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Blending the Real World and the Virtual World: Exploring the Role of Flow in Augmented Reality Experiences

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1. Introduction

Imagine a world where walking down your favorite grocery store aisle has been transformed from a mundane, routine activity to a landscape full of entertaining characters and stories that fill you with wonder and excitement. It is a world where, for example, Tony the Tiger could leap out at you as you peruse the cereal aisle, or Morris the Cat tells you about the sustainably sourced ingredients in his 9Lives cat food as you consider which cat food to buy. This is a world that could materialize into reality in the near future as advances in the development of augmented reality shopping experiences continue to evolve at a rapid pace. With an aim of linking the real world with the virtual world (Rauschnabel, Rossmann, & tom Dieck, 2017), augmented reality overlays computer generated-objects with the natural environment and enables real-time interactions (Rese, Baier, Geyer-Schulz, & Schreiber, 2017). Although in its infancy, brands such as Sephora, L'Oréal, Nike, Adidas, Mini, Topshop, Amazon and IKEA are utilizing AR with the aim of enhancing customer experiences, while investment in AR technology is expected to reach $60 billion by 2020 (Porter & Heppelmann, 2017). Additionally, the advancement of new technologies such as 5G (Newman, 2018) and the proliferation of AR lenses such as Apple AR glasses (Smith, 2019) will see AR experiences become more ubiquitous and further enhance marketers' ability to utilize AR in various shopping contexts.

Although investment in AR is anticipated to increase, many questions regarding the experiential aspects of AR remain unanswered. For instance, little is known about which particular aspects of the augmented reality experience directly influence satisfaction with the experience. This is a research topic worth exploring as it is well established in the marketing literature that customer satisfaction is a key driver of loyalty and repeat purchase decisions (Dick & Basu, 1994). Additionally, given that AR moves beyond the screen and augments the surrounding space, it is unclear how AR technology itself affects the customer experience. Through the lens of flow theory, our study seeks to narrow this gap in knowledge.

Responding to calls for research (Javornik, 2016) we first explore the role of unique AR characteristics in inducing the state of flow and second, determine whether the immersive flow state constitutes a core part of experience with the technology and satisfaction with the experience. To address these pertinent areas of research, a commercially available AR app was utilized to conduct an online, repeated measures between-subjects experiment with 500 participants. Two short films were developed depicting identical shopping experiences with or without AR. Following exposure to the film, participants were asked to complete a series of questions to test our conceptual model. Quantitative analysis in the form of partial least squares structural equation modelling was used to analyze the variables and their relative influence on satisfaction with the AR experience. Findings from this study provide key insights into understanding the most salient AR factors influencing the immersive state of flow and satisfaction with AR experiences. This paper further draws practical conclusions for marketers and designers in the creation and execution of AR technology within shopping contexts.

2. Literature review

2.1 Experiences

Premised on the belief that what consumers want are satisfying experiences rather than products (Abbott, 1956), an entire stream of marketing research concerned with how consumers experience products (Holbrook & Hirschman, 1982), shopping (Hui & Bateson, 1991; Kerin, Jain, & Howard, 1992), consumption (Holbrook & Hirschman, 1982), brands (Brakus, Schmitt, & Zarantonello, 2009; Schmitt, 1999), and environments (Chang & Chieng, 2006; Esbjerg et al., 2012; Tsaur, Chiu, & Wang, 2007) has developed over the past few decades. Experiences have been widely acknowledged as a key component to competitive brand positioning in the minds of consumers due to their ability to evoke connections with brands through sensory, affective, intellectual, and physical stimulation (Brakus et al., 2009; Schmitt, 1999; Zarantonello & Schmitt, 2010). For example, brands such as Lush include sensory experiences as a core component of their business model– e.g. one is not just buying a bar of soap at Lush, but also the experience of fragrant aromas, carefully curated music, and exciting colors of soaps, bath bombs and facial masks. Experiences thus occur as a result of some form of stimuli and can happen through direct or indirect observation or participation in events whether they are virtual, real or dreamlike (Brakus et al., 2009; Schmitt, 1999). Experiences today however can also be a *blend* of the real, virtual and fantasy. Technological advances have enabled brands to transform shopping experiences by using computer-generated objects that appear to co-exist in the same space as the real world in order to provide additional benefits to consumers. Augmented reality, for example, has been adopted by L'Oreal to provide an opportunity for consumers to virtually try on make-up and hair colors before they purchase (Pearl, 2019), and the U.S. retailer Lowe's uses AR to help consumers see what certain products will look like in their homes (Ruff, 2018). Although technological advances such

as these have transformed the shopping experience for consumers, there remains a dearth of research on the factors that influence satisfaction with AR shopping experiences. Satisfaction with an AR shopping experience is an important topic to explore as satisfaction with experiences has been associated with repeat purchase (Dick & Basu, 1994), customer loyalty, positive word of mouth (Bearden & Teel, 1983; Fornell, 1992; Fornell, Johnson, Anderson, Cha, & Bryant, 1996) and the continued success of firms (Schmitt, 1999). Additionally, in the AR context, augmented reality has been demonstrated as enhancing satisfaction with websites (Poushneh, A., & Vasquez-Parraga, A. Z., 2017). As noted however, there is a dearth of research concerning the factors that influence satisfaction with shopping experiences that include AR. We thus move next to a literature review of augmented reality before exploring the role of *flow* and experiences in the AR context.

2.2 Augmented Reality

The recent advancements in technology enable the possibility to develop new enriched environments in order to extend the physical world, blending real world objects with virtual world objects (Pantano & Servidio, 2012), resulting in an augmented reality (AR). Although many definitions of AR exist, most share a common theme in that its features are interactive, simultaneous, vivid and unique to the environment it is used in. Azuma (1997) defines Augmented Reality (AR) as a real-time view of the physical world while overlaid (augmented) with virtual computer generated information such as text, images, video or any other interactive computer-generated media. Affirming this definition, Faust et al. (2012) define augmented reality as the superposition of virtual objects (computer generated images, texts, sounds etc.) on the real environment of the user. Augmented reality provides the user with an enriched and immersive experience as the technology provides high levels of interactivity and vividness in comparison to traditional media (Yim & Park, 2019).

Whilst augmented reality has been in existence for quite some time, the use of AR in consumer markets has been hindered by large and cumbersome devices (Rese et al., 2017). However, given the continually growing adoption of the ubiquitous smartphone, brands are able to offer augmented reality services to consumer markets through smartphone applications (Dacko, 2017). Firms such as IKEA, Nike, ASOS and Amazon have implemented augmented reality in an attempt to enrich the realistic experience of their products (McLean & Wilson, 2019) and assist consumers during decision making (Heller, Chylinski, de Ruyter, Mahr, & Keeling, 2019). Javornik (2016) conceptualizes the potential of augmented reality in developing an immersive flow experience, whilst Rauschnabel, He and Ro (2018) outline the potential utilitarian and hedonic benefits of AR. AR's ability to overlay the physical environment with virtual elements including text-based information, rich media images and video, which can interact with the physical environment during real-time, offers firms new possibilities in delivering a unique experience to consumers. During decision making consumers often use mental imagery to develop a mental picture that reflects products or experiences under consideration (Pearson, Naselaris, Holmes, & Kosslyn, 2015), however the key benefit of AR is that consumers no longer need to imagine, instead they are presented with a life-like computer generated and real world representation of the product or experience (McLean & Wilson, 2019). In turn, the functions available through augmented reality have the potential to change a number of experiential activities such as product trials, information search and acquisition and product try-ons (Javornik, 2016). Thus, unlike virtual reality (VR), AR does not alter or replace the individual's real world, but instead enhances it by combining additional information (text, images, video) into the individual's current real world experience (Yim & Park, 2019). Accordingly, AR has been conceptualized as generating more interesting and greater shopping experiences in the e-commerce environment developing highly interactive and

immersive experiences (Javornik, 2016). The effects of this more realistic product experience through enhancing the quality of an individual's real world by developing a closer relation between the individual's physical space and virtual products in comparison with traditional media may influence a consumer's satisfaction with the overall experience (Dacko, 2017; Yim & Park, 2019).

Building upon Azuma's (1997) research, McLean and Wilson (2019) outline three characteristics of augmented reality, namely AR interactivity, AR vividness and AR Novelty. Accordingly, AR is interactive in real time offering the user the ability to control what they see combining the real world and the virtual world. Secondly, AR is most often presented in 3D, providing a clear, vivid and detailed representation of an image combining the real world and the virtual world. Thirdly, AR is novel in that it provides unique user specific information to each individual user based on their current circumstances or situation. Such characteristics of AR enable individuals to firstly offload mental imagery during decision making as they are able to draw out a visual representation of a particular product or service, and secondly consume richer media information.

2.3 Flow Theory

As stated previously, there is a dearth of research on the specific aspects of an AR shopping experience that influence satisfaction. There are however streams of literature in the information systems, marketing and psychology disciplines which support the development of our conceptual model. We develop our theoretical foundation through the lens of *flow theory* due to its importance in facilitating optimal experiences. We then discuss the specific aspects of augmented reality that are key to AR experience outcomes. Finally, we draw from the experiential marketing literature to further define our conceptual model and to explore the aspects of an AR shopping experience that affect satisfaction with the experience.

Csikszentmihalyi (1975, p.36) introduced the concept of flow as a 'holistic sensation that people feel when they act with total involvement'. When experiencing the notion of flow, individuals often become completely switched off to the outside (real) world, and become captivated and completely engrossed in an activity that they feel like they are encountering a natural and highly enjoyable out of body experience. Later, Csikszentmihalyi (1997) described flow as a situation in which an individual has completely focused motivation and where the individual is fully immersed, absorbed and engaged in the task at hand, with a loss of self-consciousness and experiencing enjoyment in the process. Seligman and Csikszentmihalyi (2014) explain that flow is a relatively rare occurrence in everyday life, yet almost every activity (e.g. work, study or religious ritual) is able to produce it. Csikszentmihalyi (1997) illustrated how flow exists during games such as chess, and other activities such as rock climbing and dancing. More recent research has explored the existence of flow in sports, shopping (online and offline) and in virtual games. Hoffman and Novak (2009) suggest that the critical aspect of the concept of flow is full concentration and immersion in an activity. Chen, Wigand, and Nilan (1999) outline that those that have experienced flow normally report feelings of, immersed pleasure, absorbed interest, focused attention and a perceived acceleration of time. The concept of flow and its application to technology has adapted through the works of Hoffman and Novak (1996), Novak, Hoffman, and Yung (2000), Novak, Hoffman, and Duhachek (2003) and Hoffman and Novak (2009). Hoffman and Novak (2009, p.57) indicate that the flow experience with technology is 'characterized by a seamless sequence of responses facilitated by machine interactivity, intrinsically enjoyable, accompanied by a loss of self-consciousness'. Kim, Park, Sundar, and Del Pobli (2012) further highlight that immersive tendency is a predictor of 'human-computer interaction' as it influences the psychological state an individual is in while they interact with stimuli in a digital environment.

However, the conceptualization of flow remains somewhat murky. Researchers agree that flow is something that most individuals will have experienced to some extent, either through games, reading, dancing, shopping or sports, and thus researchers along with research respondents have an understanding of the concept of flow. However, despite the conceptual and empirical advancement of flow theory over recent years, the concept still encourages debate. A unified measurement of flow has not been established within the extant literature (see: Ghani & Deshpande, 1994; Hoffman & Novak, 1996; Choi, Kim & Kim, 2007; Hoffman & Novak, 2009), however, general consensus illustrates communality that flow encompasses immersion in an activity. In parallel, the literature highlights conflicting findings regarding antecedents and consequences of flow where variables have been assessed interchangeably (Lee, Ha, & Johnson, 2019).

3. Conceptual Model

3.1 AR Interactivity and Flow

Despite such debates regarding the concept of flow, one of the most consistently argued drivers of flow is *interactivity* (Lee et al., 2019; van Noort, Voorveld, & van Reijmersdal, 2012). Hoffman and Novak (2009) illustrate that interactivity is a technological system's capability to enable individuals to easily interact, control, manipulate and be involved with content. Interactivity can be considered from two complementary positions (1) the features of the technology and (2) the user's perception (Yim, Chu, & Sauer, 2017). Accordingly, such a holistic description of interactivity provides understanding on the role of interactivity in AR.

Steuer (1992) outlines the importance of technology features in defining interactivity from the technology used. Thus, consumers' perceptions of interactivity may be swayed by the subcomponents of the technology including its *speed*, how fast individuals are able to manipulate

the content; *mapping*, the similarity of the control in the computer generated world to the real world; and *range*, how much the content can be manipulated by the individual. From a user perception perspective, interactivity is an individual's subjective perception of interactivity. Thus, interactivity cannot be experienced without the motivation of the individual to participate with the technology. Therefore, interactivity is only developed if consumers are willing to participate. Importantly, inherent to augmented reality technology is participation, in manipulating computer generated objects combining the real world with the virtual world.

Augmented reality technology is arguably one of the most interactive types of technology, consisting of the aforementioned high levels of user participation. Given that the interactivity involved with augmented reality involves manipulating both the real world and the virtual world and extends beyond the screen (Javornik, 2016), we posit that such user participation and control will lead to an absorbing state of mind while using the interactive features, immersing the individual in the activity and positively influencing the state of flow. Thus we hypothesize:

H1: The interactivity of the Augmented Reality technology will more positively influence the state of flow than a traditional shopping experience

3.2 AR Vividness and Flow

Vividness is defined as 'the ability of a technology to produce a sensorially rich mediated environment' (Steuer, 1992). It refers to the process of combining the sensory experience of real objects that can be seen with the non-sensory imaginary objects created in an individual's mind to create a clear image of a product of experience (Lee, 2004). Flavián, Gurrea, and Orús (2017) posit that vivid information can come in many forms including images, audio and visual content that evokes the physical and experiential aspects of a purchase. In the digital environment, vividness is often associated with the aesthetic appeal of the product display on a website or mobile app

(Flavián et al., 2017). A more vivid display of products is more likely to influence a consumer's cognitive processing (Keller & Block, 1997) due to its more interesting appeal which results in an increased evaluation of the product's information than what pallid information would induce (Jiang & Benbasat, 2007).

Accordingly, the vividness of the information can heighten the perception of information quality through increasing the number of sensory dimensions, which in turn may increase cognitive processing. Similar to interactivity, vividness helps consumers to mentally visualize products and upcoming experiences (Phillips, Olson, & Baumgartner, 1995). Thus, enhancing the vividness of product depictions can result in increased product related thoughts and cognitive absorption. Augmented reality enables individuals to develop a clear and detailed view of the real world and the virtual world (McLean & Wilson, 2019). Such an enriched environment provides multiple sensory objects, offloading the need to imagine how products may look, or the need to seek further information. Therefore, the detail, clarity and well defined representation of products combining both the real world and virtual world is likely to influence an individual's absorption in their activity leading to an immersive flow experience, thus we hypothesize:

> **H2:** The vividness of the Augmented Reality technology will more positively influence the state of flow than a traditional shopping experience

3.3 AR Novelty and Flow

McLean and Wilson (2019) outline that the augmented combination of the real world and the virtual world results in a continually unique experience. Thus, each time an individual utilizes augmented reality they often encounter unique stimuli due to the range and scope of manipulation between the virtual world and the real world. Therefore, it is important to note that novelty in the context of this study does not refer to the *newness* of the technology, instead novelty refers to the

unique, personalized, novel information (stimuli) individuals are presented each time they use the AR technology. AR content can be delivered in the form of text, images, audio and video (Javornik, 2016). Recent AR apps have enabled brands to extend storytelling through audio and video with AR (e.g. 19 crimes wine) and through the use of image placement (e.g. IKEA). The ability to place virtual objects such as furniture in one's own room, or to view a video overlaid on one's current real world environment, provides highly personalized, novel information (Preece, Sharp, & Rogers, 2015; McLean & Wilson, 2019). As a result, AR enables consumers to personalize information to their own needs and preferences.

Moreover, a distinguishing feature of novelty is encountered during information processing as novel information has the capacity to draw the attention of consumers leading to curiosity and becoming deeply engrossed (Hoffman & Novak, 2009; Kover & James, 1993). Drawing on Cue Utilization theory (see: Easterbrook, 1959) the unusual characteristic of novel stimuli appears to encourage cognitive processing. Conversely, familiar stimuli do not provide the same cues required to ignite cognitive processing, resulting in less arousal and immersion in the activity (Yim et al., 2017). Given the novel stimuli presented through augmented reality elicits cognitive processing, we suggest that AR novelty will spark an individual's cognitive flow leading to higher arousal. Thus we hypothesize:

H3: The novel information presented through Augmented Reality technology will more positively influence the state of flow than a traditional shopping experience

3.4 Flow and the AR Experience

One of the key tenets of flow theory is that a state of flow is characterized by stepping out of one's current reality and into a state of focused attention and concentration. Whether playing the piano, or playing Pokémon Go, a state of flow finds the player immersed in the activity at hand

with little regard to the banal thoughts that generally consume human minds (Csikszentmihalyi, 2014). This is due to the need for humans to keep consciousness in an organized state and focused on some activity that requires attention. Hence, even simple activities such as shopping can induce a state of flow as there are clear goals associated with these activities and the mind is focused on completing them. When consciousness is in an unorganized state however (e.g. having nothing to do and in a state of boredom), the quality of an experience declines with one feeling less happy, alert and creative. Being in state of flow has therefore been associated with the 'optimal experience' and a 'deep sense of enjoyment' (Csikszentmihalyi, 1990).

AR experiences are uniquely positioned to facilitate a state of flow due to some of the characteristics discussed previously (vividness, interactivity and novelty) and the attention and concentration that occur as a result of the tasks of participating in an AR experience – e.g. holding a mobile phone in front of an AR-enabled product and viewing the augmented reality information. Csikszentmihalyi, (2014, p. 156) states that 'through the allocation of attention, which represents psychic energy and is in limited supply, the self can produce and then process information about its outer environment and its inner states.' AR applications that induce flow could therefore bring value to an overall shopping experience. For example, the marketing literature espouses that consumers seek imaginative, entertaining and fun experiences (Holbrook & Hirschman, 1982) that are relevant and engender learning (Poulsson & Kale, 2004). Experiences therefore serve hedonic and utilitarian purposes for the consumer facilitating, not only entertainment and pleasure (Holbrook, 2000), but also value to the consumer with the provision of useful information and learning (Tynan & McKechnie, 2009). For example, the AR Patron app enables a consumer to not only learn about its distillery in Jalisco, Mexico, and various cocktail recipes from a virtual

bartender, but the experience also offers the consumer a sense of play by planting a cactus farm in the middle of their living room (Beltrone, 2017).

Although the literature provides useful context for what consumers want from experiences, there is a dearth of research on the factors of an AR experience that affect satisfaction. As mentioned previously, customer satisfaction is an important aspect of experiences due to its ability to influence repeat purchase behavior (Dick & Basu, 1994), customer loyalty, positive word of mouth (Bearden & Teel, 1983; Fornell, 1992; Fornell et al.lusch, 1996), and continued firm success (Schmitt, 1999). We therefore add the following hypotheses to our conceptual model:

H4: information usefulness will have a more positive affect on satisfaction with the experience when the use of AR technology is part of the experience

H5: information usefulness will have a more positive affect on learning when the use of AR technology is part of the experience

H6: learning will have a more positive affect on satisfaction with the experience when the use of AR technology is part of the experience

H7: enjoyment will have a more positive affect on satisfaction with the experience when the use of AR technology is part of the experience

Experiences must also be engaging as they are a distinct component of the consumption journey that should foster interaction between the consumer and the provider of the experience (Lusch, Vargo, & O'brien, 2007; Poulsson & Kale, 2004; Tynan & McKechnie, 2009). As such, experiences happen as a result of engaging consumers in a co-created activity between the consumer and experience provider. With regard to AR experiences, marketers can design experiences that facilitate consumer engagement with brands by providing the consumer the opportunity to interact with content and having control over various aspects of the AR experience

(Scholz & Smith, 2016). For example, Target rolled out an AR feature called *See it in Your Space* which enables consumers to place three-dimensional versions of real Target home products within photos of actual rooms in their homes and move them around to see how they would look (Target, 2018). Unsurprisingly, consumer engagement through experiences has also been referred to as *flow* within the experiential marketing literature (Poulsson & Kale, 2004; Tynan & McKechnie, 2009) due to the value that experiences must be able to offer to the consumer, the interaction between the experience provider and the consumer, and the sense of enjoyment that should be a part of the experience. Hence, a state of flow could potentially affect both the hedonic and utilitarian aspects of an AR experience due to the nature of being in a state of flow and the focus and concentration it elicits. We therefore complete our conceptual model with the following hypotheses:

H8a: flow more positively affects information usefulness when the use of AR technology is part of the experience

H8b: flow more positively affects learning when the use of AR technology is part of the experience

H8c: flow more positively affects enjoyment when the use of AR technology is part of the experience

3.5 Conceptual Model Diagram

With regard to understanding the variables that influence satisfaction with an AR experience, we created seven different dependent variables for the model (see Table 1 for the scale items associated with these independent variables): Vividness (H1), Interactivity (H2), Novelty (H3), Information Usefulness (H4, H5), Learning (H6), Enjoyment (H7) and Flow (H8a-c).

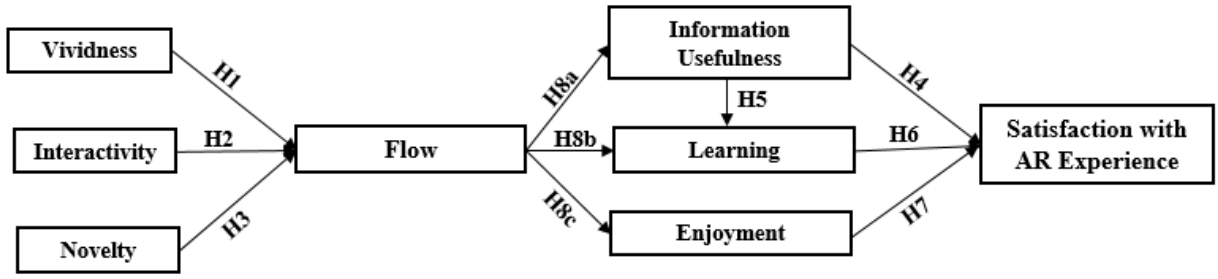

Figure 1 - Factors Affecting Satisfaction with an AR Experience

Next, we discuss the methodology utilized to support our study.

4. Overview of the Present Research Methodology

In order to construct a context that allows for AR technology to be readily experienced in an online survey collection platform, two videos were created (with and without the use of AR) utilizing a first-person perspective of a shopping experience for a bottle of wine. In the AR condition, the first-person perspective enters a wine shop and picks up a bottle of wine, turning the wine left and right to read the label. The video then shows a hand pulling out a cell phone, opening the *AR* phone application, and initiating an AR experience in which the wine label begins to interact with the viewer through narrative storytelling. In the control condition, the first-person perspective enters a wine shop and picks up a bottle of wine and evaluates the label, but does not pull out a mobile phone and engage the AR experience. Both videos are identical with the exception of the phone and AR experience. In order to ensure both experiences were as true to life as possible, a sound technician was employed to add ambient background noise recorded in the wine shop using a ZOOM H4n Portable Audio Recorder to both videos. First-person perspective in the video was achieved using a GoPro Hero 5 Black mounted on the researcher's head with a head strap. Head and arm movements were kept slow and controlled during recording so as not to

disorient the viewer. The footage was edited with Final Cut Pro X on an iMac Pro to create the finished video content.

Wine shopping was chosen as an attractive test scenario as wine decisions are often based on limited knowledge and are heavily influenced by heuristic cues such as those provided by various marketing tactics (e.g. labels, brand names, and shopping experiences; Danner et al., 2016). Additionally, we chose to make use of a commercially available AR experience developed by the *19 Crimes* wine brand to increase the realism of the experience for our participants.

As prior brand knowledge was identified as a potential confound, we conducted our study in the UK to allow for the most effective pre-screening of participants to produce a sample of consumers who did not recognize the brand. Age, location, wine consumption frequency, and brand recognition were measured and used to screen participants in both our pilot and experiment. We determined our target sample size and manipulations in advance, and report all data exclusions and analysis conducted on the data in this report.

4.1. Experimental design

Five hundred UK data panel participants were randomly assigned to a repeated measures between-groups design (augmented reality vs. no augmented reality). The panel was comprised of 356 female and 144 male college-educated participants aged 18+ (with a majority of the sample aged 25-54 years at 80.8%). This sample is representative of wine consumption by gender in the UK (Statista, 2013).

Participants were recruited to participate in a 10-15-minute experiment on wine shopping. Participants were screened for age (above 18), location (UK), frequency of wine consumption (more than 'never', and recognition of the wine brand (no recognition). Upon passing the pre-screen assessment, participants read about a hypothetical shopping scenario and were asked to do

their best to imagine themselves in the role described while watching a video in the first-person. Participants were instructed to imagine themselves with the need to purchase a bottle of wine. Subsequently, participants were randomly presented to one of two first-person perspective videos simulating shopping in a wine store and assessing a particular bottle of wine with and without the experience of augmented reality. After watching the video, participants completed several scales presented in randomized order.

4.2. Measures

To test our conceptual model, several survey instruments were identified from prior literature and adapted to relate the scales to the AR experience. Detailed descriptions of survey items relating to each variable is provided in Table 1.

[INSERT TABLE 1 HERE]

4.3 Data analysis

To determine the antecedents of flow and Satisfaction with the AR Experience we employed partial least squares structural equation modeling (PLS-SEM). According to Hoyle (1995, p. 1), SEM 'is a comprehensive statistical approach to testing hypotheses about relations among observed and latent variables.' This method has also become 'quasi-standard in marketing and management research when it comes to analyzing the cause-effect relations between latent constructs' (Hair, Ringle, & Sarstedt, 2011, p. 139). PLS-SEM was suitable for our study because the theoretical model includes a mix of reflective and formative indicators (Lowry & Gaskin, 2014) and the models being tested are exploratory in nature (Hair, Hult, Ringle, Sarstedt, & Thiele, 2017; Lowry & Gaskin, 2014; Sarstedt, Hair, Ringle, Thiele, & Gudergan, 2016).

5. PLS-SEM Results

5.1 Evaluation of the structural model

Two PLS-SEM models were created to determine the factors that influence satisfaction with the AR shopping experience (treatment group) and satisfaction with a shopping experience (control group). Seven different independent variables, demonstrated in Table 1, were tested in the models based on the literature review. In order to assess the validity of the measurement models, the methods detailed by Wong (2013) and Hair, Hult, Ringle, and Sarstedt (2016) were utilized. Discriminant validity was established when the factor loading coefficients for the items that constituted each latent variable were greater than their cross-loadings on alternative latent variables. The cross loadings for the models were assessed and both models fit the criteria. These are demonstrated in Tables A.1 and A.2. Convergent validity was established as the average variance explained (AVE) by the multiple indicators of each latent variable was > than 0.5. Internal consistency reliability was established, as all of the composite reliability coefficients for the latent variables were > 0.6. These are demonstrated in Tables A.3 and A.4 in the Appendix. We estimated the statistical significance of each path coefficient (β) through bootstrapping. We randomly sampled the raw data 5,000 times and computed the mean of each β coefficient. To confirm the validity of our models, we use Cronbach's alphas and the composite reliability scores. These are demonstrated in Tables A.3 and A.4 in the Appendix.

5.2 PLS-SEM Results

Table 2 displays the significant predictors and hypotheses results of the factors that influence satisfaction with the shopping experience for both the treatment (AR) and control group (no AR) PLS-SEM structural models. As demonstrated in Table 2, Panel A (treatment group, with AR experience), all hypotheses were supported, or partially supported, as follows: Vividness (H1),

Interactivity (H2) and Novelty (H3) all positively affect Flow (R2 .49); Information Usefulness (H4) positively affects Learning (R2 .55); Information Usefulness (H5), Learning (H6), and Enjoyment (H7) all positively affect Augmented Reality Experience Satisfaction (R2 .77); and Flow (H8a,b,c) positively affects Information Usefulness (R2 .27), Learning (R2 .55), and Enjoyment (R2 .68). Notably, the two paths with the highest affect are Flow (H8c) affecting Enjoyment (t-value 41.99, R2 .77) and Flow (H8a) affecting Information Usefulness (t-value 11.68, R2 .27) Table 2, Panel B demonstrates the results of the Control Group (no AR experience). As demonstrated in the table, all of the factors were significant in predicting satisfaction with the shopping experience with the exception of Flow affecting Learning (H8b) and Learning affecting Satisfaction with the shopping experience. Table 2, Panel B, also demonstrates several key differences when compared to the treatment group (Panel A). Notably, the standardized coefficients for a majority of the variables in the treatment group (Panel A) are greater than the control group (Panel B) - the exceptions being *Interactivity* affecting *Flow* (.151 versus .194), *Information Usefulness* affecting *Learning* (.552 versus .632), and *Information Usefulness* affecting *Augmented Reality Experience Satisfaction* (.352 versus .430). It is worth noting that although these three individual standardized coefficients were slightly less than the control group, they were all significant and their effect sizes (R^2) were also greater than the control group. Hence, these three hypotheses were noted as 'partially' significant. Finally, Table 2, Panel A, also demonstrates that the overall effect sizes (R^2) of all of the factors of the treatment group (AR) are greater versus the control group (Panel B, no AR), further demonstrating the impact of the AR experience versus the shopping experience without AR.

[INSERT TABLE 2 HERE]

6. Discussion

This research responds to calls for research (Javornik, 2016) in furthering our understanding of Augmented Reality in consumer markets. Given the significant investment in augmented reality by brands, and its potential to enhance the shopping experience, this research advances our theoretical knowledge and practical application of augmented reality. Firstly, the research outlines the role of unique AR characteristics (AR interactivity, AR vividness and AR novelty) in inducing the state of flow. Secondly, the research outlines the important role of augmented reality in storytelling and the significant effect of the immersive AR flow state on learning. Thirdly, the research determines that the immersive flow state constitutes a core part of experience with the technology and the value that AR adds to facilitating satisfactory experiences. The results of our experiment provide supporting evidence for our conceptual model and highlight the significant influence and pathway of seven variables on satisfaction with the augmented reality experience. Significant casual relationships were determined for *Vividness* (H1), *Interactivity* (H2), *Novelty* (H3), *Information Usefulness* (H4, H5), *Learning* (H6), *Enjoyment* (H7), and *Flow* (H8a-c). Our conceptual model therefore adds to the extant literature on augmented reality by identifying and mapping out several key variables which influence satisfaction with augmented reality experiences.

Specifically, our findings affirm that the AR characteristics; AR *Vividness*, AR *Interactivity* and AR *Novelty* are all key contributors to the immersive state of *Flow*. While previous research has outlined the role of interactivity in influencing the state of *Flow* (Hoffman & Novak, 2009), augmented reality's mode of operation goes beyond the screen and interacts with the real-world space. The results of this research indicate a more significant state of flow with augmented reality in comparison to a regular shopping experience, thus our research adds support

to the previous conceptualizations (Javornik, 2016; Flavián et al., 2017) that augmented reality may differ in relation to its impact on flow, which we find can create a more immersive environment, resulting in consumers' becoming more engrossed in their activity.

Moreover, the vividness of the AR technology enables brands to provide consumers with a sensorially rich mediated environment. AR enables consumers the control to combine the sensory experience of real objects with the added sensory experience of computer-generated objects. Conversely, traditional real-world environments or other digital environments (e.g. the web) requires individuals to use the sensory experience of real world objects along with their imagination to create a clear picture of a product, the brand's story or experience (Lee, 2004). Such heightened computer/real-world mediated vividness, which can be presented in multiple formats (images, text, video, audio) evokes a deeper immersive flow state. Thus, such an enriched environment provides multiple sensory objects, offloading the need to imagine how products may look, or the need to seek further information, enabling consumers to focus on their activity. Therefore, in line with Keller and Block (1997) a more vivid display of products, in this case through augmented reality, is more likely to influence a consumer's cognitive processing resulting in the flow experience due to its more interesting appeal which results in increased evaluation of the product and its information than what pallid information would involve.

Furthermore, the augmented combination of the real world and the virtual world continually creates a unique experience, personal to each consumer's environment. This research finds that the novel (unique) information encountered from augmented reality technology during information processing draws the attention of consumers and leading them to become deeply engrossed in the activity. Our findings are in line with Cue Utilisation theory (Easterbrook, 1959) in that novel stimuli from the augmented reality encourages cognitive processing, while usual

pallid stimuli do not provide the same cues resulting in less immersion in the activity. Thus, the novel stimuli presented through AR has a greater influence in inducing the state of flow than non-AR presented information.

We further find evidence that the state of *flow* positively influences consumer perceptions of *Learning*, *Information Usefulness* and *Enjoyment*, and that these perceptions, in turn, are significant predictors of satisfaction with the experience. Two of the most compelling findings from the study were that *Learning* was a significant predictor of satisfaction with the AR experience in the treatment group, versus no significance in the control group, and *Flow* was a significant predictor of *Learning* in the treatment group versus no significance in the control group. Thus, the AR experience not only induces the state of flow, but also further informs customers on the product or the brand. Therefore, AR acts as a useful means of educating consumers about the brand or the product. The further learning experienced through AR in turn influences a consumer's satisfaction with their experience. These findings can be potentially explained by revisiting the concept of *flow*. A state of *flow* is characterized by a sense of serenity, losing the worries of everyday life, immersion, enjoyment and focused attention. A state of *flow*, therefore supports cognitive information processing as attention is focused and free of distraction (Csikszentmihalyi, 2014). Based on his research of *flow,* Csikszentmihalyi (2014) reports that 15% of the best everyday experiences occur in the context of learning – and that learning is directly associated with happiness due to personal growth. He explains that humans inherently seek challenge and growth through learning and find ways to 'get deeply involved with the world around' by learning (Csikszentmihalyi, 2014, p. 163). In the context of augmented reality, the results of our study suggest that AR presents a powerful way to engender the state of flow and subsequently learning, enjoyment and satisfaction in the shopping environment. It does so by facilitating a state of *flow*

through the components that are unique to AR (*interactivity, novelty and vividness*) and the provision of useful information and learning that takes place via the combination of the real world and the virtual world. The findings from our study therefore add to the extant literature on *flow* and experiential marketing with empirical evidence of the value that AR adds to inducing satisfactory shopping experiences by facilitating a state of *flow*, providing useful information and engendering learning and enjoyment.

6.1 Practical Implications

Our research further provides practical contributions to the areas of marketing strategy, advertising, consumer engagement, and design. Importantly, our research suggests that augmented reality can be an effective tool with which to enhance satisfaction with customer experiences in the shopping context. As consumers are presented with numerous brands while shopping, and any number of distractions, the use of AR to induce a state of flow, and thus focused attention, could help brands draw consumers' attention and to further differentiate themselves from their competitors in the shopping environment. Further, by providing useful information and engendering a sense of learning and enjoyment, bricks and mortar retailers could potentially benefit from stocking products that use AR. Our research suggests that AR provides additional value to the shopping experience by inducing a state of flow and serving consumers' need for useful information, learning and enjoyment. In a world where online retailers continue to take market share from bricks and mortar stores, the provision of well-executed and designed AR experiences could potentially help managers bring consumers in store.

Given the positive influence of flow on learning, augmented reality offers managers a way of educating customers on their products and services. Utilizing AR technology enables brands to go beyond the label or packaging of the product to provide consumers other relevant product or

brand information joining up the physical world and the digital world. Relatedly, brands are able to further engage in interactive, vivid and novel storytelling through augmented reality, encouraging cognitive processing of the information.

Accordingly, the results of our research stress the importance of practitioners to design AR experiences which balance the attributes of *Vividness*, *Interactivity*, and *Novelty* to better facilitate the consumer experience of *Flow*. Thus, managers should develop AR technology that provides a clear, detailed and well-defined representation of products, enable consumers to manipulate the real world and virtual world, and offer an experience unique to the consumer's environment.

Lastly, managers should note that augmented reality offers consumers an enriched environment that provides multiple sensory objects, which in turn offloads the need to imagine how products may look, or the need to seek further information. Therefore, the detail, clarity and well defined representation of products combining both the real world and virtual world enhances an individual's learning about the product or brand. Additionally, managers should note that familiar stimuli do not provide the same cues required to ignite cognitive processing, resulting in less arousal and immersion in the activity. Given the novel stimuli presented through augmented reality eliciting cognitive processing, managers are able to story-tell about the brand while sparking an individual's cognitive flow leading to higher arousal, increased learning about the brand and positive experiences.

7. Limitations and Future Research

Limitations associated with this study may pave the way for future research. A key limitation is our focus on a commercially available augmented reality experience focused on the wine industry. We chose this augmented reality experience and industry due to the nature wine shopping and to increase the realism of the experience for the study's participants. Although the use of this

industry and AR were practical for a sound execution of the study, research could undertake a similar study with other forms of augmented reality and industries to determine whether similar outcomes would occur.

Moreover, it would be useful to assess different types of augmented reality technology and their effects on flow. For example, examining AR apps with differing levels of *interactivity, vividness* and *novelty* to assess if there are any differences on the flow experience could provide further insights.

Additionally, this research assesses the influence of AR at one time point. It would be useful to assess the influence of AR over time to discern whether the passage of time has any influence on outcomes.

Finally, a further limitation is the location of the experiment (the United Kingdom), given that augmented reality is being adopted by brands around the world, researchers should undertake a similar analysis with receivers in other countries.

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9. Appendix

[INSERT TABLES A.1, A.2 , A.3 and A.4 HERE]