 2010; Swan II et al., 2005). Recently, manufacturers announced their efforts to enter consumer markets with a novel technology that is termed 'Augmented Reality Smart Glasses' (ARSGs), which—broadly speaking—realistically integrates virtual objects into a user's view field in glasses-like devices. While Google Glass, one of the first commercially launched ARSGs, has received a lot of media attention, its success in consumer markets was limited. However, recently many other companies joined in the field to develop their own commercially available ARSGs like Vuzix Blade, Epson Moverio BT-300, Solos, Everysight Raptor. Initial support for these ARSGs were limited but they have received some software updates to add many other features like video streaming, drone control, etc. Some well-known companies have developed their own versions of ARSGs for different purposes, for example, Amazon Echo Frames, Snap Spectacles, Microsoft HoloLens, etc. Studies suggest that other devices such as HoloLens are much more promising due to their holographic possibilities and gesture control.

Interaction, navigation, and immersion are the common properties of augmented reality and virtual reality applications (Di Serio, Ibáñez, & Kloos, 2013). Interactivity is defined as the users' capacity to modify and receive feedback to their actions in the reality where the experience is taking place (Carrozzino & Bergamasco, 2010; Muhanna, 2015). Different media offer different levels of interactivity and, therefore, there is a continuum ranging from low behavioral interactivity (navigation control) to high interactivity (capacity to control and modify the environment) (Bowman & Hodges, 1999; Muhanna, 2015). External devices, such as computers or smartphones, provide an

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indirect interactivity through clicking and pressing keys that transform these actions into activities shown on the screen. Internal technological tools, such as HMD or haptic gloves, provide direct and sensory-based levels of interactivity due to their greater capacity for behavioral tracking (gestures, movements, and gazes) thereby increasing realism.

Exploring a large virtual environment usually required lots of space in the real world. Consequently, many systems related to virtual environment exploration could only be realized in small scale or using a controller to move in the virtual world. Using controller to control movement in the virtual world will provide one solution, but consequently the system will not provide natural feeling for the users. Another possible solution is to use walking in place principle to explore a large virtual reality environment, so we do not need to provide lots of space in the real world (Tregillus & Folmer, 2016; Wilson, Nguyen, Harris, & Williams, 2014).

Technological embodiment plays a key role in creating immersive experiences due to its ability to involve the human senses (Biocca, 1997). Immersion allows users to better focus on what is in front of them and extend their perception of time, which may result in positive effects on satisfaction with the experience (Rudd, Vohs, & Aaker, 2012). For instance, fully immersive VR equipment offers a sense of embodiment since users see themselves as components of the virtual environment, feeling that the VR devices (HMD, gloves, etc.) belong to their own bodies (Shin, 2017). Other artifacts, such as AR and MR glasses, are expected to revolutionize consumers' behavior by extending their perceptual body, adapting the technological capabilities to the users' skills (I. Tussyadiah, 2014). Accordingly, technological embodiment involves the integration of the technological devices into the human body and this, as a consequence, will serve to extend the participants' natural abilities by enhancing their motor and perceptual skills, improving their experiences (I. P. Tussyadiah, Jung, & tom Dieck, 2017).

The increasing importance of AR in marketing can already be traced in practitioner-oriented publications (Bona, Kon, Koslow, Ratajczak, & Robinson, 2018; Kunkel, Soechtig, Miniman, & Stauch, 2016) as well as recent academic work (Hilken, de Ruyter, Chylinski, Mahr, & Keeling, 2017; Javornik, 2016b; Poushneh & Vasquez-Parraga, 2017; Scholz & Duffy, 2018). Marketing scholars have recently realized the need for research on AR. In particular, extant research shows how and why consumers interact with branded AR (Huang & Liu, 2014; Poushneh, 2018), how AR drives consumer decision making (Beck & Crié, 2018; Hilken et al., 2017; Javornik, 2016b), factors that determine in-app purchases in AR games (Rauschnabel et al., 2017), and how scholars should address these challenges (Javornik, 2016a). Likewise, on a strategic level, a few studies proposed strategic frameworks for the management of AR (Scholz & Smith, 2016) or studied how companies promote AR (Feng & Mueller, 2019).

Mixed reality elements have played a role in many behavioural aspects of consumers for example, Javornik (2016b) showed that perceived augmentation represents a fitting concept for understanding consumer responses to AR features and, furthermore, that flow mediates effects of perceived augmentation on consumers' affective responses and behavioural intentions. Virtual Fitting Rooms (VFR) where consumers can try clothes virtually increases specific curiosity about the product, intention to patronize (online and offline) and intention to purchase (online

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and offline (Beck & Crié, 2018). Huang & Liu (2014) found that narrative experience induces a higher experiential value than other simulative experiences, including presence and media richness. Poushneh (2018) indicated that individuals pay attention to both the privacy of their personal information as well as augmentation quality. The results also indicated that the ability to control access to personal information significantly affects user satisfaction.

Therefore, several consumer-end industries (e.g. retailing, tourism, fashion, entertainment, automotive, services) can provide their customers with improved experiences by using these cutting-edge, reality-virtuality technologies. For example, in pre-purchase situations, the consumer may foresee how their living room would look with new decoration or to "try on" clothes before going to a store - with AR applications, or anticipate the experience of riding a roller coaster with a VR HMD. During consumption situations, consumers might use VR devices to study the wine making process during a wine-tasting session. Thanks to AR development, they might look at real-time GPS information on their windshields while driving. In the post-purchase stage of the journey, the consumer might receive immediate assistance as to how to repair a washing machine, using MR glasses, or create a 360-degree VR video about a recently taken trip.

3.2 Environmental mediators

Atmospherics are key determinants of enjoyable shopping environments and have been shown to impact consumers' emotional states and, in consequence, shopping outcomes (Roschk, Loureiro, & Breitsohl, 2017). The retail atmosphere is one of the most active areas of retailing studies. Research on how retail environments can affect consumer behaviour owes much to the work of Kotler (1973). Coining the term "atmospherics", Kotler (1973) argued that buying environments can be purposefully designed to produce specific emotional effects in shoppers, thereby enhancing their purchase probability. Donovan & Rossiter (1982) applied the pleasure, arousal, and dominance model of (Mehrabian & Russell, 1974) to retail settings, in the belief that analysing retail space according to these dimensions could effectively predict customer behaviour (see Crowley, 1993). Since the work of Donovan & Rossiter (1982), researchers have largely explored how individual atmospheric variables such as music (e.g. Milliman, 1982; Morin, Dubé, & Chebat, 2007; Yalch & Spangenberg, 2000), colour (e.g. Bellizzi & Hite, 1992), odour/scent (e.g. Hirsch, 1995; Michon, Chebat, & Turley, 2005; Spangenberg, Crowley, & Henderson, 1996), lighting (e.g. Areni & Kim, 1994), and crowding (e.g. Machleit, Eroglu, & Mantel, 2000) can affect a range of outcomes in retail stores, treating them as independent causal effects. These outcomes have included affective responses (e.g. Bellizzi & Hite, 1992), shopping duration (e.g. Yalch & Spangenberg, 2000), merchandise evaluations (e.g. Areni & Kim, 1994), and shopping satisfaction (e.g. Machleit, Eroglu, & Mantel, 2000).

Similarly, online retailers could provide an atmosphere via their website which can affect shoppers' image and experience with the online store (S A Eroglu, Machleit, & Davis, 2000). To that end, A. P. Vrechopoulos, O'Keefe, & Doukidis (2000) introduced the term "Virtual Store Atmosphere" in web retailing and then Siomkos & Vrechopoulos (2002) first developed the "Virtual Retail Mix" including "Virtual Store Atmosphere" as an element of this mix. Along these lines, Constantinides (2004) stated that website atmospherics, such as layout and product

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presentation, have the potential to engage consumers in unique and enjoyable experiences. Customers perceive servicescapes holistically (Bitner, 1990; Mattila & Wirtz, 2001), so multiple store environment cues likely influence their perceptions of value and their subsequent behaviors (Baker, Parasuraman, Grewal, & Voss, 2002). Retailers need to do the same if they are to effectively manage their store environments. Store atmospherics seek to make retail environments more enjoyable for shoppers (Brand, 1963), thus encouraging them to stay longer, and, ultimately, to spend more, and/or return more frequently. Although there are several studies addressing specific atmosphere factors (e.g. El-Adly & Eid, 2016; Garaus, Wagner, & Kummer, 2015; Sachdeva & Goel, 2015), there is a limited number of studies looking simultaneously at the whole set of factors.

There are, of course, virtual store environments which can involve a holistic store atmosphere experience, as shown by Parsons & Conroy (2006), and there have been a number of studies that have examined aspects of store atmosphere on the internet (Carvalho, Pianowski, & Gonçalves, 2020; Cheng, Wu, & Yen, 2009; Krasonikolakis & Vrechopoulos, 2009; Menon & Kahn, 2002; Ng, 2003; wu, Lee, fu, & Wang, 2013). Virtual Reality Environments (VREs) by the help of technology can provide an environment where participants meet all five human senses (vision, hearing, olfaction, touch, and taste through electronic tongue). This is considered as an important cue of VREs, enabling telepresence and interactivity (Steuer, 1992) which results in highly vivid and enjoyable interfaces where the user has the control in modifying elements of the environment in real time. Ballantine, Parsons, & Comeskey (2015) provides holistic understanding of how retail atmospheric cues can influence the overall retail experience; from how a retail store is initially evaluated through to the intention to purchase.

Berman, Barry, and Evans (1995) divide atmospheric stimuli or elements into four categories: the exterior of the store, the general interior, the layout and design variables, and the point- of-purchase and decoration variables. Moreover, in an extensive review of the atmospherics literature, Turley & Milliman (2000) developed a systematic classification of atmospherics 'to consolidate the knowledge gained in this area and to encourage additional research' based on a review of experimental evidence. This classification includes five categories: external variables; general interior variables (GIV); layout and design variables; point-of-purchase, and decoration variables; and human variables in which total 57 specific cues were identified.

The typology of Turley & Milliman (2000) constitutes the most comprehensive classification of atmosphere factors and provides an advanced guide for empirical studies examining the effect of each category. Using this classification will help strengthen and develop consumer behaviour theory in this area and lead to more comprehensive theoretical and managerial implications. Furthermore, it will allow retailers to have a more adequate and comprehensive approach to differentiate their retail environment from competitors.

The focus of the future studies will be on atmospheric cues defined by Turley & Milliman (2000), which are the following:

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External variables: The external variables include the storefront, marquee, entrances, display windows, building architecture, the surrounding area, and parking. The amount of research of external variables is less than other variables. Mower, Kim, & Childs (2012) indicated the presence of window display and landscaping influenced respondents' liking of the store exterior and patronage intentions. Hyllegard, Ogle, Yan, & Kissell (2016) shows that landscaping, store greeter, electronic kiosk had relatively minimal impact on college students' emotional states and liking of the storefront.

General interior variables: This category includes such variables as flooring/carpeting, lighting, scents and sounds, temperature, cleanliness, wall textures, and colour usage. GIV surround consumers while they are in the shopping venue, during the actual shopping visit, and have a key role in influencing consumers' mood and experience. Elmashhara & Soares (2020) studied the influence of GIV on shoppers' emotions and behaviour in shopping malls. Moreover, GIV have an impact on consumers' behaviour even if they are not consciously aware of them (D'Astous, 2000; Jani & Han, 2015). Terblanche (2018) argued that the internal shop environment has a strong positive relationship with cumulative customer satisfaction, therefore, with re-patronage intentions.

Layout and design: Included in this category are variables such as fixtures, allocation of floor space, product groupings, traffic flow, department locations, and allocations within departments. A long list of attributes has been researched, including layout and store design (Ainsworth & Foster, 2017; Murray, Elms, & Teller, 2017), shelf space, and display (Daunfeldt & Rudholm, 2014; Lindström, Berg, Nordfält, Roggeveen, & Grewal, 2016).

Point-of-purchase and decoration: This category includes product displays, point-of-purchase displays, posters, signs, cards, teletext messages, and wall decorations. Blazquez, Boardman, & Xu (2019) show that atmospheric cues and design features have a significant impact on the perceived brand image and on both impulse and non-impulse purchase behaviour, also the influence of product displays on purchase behaviour.

Human variables: This category includes customer crowding or density, privacy, customer characteristics, personnel/employee characteristics, and employee uniforms. Human variables with social mediators will be considered in the next section.

3.3 Social mediators

Human-related environmental stimuli, i.e., Human variables or social elements/cues can be subclassified into two large categories namely, the effect of other customers, and the effect of sales associates, each of which includes some sub-dimensions. As an illustration, number of other customers (human crowding) and social relations can be considered as the subdimensions of the effect of other customers, and physical attributes like dressing and Behavioral attributes of the salespersons can be counted as sub-dimensions of the effect of sales associates as shown in Figure 1 (J. E. Kim & Kim, 2012). By emerging the Virtual Reality (VR) and Augmented Reality (AR) technologies and using this environment in retailing, another category can be added to the two aforementioned categories which is the effect of the appearance of the shoppers on themselves. This type of effects

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can appear either through avatars which are the representatives of the shoppers in the virtual shops, or through magic or smart mirrors implemented in the VR or AR (Boardman, Henninger, & Zhu, 2020; Javornik, Rogers, Moutinho, & Freeman, 2016; Moon, Kim, Choi, & Sung, 2013).

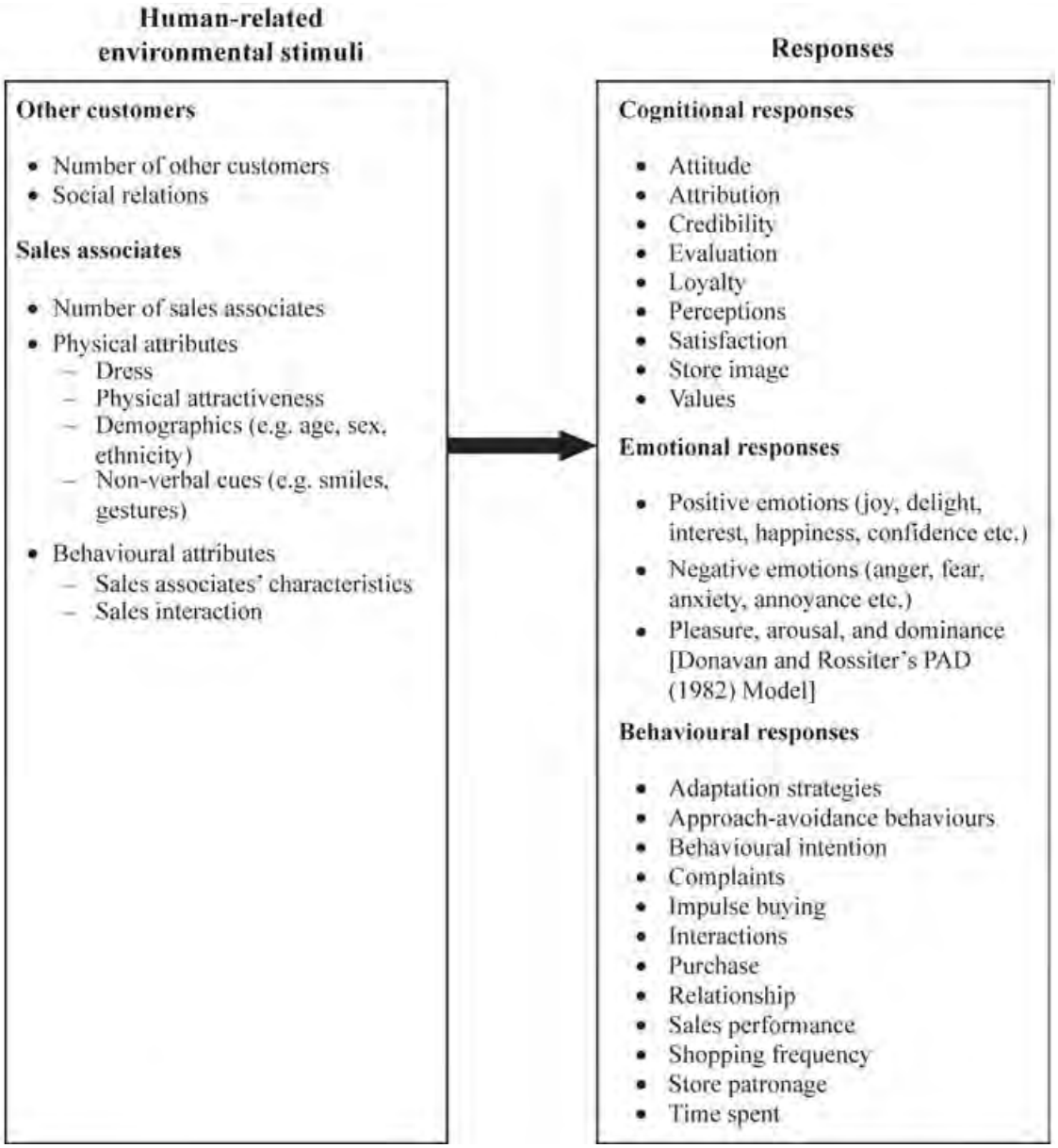

Figure 1 Conceptual framework of human-related environmental stimuli and responses. (J. E. Kim & Kim, 2012)

In the category of the effect of the other customers, considering the literature, many studies investigated the crowding issue as the impact of other consumers as an environmental variable (Turley & Milliman, 2000). Crowding in a retail store can be considered as actual shopper density or perceived crowding (Harrell & Hutt, 1976). The perception of crowding occurs when a shopper thinks

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that the available space is scarce and it restricts the freedom for his activities (Sevgin A. Eroglu, Machleit, & Barr, 2005). Perceived crowding consists of two dimensions: human crowding perceptions resulted from the number of people in a certain space and spatial crowding perceptions created by store configuration and number of the objects (Machleit, Kellaris, & Eroglu, 1994). Emotions arising as a result of crowding perceptions can impact on shopping satisfaction. Atmospherics researchers have found that shoppers who are confronted with a large number of other shoppers in stores and shopping malls, can experience a feeling of crowding, which in turn, it adversely affects the consumer attitudes towards the store and shopping satisfaction (Sevgin A Eroglu & Machleit, 1990). Previous studies tried to reduce the perceptions of crowding and consequent outcomes by manipulation of atmospheric elements. For instance, Eroglu et al. (2005) investigated the relation between music and crowding perceptions in a shopping mall. Bateson & Hui (1987) findings says that dominance is correlated with pleasure and personal control and is negatively correlated with crowding. They confirmed the results in a subsequent crowding study (Hui, Bateson, Hui, & Bateson, 1991). Moreover, in a recent study, Van Kerrebroeck et al. (2017) investigated the impact of Virtual Reality entertainment in a store on consumers' attitudes, approach/avoidance behavior, satisfaction and loyalty intentions, considering perceived crowding. According to their findings, consumers reported more positive responses on all measured outcome variables after being exposed to the Virtual Reality experience. In addition, the impact on mall attitudes, satisfaction and loyalty is more noticeable in the situation of higher perceived crowding. On the contrary, some findings in the context of discount stores or hypermarkets suggest that the high human crowding may have positive impact on pleasure as it delivers a cue of bargains (J. G. T. Li, Kim, & Lee, 2009).

The other category of human variables associates to the retail salespersons. The appearance of retail employees is critical since it conveys the attributes of the firm to the consumers (Solomon, 1985). According to Bitner (Mary Jo Bitner, 1990) a disorganized environment with an employee in less than professional apparel can influence a customer’s attributes and satisfaction in the time of service failure. Baker, et. al., investigated the effects of social cues namely, number and friendliness of employees, and they found that the more social cues present in the store environment, the higher subjects’ arousal (Baker, Levy, & Grewal, 1992). In another work, Baker, et. al., studied the impact of salespersons in aprons and greeting the customers on the perceptions of service quality in a retail environment (Baker & others, 1986). Based on their findings, the store with the prestigious social factors (more salespersons, wearing aprons, and greeting customers) were seemed as a higher service quality than less social factors (one salesperson, wearing no apron, and not offering a greeting).

Today’s world has another retailing channel in the form of 3D immersive virtual reality retail stores in which not only do sellers have more opportunities to sell their products, but also consumers have multichannel access for shopping. Hence, these innovative shopping channels should be investigated from a consumer’s point of view (McGoldrick & Collins, 2007). There is an excess of research on traditional and web retail settings and their effects on wide-ranging of consumers’ emotions and behaviors. Yet, in the case of VR retailing the research is still in its early stages (Munir, Barry, & Asma, 2016). By reviewing the literature, as the early researches conducted to investigate the VR-based stores atmospherics can mention the works done by (A. Vrechopoulos, Apostolou, & Koutsiouris,

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2009), Krasonikolakis et al. (2011), and Hassouneh & Brengman (2015). Vrechopoulos et al. (2009) opened the door for further study of VR-based stores' atmospherics cues such as crowding, sounds and store theatrics. In the VR framework, not only are the previous models required an investigation, but also further investigation is required for emerging factors such as self-social cues coming to existence embodiment in an avatar or magic mirrors. Hence, the following paragraphs are dedicated to review the social cues in VR.

As an intrinsic feature of VR, it enables the users to interact with others in real time in a 3D simulated immersive environment (Kaplan & Haenlein, 2009). Another unique feature of VR is that users can create fully customized virtual self-presentations in the form of avatars. Users can create an avatar that represents the user's real or ideal self (Kaplan & Haenlein, 2010). A social aspect of consumers' avatar-based behavior in VR is the concept of social presence. Social presence or the sense of "being with others," is a distinction factor in virtual reality (Biocca, Harms, & Burgoon, 2003). Several researches have confirmed the effect of social presence on a consumer's experience in a virtual shopping environment. For example, Holzwarth et al. (2006) found that the social presence created by an avatar on a shopping website generate more positive brand attitude, greater satisfaction, and higher shopping intention. Other studies has suggested that social presence is enhanced by humanoid agents, such as virtual salespeople (Nowak & Biocca, 2003). Shoppers practice a greater social presence when they feel an avatar is a digital representation of another human than a computer-controlled agent (Guadagno, Blascovich, Bailenson, & Mccall, 2007; Guadagno, Swinth, & Blascovich, 2011). Shopping in VR provides a situation for customers to see others such as salespeople and peer shoppers, and to communicate with them in real-time. Moreover, VR allows avatars to take the form of sophisticated, realistic, 3D graphic, humanoid representations. These avatars, with their eye-contact and mimicking of human-like gestures, improve the social interactions. Shoppers can experience a solid sense of social presence and enjoy a more pleasing shopping experience than they would in conventional online stores (Papadopoulou, 2007). Salesperson avatars and peer consumer avatars are two types of interactive avatars that add to the consumer's perceived level of social presence in virtual shopping environments.

Previous studies have documented the constructive impact of sales associates on a customer's shopping enjoyment, attitude toward brand, and purchase intention in conventional brick-and-mortar stores. These researches propose that the interaction between salesperson and customers can enhance the enjoyment of shopping, satisfaction, and purchase intention (Babin, Babin, & Boles, 1999; Reynolds & Beatty, 1999). Besides, the close relationship of a sales personnel and a customer can create social encounter which in turn motivates the consumers to keep the bond with the brand (Chang, 2006; Jap, 2001). In virtual shopping environments, salesperson avatars can play the role of shopping assistants or company representatives. In a research Papadopoulou (2007) has proposed that salesperson avatars can satisfy a shopper's desire for face to face communication during shopping. Moreover, according to Jin & Bolebruch (2009) a humanoid avatar in a virtual store enhances the consumers' shopping enjoyment, product involvement, and brand attitude. In VR, social encounters of consumer avatars and salesperson avatars occur realistically.

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Another social interaction in a virtual shop can happen between peer shoppers. Several researchers have proposed the social aspect of these encounters as an important motivation for shopping (Roy Dholakia, 1999), but it is difficult in today's web-based shopping for consumers to enjoy a social experience which can be one of the reasons the a lot of consumers still choose brick-and-mortar shopping over online shopping. This gap can be covered by virtual environment with some of its offering features such as being multiuser, real-time, and avatar-based. Shoppers can experience shopping with other consumers, either strangers or close friends and family members. According to the literature, the one of the important of shopping facilitator is the social interaction among stranger shoppers (Tauber, 1972) by discussing the products, exchanging social pleasantries, and offering product advice (Harris, Baron, & Parker, 2000; McGrath & Otnes, 1995). Furthermore, pleasant communications with other customers improve the consumer satisfaction and enjoyment (Harris, Davies, & Baron, 1997). Based on the literature, a significant amount of research has investigated the influence of social interaction between salesperson and consumer or consumer with themselves, yet the potential interaction impact between both types of social exchange remains mostly unexplored in online and especially virtual shopping environments.

3.4 VR and social mediators

There are many areas of social interaction between people where it is important to have a good scientific understanding of their influence on shopper behavior. It is problematic to carry out experimental studies in this area for reasons discussed below. However, immersive VR provides a powerful tool for the simulation of social scenarios, and due to its presence-inducing properties can be effectively used for laboratory-based controlled studies. with social psychology. Loomis et al. (1999) pointed out how VR would be a useful tool for research in psychology and Blascovich et al. (2002) in social psychology. Here, the potential benefits are enormous.

First, studies that are impossible in reality for practical or ethical reasons are possible in VR. Second, VR allows exact repetition of experimental conditions across all trials of an experiment. Moreover, virtual human characters programed to perform actions in a social scenario can do so multiple times. This is not possible with confederates or actors, who can become tired and also have to be paid. Although it is costly to produce a VR scenario, once it is done, it can be used over and over again. Also, the scenarios can be arbitrary rather than restricted to laboratory settings. Rovira et al. (2009) pointed out how the use of VR in social science allows for both internal and ecological validity. The first refers to the possibility of valid experimental designs including issues such as repeatability across different trials and conditions, the precision at which outcomes can be measured, and so on. The second refers to generalizability.

In particular, VR can be used to study extreme situations that are ethically and practically impossible in reality. This relies on presence – Place Illusion and Plausability Illusion – leading to behavior in VR that is sufficiently similar to what would be expected in real-life behaviors under the approximately the same conditions.

Zaki and Ochsner (2009) stress three critical ways that real-life social information differ from laboratory stimuli. Specifically, they discuss the ways in which cues about target states in the real world are: (1) Multimodal (include visual, semantic, and prosodic information); (2) Dynamic in that

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stimuli are presented serially or concurrently to participants over time; and (3) Contextually embedded so that participants are presented with stimuli and environmental information that can frame their interpretation of another's internal states. Multimodal stimuli are important for an ecologically valid social neuroscience because social mentalizing and interactions occur in situations that involve the convergence of multiple channels such as auditory perception of social cues (verbal utterances, intonation, prosody); visual perception of social cues (nonverbal communication, gestures, postures, facial expressions); and emotional perception (positive and negatively valenced representations ofthe other's internal states).

Zaki and Ochsner (2009) emphasize the importance of the emotional modality because early neuroimaging studies of emotion treated cognitive phenomena as qualities (shape, size, or color) of a stimulus. They give the example of showing participants negatively valenced stimuli (e.g., gruesome picture) and then infer that this caused the participant to experience negative affect without actually measuring the participant's subjective experience or other behavioral indices of emotional responding.

Need for dynamic stimuli

There is also need for greater emphasis upon dynamic stimuli that will allow assessment of participants as they act upon stimuli interactively instead ofa passive response to static stimuli. While limiting stimuli to static representations with constrained variance along tractable dimensions is important for maintaining experimental control over the social cognitive processes studied in an experiment, such experimental constrictions can result in artificially constrained understandings of the social cognitive processes involved. There is a need to emphasize dynamic stimuli that reflect real-life interactions in which participants react to dynamic stimuli in an interactive way that modifies subsequent dynamic stimuli. An unfortunate limitation of many social neuroscience approaches is that the participant is presented static and controlled stimuli that lead the participant to believe and act ''as if'' the participant could modify the course of a social interaction. As such, many current social neuroscience approaches do not include real-time dynamic and adaptive virtual agents with complex cognitive architectures (Faur et al., 2013). Although advances in technologies now allow dynamic interactions with intelligent virtual agents, many constraints on experimental designs and subsequent statistical analyses often restrict.

Contextualized succession of events (narratives)

In addition to multimodal and dynamic stimuli, ecologically valid social neuroscience paradigms also involve the contextualized succession of events that are intuitively clear when associated within a sequence. While many social neuroscience approaches use various stimulus approaches (comic-strips, video-based mental state inferences) to depict an agent performing actions following a specific schema, they often do not promote a context that will prompt the participant to have an invested interest in this agent. Without adequate social context, the participant may not enter experience an empathetic relationship with the agent. Further, given the assumption that social interaction may be experienced as motivating and rewarding, social neuroscience approaches should implement a social context that allows for assessment of motivations to interact socially. Social neuroscience experiments place participants in a scanner and instruct them to fixate on stimuli presented on a monitor. Neuroimaging resulting from such studies appears to be significantly dissimilar to studies in which the participant is performing such tasks together with another agent. The addition of another

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agent results in a differential increase of neural activity in brain areas that have been related to grasping another's mental states (Schilbach et al., 2008).

In recent years, several studies has been conducted using VR for study several aspects of social interactions like proxemics, and embodiment among others.

Proxemics is the study of interpersonal distances between people, discussed in depth by Hall (1969). He defined intimate, personal, social, and public distances that people maintain toward each other (and these distances may be culturally dependent). An interesting question is the extent to which these findings also occur in VR. If a virtual human character approaches and stands close to you, in principle this is irrelevant since nothing real is happening – there is no one there. Even if the character represents a physically remote actual person who is in the same shared virtual environment as you, they are not really in the same space as you, and therefore not close. There has not been a great deal of work on this topic that has exploited VR. Bailenson et al. (2001) showed that people tend to keep greater distances from virtual representations of people than cylinders in an immersive VR. This work was continued in Bailenson et al. (2003) where it was shown that participants maintain greater distances from virtual people when approaching them from the front, than from the back, and also greater distances when there is mutual eye gaze. Participants also moved away when virtual characters approached them. Readers might be wondering – so what? This is obvious. It has to be remembered though that these are virtual characters, no real social interaction is taking place at all. Further studies have shown that proxemics behavior tends to operate in virtual environments (Guye-Vuilleme et al., 1999; Wilcox et al., 2006; Friedman et al., 2007).

VR offers a very powerful tool for the neuroscience of body representation. For a recent review of this field, see Blanke et al. (2015). It can be used to do effectively and relatively simply what is impossible by any other means – instantly produce an illusion of change to a person's body.

Yee and Bailenson (2007) introduced a paradigm called the "Proteus Effect," where it was argued that the digital selfrepresentation of a person could influence their attitudes and behaviors in online and virtual environments. Essentially, the personality or type of body or the actions associated with the digital representation would influence the actual real-time behaviors of participant, both in the VR and later outside it. In their 2007 paper, they showed that being embodied in an avatar that had a face that was judged as more attractive than their actual one led participants to move closer to someone else displayed in a collaborative virtual environment than those participants whose avatar face was judged less attractive. Similarly, being embodied in taller avatars led to more aggressive behaviors in a negotiation task than being embodied in shorter avatars. These results also carried over to representations in online communities (Yee et al., 2009). Groom et al. (2009) embodied White or Black people in a Black or White virtual body, in the context of a scenario in which they were in an interview applying for a job. The embodiment was through an HMD with head tracking, with the body seen in a mirror, and lasted for just over 1 min. Using a racial Implicit Association Test (IAT) (Greenwald et al., 1998), they found after the exposure there was greater bias in favor of White for those embodied in the Black virtual body. This difference did not occur when participants simply imagined being in a White or Black body.

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Hershfield et al. (2011) studied the effect of embodiment in aged versions of themselves on their savings behavior. They embodied people in a virtual body that either had a representation of their own faces, or their faces aged by about 20 years. The virtual body was shown in a virtual mirror. They found some modest evidence in favor of the hypothesis that being confronted with their future selves influenced their behavior toward greater savings for the future.

One of the few studies about VR and social interactions in virtual shoppings has been proposed by Yoo et al (2015). This study examined how operating elderly or young avatars affected shoppers' product perceptions and purchasing behaviors. Results showed that walking speed in a virtual store was significantly slower among the participants operating elderly avatars than among participants using young avatars. Additionally, the age of a shopper's avatar affected product choice in a 3D online commerce setting. Participants operating elderly avatars chose the magazine related to the elderly more frequently than the participants in the young avatar condition. This study also investigated how pre-existing biases, prejudices, and stereotypes moderated the effects of avatar priming. The results showed that participants with high ageism were not affected by the exposure to the elderly avatars as much as participants with low ageism were. When participants were low in ageism, they appeared to assimilate with the elderly avatars, and the priming outcomes were stronger because participants' real and virtual identity were attitude-congruent. This enabled the activation of the constructs associated with the elderly, and those constructs were non-ageist. When participants were high in ageism, their high levels of ageism led to identity contrast effects between their real identities and their virtual identities, thus weakening the effect. Because they did not connect with the avatars, the priming effects were weaker on more ageist participants.

3.5 Narratives mediators

In the emerging field of mixed reality technologies, there is an increasing use of content, which is mediated through interactive storytelling techniques. In this context, narratives may be used as rhetorical devices for influencing or guiding human decision-making in different commercial applications. On the other hand, the narrative mode has been widely recognized as a fundamental human cognitive faculty to make sense of the world.

Therefore, it is relevant in RHUMBO to investigate the narrative cognitive faculties that may have relations to decision-making in immersive systems. Usually, this kind of faculties are investigated based on subjective explicit measures using questionnaires, interviews etc. In RHUMBO we attempt to characterize the effects of narratives in decision-making by the use of implicit psychophysiological measurements, such as brain activity, heart rate, galvanic skin response and eye tracking, when making choices in immersive environments.

Current state-of-the-art in the interdisciplinary study of interactive narratives and immersive technologies is extending narrative interactions to mixed reality systems. Most contributions have been developing narrative frameworks for VR and Mixed Reality Systems (e.g. Kors et. al. 2016; Hardee, 2016; Olsson and Salo 2012; Nakevska, 2017; Ostrin et.al. 2018), but the cognitive aspect of narrative involvement in mixed reality systems has been very little investigated. Furthermore, there has not been an easy relation between cognitive science and narrative studies (Ryan, 2010).

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Postclassical studies of Narrative have taken advantage of cognitive sciences (including various fields such as psychology and linguistics). After the "post-structuralism revolution", studies under the label of "cognitive narratology" begun to rise in the last two decades (Herman, 2007). Since then, there has been a rising interests in the cognitive aspects of narrative generation and intelligibility (Finlayson, 2013; Sanford and Emmott; 2012; Ryan, 2006; Ryan, 2010; Bruni et. al., 2014; Bruni and Baceviciute, 2014; Bruni and Baceviciute, 2013).

There has been a lack of studies, which explore the cognitive faculties during a narrative experience in mixed realities. Most of the previous work has been on comparing the brain activities during a narrative with a non-narrative situation. In RHUMBO we explore and define metrics for activated cognitive faculties during a specific narrative trajectory in a virtual experience in marketing (VEM) (Alcañiz et al, 2019). To define these metrics, the idea is to identify what are the "features" or "parameters" in an (interactive) narrative experience that could be of interest. In our case, we will concentrate on what we call the "hindsight" and "foresight" loop, for which we are constructing a theoretical and empirical framework. The next step in the framework is to define what are the cognitive processes, faculties, or tasks that are related to hindsight and foresight (e.g. episodic and semantic memory, attention, and anticipation). Finally, based on these cognitive faculties, we will define the psychophysiological markers and metrics for characterizing these features during the narrative involvement of the consumer in a virtual experience in marketing (VEM).

Narrative foresight focuses on the answer to the question "what comes next?" based on the information from past events (Milojević and Inayatullah, 2015). When we are trying to answer this question, we are imagining future events. When developing foresight, it is essential to consider the kind of information on which this activity is based (Schwarz, 2015). Moreover, foresight has been argued to be intrinsically linked to hindsight (MacKay and McKiernan, 2004; Ingvar, 1985), which again is related to information absorbed from past events. It has been stated that foresight is a key human survival strategy, and by the same token, episodic memory (as claimed by Ingvar, 1985, "memories of the future") may indeed have evolved to support the "foresight system" (Suddendorf, 2010). A study on the concept of envisioning the future (which may have some relations with foresight) introduced two different sets of brain regions which play roles in processing the simulated past and future (Szpunar et. al., 2007). One set of regions was more active while envisioning the future than while recalling the past (and more active in both of these conditions than in a task involving imagining another person), and the second set of regions demonstrated indistinguishable activity during the future and past tasks (but greater activity in both tasks than in the imagery control task).In our perspective, "storifying" our experience implies grasping together and integrating into a whole what would otherwise be perceived as multiple and scattered events. This brings together goals, causes, characters, events, objects, etc, together within the temporal unit of a whole and complete action, and in fact includes must of the other mediators listed above (MRM, EM, and SM).

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4 Experimental design for mediator experiment

4.1 General aspects

After analyzing in section 3 the state of the art about RHUMBO's mediators, and given the time and resources constraints, RHUMBO will focus on the study of Mixed Reality Mediators (MRM) and Social Mediators (SM).

The main objective for these studies is to show that **the introduction of theses mediators into the shopper experience introduce significant changes in terms of shopper behaviour**. And analyze in which direction are these changes in terms of cognitive, emotional and economic dimensions.

Following are the proposed MRM and SM mediators:

4.2 General methodology for Mixed Reality Mediators experiments

Driven by the proliferation of MR technologies, many firms are pursuing a strategy of service augmentation to enhance customers' online service experiences. With MR, customers can dynamically engage with goods and services, for example by virtually placing an IKEA sofa in a real-time view of their living room, changing the Dulux colour of their wallpaper, or trying on the latest style of sunglasses, clothing, or makeup in a virtual mirror. Thus, MR helps customers see how products fit them personally or in their environments, while still maintaining the convenience of online purchasing. Although there has been an increase in research on MR, majority of aspects of consumer behaviour on MR is still unknown. Moreover, there is an innovation of technology every few years which changes current theories and requires further research. Researching AR is a cumbersome task, where the validation of research is done in physical environment, which has high physical constraints and low control over variables. Contrastingly, the manipulation of variables in VR is easier, cost effective and imaginative, where it is possible to simulate functionalities which are physically not possible (or may be possible in the near future), for example, viewing the interior of products. A possible solution to this is simulating the MR glasses interface over a VE. This will create a "simulation inside a simulation" giving endless opportunities to create different types of interfaces of current MR glasses, predicting the interfaces and functionalities of MR from the future.

As far as authors of this deliverable know, there are no studies which have simulated a MR glass over a VE to study the functionality of a MR glass let alone the behaviour of the consumers which will be using these MR glasses. Therefore, we plan to simulate MR glasses on a virtual store/hypermarket to provide additional details through MR interface to study different behavioural aspects of a shopper.

4.3 Description of MRM experiments

In this section, first a list of potential mixed reality mediators are listed regarding our revision of the state of the art and new functionalities that mixed realities will offer at new shopper experience. Then, among them a first set of mediators will be chosen to be conducted in the experiments of the RHUMBO framework.

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a. Marketing at shelf level

- Audiovisual Advertising content
- Personalized Promotions

Figure 2. Advertises implemented in AR-based shop.

b. Navigation Signage

- Signals to route shopper path
- Categories signage

Figure 3. Categories signage in AR-based shop.

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c. Product related content

- Augmented packaging
- Changes related to type of content:
  - Technical vs Emotional vs Marketing vs Social vs Economic vs Health related

Figure 4. Augmented packaging in AR-based shop.

d. Visual aspects for interface

- Way of representing data
  1. Analytic vs Holistic
  2. Visual vs Verbal vs Auditive
- Style of interfaces
  - Realistic vs Cartoon
- Layout of information augmented panels
- Comparison of products

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(a) (b)

Figure 5. The method of representation of the information in AR-based shop.

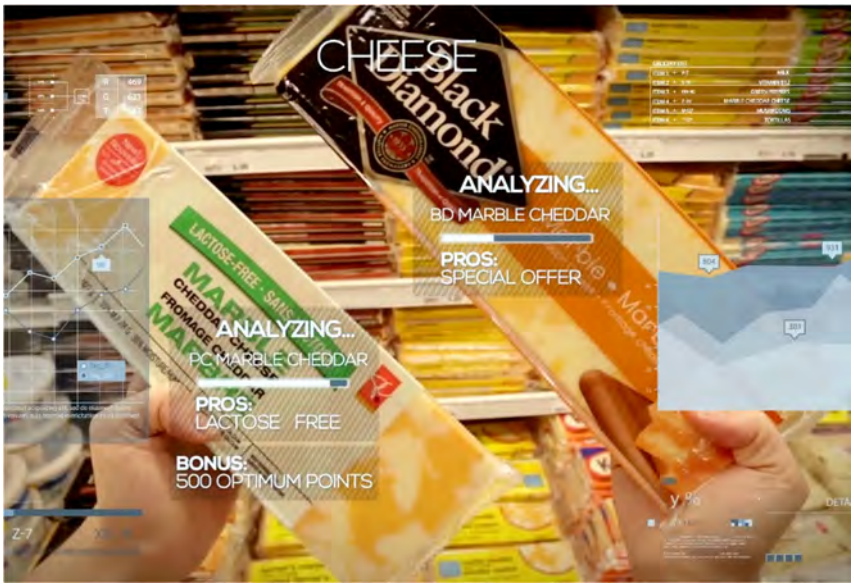

Figure 6. Comparison property in AR-based shop.

e. Interaction with augmented information

- Hand vs voice vs joystick

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f. Gamification aspects

Figure 7. Gamification in AR-based shop.

g. Personalization

- Personalized content vs generic content
- Recommendation of products

Figure 8. Personalized information in AR-based shop.

h. Logistic info (MRM)

- Time for cash out
- Ways to pay
- Augmented shopping list

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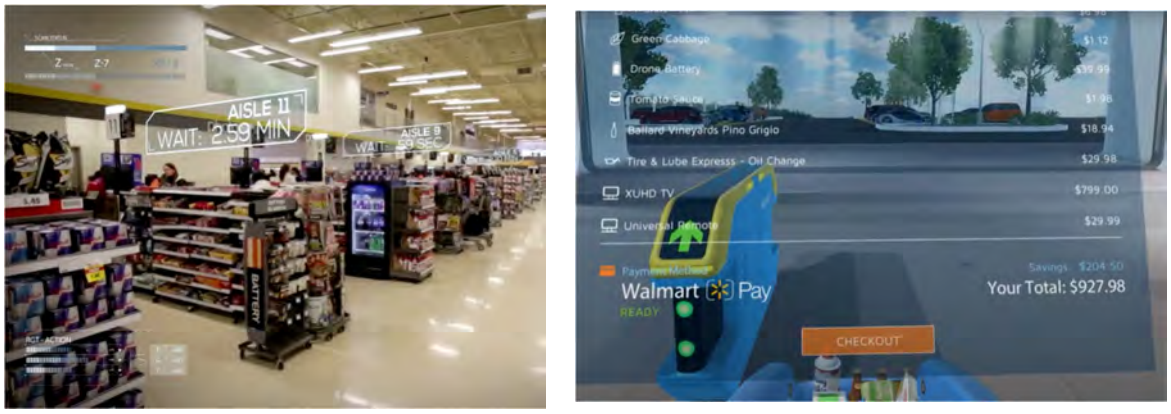

(a) (b)

Figure 9. (a) time for cash out, (b) payment method.

Experiment MRM 1

The VE developed for this experiment will be a multi-level 10x6 m2 virtual store with different types of shelves. To access each floor of the store, an elevator simulator will be used. The subject will do a free customer journey with no time limits and with a limited budget with a contextual pre-narrative (motivation for the subject).

Objectives:
To analyse the effect of the MRM product related content mediators in the shopper behaviour.

Selection of final design for mediators

In order to define the first set of mediators to product related information and their parameters, a series of pre-test studies will be conducted presenting several options for these mediators.

In these pre-tests a series of possible presentations of MRM stimulus related mainly with marketing and product related interaction will be designed following the previous list. On these possible mediators with different parametrizations will be presented in order to be tested:

Marketing campaigns at the shelf level	• Static images • Animated GIFS • Videos • 3D content • Personalized content
Promotions at the shelf level	• Static promotions • Animated promotions • 3D promotions

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	• Personalized promotions
Product related content	• Change of aspect of packaging • Technical vs Emotional vs Marketing vs Social vs Economic vs Health related • Personalized content • 3D content vs plan content • Only video vs audio + video • Interactive content

Table 1. List of possible mediators' effects for study 1

In a first step, our proposal is to employ a mixed design (between and with-in) in which two groups will complete two purchases of the two conditions. All conditions will be counterbalanced to reduce dependence of conditions on each other.

First, shoppers will be introduced to the technology in a neutral room where they will learn how to manipulate objects and navigate the environment and also how to employ MRM glasses that will be ready during experimental conditions.

In one condition the participants will have to make a purchase action in one of the 10x6 meters floor prepared regarding narrative without MRM mediators (control condition). In a second task in another 10x6 meters floor participants must complete a second purchase action regarding narrative with MRM mediators.

	Group 1	Group 2
All the purchase tasks with limited budget and no time limit	No MRM mediators	MRM marketing and product mediators
	MRM marketing and product mediators	No MRM mediator

Table 2. Mixed design for study 1

In a series of pre-tests, it will be decided if during MR mediators condition we keep only a dimension of MRM mediators from table 1 or if we combine more than 1 MRM mediators along the 10 x 6 meters space and/or levels of the store.

During the experiment proposed behavioural variables which will be studied:

Explicit responses:

- Products purchased
- Shopping time
- Budget spent
- Questionnaires

Implicit responses:

- Emotional response: Arousal

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- Visual attention
- Product interaction
- Navigation patterns
- Body posture
- Cognitive load

Experiment MRM 2

In this case the methodology proposed will be similar to methodology proposed in Experiment MRM 1 but tanking into account in this case MRM mediators related to navigation a logistic cues.

The VE developed for this experiment will be also a multi-level 10x6 m2 virtual store with different types of shelves. To access each floor of the store, an elevator simulator will be used. The subject will do a guided customer journey with no time limits and with a limited budget with a contextual pre-narrative (motivation for the subject).

Objectives:

To analyse the effect of different MRM mediators related to navigation at the store. The number and type of MR characteristics (mediators), above detailed, will be selected after conducting a series of pre-test studies.

In this case these possible mediators with different parametrizations could be:

Navigation	• Signage to route shopper path • Categories signage • 3D vs 2D content • Augmented Shopping list • Augmented map

Table 3. List of possible mediators' effects for study 2

The experiment will be similar to experiment MRM 1 but little changed as it will be guided navigation where the shopper will be asked to purchase the product s/he wants from the store given a particular shopping list and a limit budget with no time constraints. In the first task, navigational assistance condition will include the directions on the floor and signage over the head and on shelves describing the sections of products located on different floors on MR interface whereas no navigational assistance condition will not provide any directional help. All conditions will be counterbalanced to reduce dependence of conditions on each other.

Different types of MR interfaces will be studied which are defined in the following table:

	Group 1	Group 2
All the purchase tasks with shopping list, limited budget and no time limit	No MRM navigational assistance mediators	MRM navigational assistance mediators

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	MRM navigational assistance mediators	No MRM navigational assistance mediators

Table 4. Mixed design for study 2

Proposed behavioural variables which will be studied:

Explicit responses:

- Products purchased
- Shopping time
- Budget spent
- Questionnaires

Implicit responses:

- Emotional response: Arousal
- Visual attention
- Product interaction
- Navigation patterns
- Body posture
- Cognitive load

4.4 Description of SM experiments

In this section, first a list of potential experiments for conducting in the RHUMBO project will be discussed. Among these possible experiments, two tentative experiments are chosen to be carried out.

List of possible experiments

1. Self-social cues: in this conceptual experiment the impact of the avatar selected as a representative of the person on his/her behaviour and decisions will be examined. The possible independent variables for manipulation can be on the customers' age, gender, color, humanoid or fantasy avatar, etc. As an illustration, for manipulation of the age, it is possible to provide the person with a younger, older, or different-age avatar in the virtual environment. The other option is using a magic mirror to induce to the person that he/she has an old/young face. By manipulation of these parameters, it is expected that some behaviour of the person like speed of traveling in the shop, risk taking, purchase intention, etc. would change. In the same way, other demographics of the person can be manipulated to investigate their impacts on the consumers' behavior.

2. Peer customers' social cues: regarding this parameter there are several independent variables to be manipulated, each of which can be a separated experiment.
   - Customer agent representation: cartoon or humanoid, dressing, etc.
   - Number of other customers: none, low, or high crowded
   - Nonverbal cues: smiles, gestures, etc.
   - Demographics: age, race, gender

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According to the literature, the effect of existence of the other shoppers which is called crowding effect will cause stress by reducing the freedom of the consumers in the store. On the other hand, it might reduce the risk of shopping by communication between the peer costumers, either stranger or acquaintance, or by following the behaviour of the other customers. As an illustration, the act of purchasing a product by other customers might bring about confidence for other shoppers about this specific product and subsequently reduce their risk of purchase. Another possible impact of having companion in the shopping travel would be increment of joy for the customers. Figure 10 shows the concept of the existence of other shoppers in an augmented environment.

Figure 10. existence of humanoid shoppers in the shop and a companion in the shape of cartoonish dog during shopping.

3. Sales associates' social cues: in this regard there will be several options each of which can be examined in a separated experiment.
   - Existing of a seller
   - Representation of seller: humanoid vs cartoonish avatar
   - Way of interaction: voice vs type writing
   - Personalized or no personalized comments

Figure 11 shows two different kind of communications between the seller and the shoppers.

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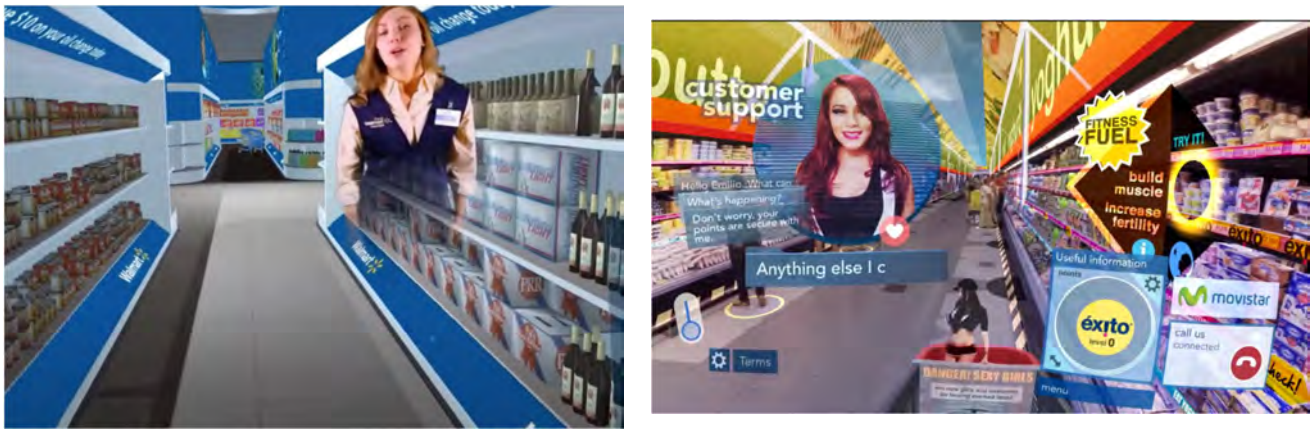

(a) (b)

Figure 11. (a) a seller constructing the shopper only with voice. (b) a seller advising the shopper with written points.

Experiment SM 1

In this study the influence of different social mediators will be studied. The VE developed for this experiment will be a multi-level 10x6 m2 virtual store with different types of shelves. To access each floor of the store, an elevator simulator will be used. The subject will do a free customer journey with no time limits and with a limited budget with a contextual pre-narrative (motivation for the subject).

Objectives:

To analyse the effect of the 3 independent peer customers social mediators in the shopper behaviour that will be showed as three conditions: (to be showed at three levels of the store)

	Control	Target 1	Target 2
Task: free navigation with limited budget	shopping alone	low crowded	high crowded
	shopping alone	low purchase rate of other shoppers	high purchase rate of other shoppers
	shopping alone	cartoony shape companions	humanoid companions

Explicit responses:

- Products purchased
- Shopping time
- Budget spent
- Questionnaires

Implicit responses:

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- Emotional response: Arousal
- Visual attention
- Product interaction
- Navigation patterns
- Body posture
- Cognitive load

Experiment SM 2

In this experiment, the impact of the existence of a seller in the form of avatar or a playback video on shopper behavior will be investigated. These variables will be measured using explicit measures (scales/questionnaires and behavioural data namely, eye-tracking, body posture, and navigational pattern) and implicit measures (neurophysiological data).

In the virtual shops there are several possibilities such as shopping without a seller in the virtual environment, shopping with an avatar-based seller in the virtual store, a computer-controlled seller avatar, a playback of a recorded video, or a live video of a human seller.

The probable shopping environment for this experiment would be a virtual hypermarket, cloth store, or a cosmetics shop, and three tasks are proposed for this experiment.

The VE developed for this experiment will be a multi-level 10x6 m2 virtual store with different types of shelves. To access each floor of the store, an elevator simulator will be used. The subject will do a free customer journey with no time limits and with a limited budget with a contextual pre-narrative (motivation for the subject).

Objectives:
To analyse the effect of the 3 independent peer customers social mediators in the shopper behaviour that will be showed as three conditions: (to be showed at three levels of the store)

	Control	Target
Task: free navigation with limited budget	shopping alone	shopping with existence of a seller
	seller with random hints	seller with personalized advices
	humanoid companions	cartoonish companions

Explicit responses:

- Products purchased
- Shopping time
- Budget spent

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- Questionnaires

Implicit responses:

- Emotional response: Arousal
- Visual attention
- Product interaction
- Navigation patterns
- Body posture
- Cognitive load

In a pretest pilot study, it will be decided that if the experiments will be performed in one single task and some floors of a shopping mall with a single objective (free-navigation), or they will be carried out in several tasks with different objectives.

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