The Effects of Augmented Reality (AR) Modality and User-Virtual Product Interaction Design on Consumers' Product Evaluation: A Cognitive-Experiential Self-Theory Perspective

by

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Abstract

Given the rise of augmented reality (AR) application in retail settings as well as the recognition of theoretical and empirical literature gap in how consumers' product evaluation can be shaped by AR, this research investigated the effects of *AR Modality* and *User-Virtual Product (VP) Interaction* design factors in a mobile shopping app on consumers' cognitive and experiential processing of product information and product attitude. For this investigation, the AR-Based Cognitive-Experiential Product Evaluation Model [AR-CEPEM] was proposed as a theoretical framework by integrating the cognitive-experiential self-theory (CEST) that posits dual information processing systems, including rational and experiential systems, with two learning theories, cognitive load theory (CLT) and experiential learning theory (ELT).

An online experiment using a 2 (AR Modality: visual-only modality vs. visual + auditory modality) × 2 (User-VP Interaction: yes vs. no interaction) × 2 (Product: a watch vs. a flower vase) mixed design was conducted with a national sample of 480 U.S. mobile shoppers aged between 18 to 54 that was recruited via a sampling company. Results revealed that both the rational and experiential systems of product information processing were at work during consumers' simulated AR-based mobile shopping. Specifically, for the rational system, consumers' level of cognitive attention positively influenced their perceived utilitarian value of a product influenced, which eventually influenced their product attitude. Similarly, for the experiential system, consumers' level of sense of presence positively influenced their perceived hedonic value of a product, which also influenced their product attitude. The two AR design factors did not significantly affect the proposed dependent variables. However, when there was an interaction effect between User-VP Interaction × Product, sense of presence was affected.

Also, the interaction effect of AR Modality × User VP-Interaction × Product was significant for perceived utilitarian value of a product. The results overall suggested that the effect of the AR design factors differed between the two products.

The current study contributes to the existing AR and consumer behavior literature by demonstrating the psychological mechanisms responsible for product information processing during AR-based product evaluation. The two variables identified in this study to represent the rational and experiential systems—cognitive attention and sense of presence, respectively—significantly impacted consumers' evaluation of the utilitarian and hedonic values of a product on an AR mobile shopping app. Furthermore, the study provides theoretical implications for the CLT and ELT literature by extending their applicability to consumers' product information learning in the AR environment. From practical standpoints, the findings of this study highlight a need to consider tailoring AR design features in a retailer's mobile shopping app depending upon the type of products carried. The findings benefit marketers and retailers in designing their mobile shopping apps to enhance consumers' overall product shopping experiences.

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CHAPTER 1. INTRODUCTION

Background

Retail has rapidly evolved due to the digitalized world. Among the recent growing retail technologies, virtual reality (VR) and augmented reality (AR) are two of the most noticeable technology areas that have significant influences on consumers' shopping experiences and their product evaluation (Suh & Lee, 2005). People have been introduced to a virtually enhanced world through AR that provides virtual information overlaid in the real world (Farshid et al, 2018). AR creates a mixed reality of the real world and the virtualized world instead of replacing the real environment. Thus, AR can be described as an interactive technology that presents virtual objects in the real world to provide users with interactions with computer-generated objects (Azuma, 1997). AR, thus, is distinguished from VR, which replaces the reality by making users immersed in an alternative reality.

Due to the potential increase of consumers' shopping experience with AR, retailers have integrated AR into their retail stores (both offline and online) to better promote products (Yim et al., 2017). Furthermore, AR has been widely used by retailers as a way to intrigue consumers by providing them with enhanced shopping experiences (Suh & Lee, 2005). For instance, cosmetic retailers (e.g., Sephora) have adopted AR to enhance consumers' in-store shopping experiences by enabling consumers to virtually try on make-up on their own faces. For online settings, furniture retailers (e.g., IKEA) and lifestyle product retailers (e.g., Magnolia) have adopted AR in their mobile shopping apps by providing virtual images of products for consumers to experience the products in their homes. Moreover, a mobile app with the AR application has enabled consumers to virtually try on clothing and shoes (e.g., Wanna Kicks) without having to go to physical stores. By implementing AR, retailers aim to interact with consumers more persuasively by enabling consumers to simulate experiencing their products

(Yim et al., 2017). As many consumers tend to have time constraints to visit physical stores, the AR mobile shopping app is expected to be a great shopping tool for those consumers who instead shop online (Dacko, 2017) but still desire to try products before they make purchase decisions.

The use of AR in retail can be advantageous for both retailers and consumers. Using AR, retailers can differentiate their services from other retailers by providing fun and improved shopping experiences for consumers (Dacko, 2017). Additionally, product return rates may be reduced by implementing AR because consumers would be able to make better purchase decisions if they could virtually experience products in the real environment prior to making purchase decisions (Dacko, 2017). For consumers, the use of AR is beneficial because they can preview and try products virtually in a more exciting way by simultaneously being exposed to virtual products and being present in the real environment while shopping for products (Dacko, 2017). Trying virtual products in the real environment in which the products may need to be used can provide an additional significant benefit for consumers because many consumers have difficulties making product purchase decisions without trying them prior to their purchase (Katawetawaraks & Wang, 2011). The difficulties in making a product purchase decision can occur in consumers' online shopping even more frequently than in-store shopping because consumers need to make purchase decisions by merely viewing product images and specifications online (Katawetawaraks & Wang, 2011). To better manage consumers' challenges of making a purchase decision, retailers ask consumers to imagine themselves interacting with products to enhance consumers' product evaluations and purchase intentions (Zhao et al., 2011). This imagination could be aided by AR because AR focuses on the interactivity between consumers and products by providing vivid experiences (Orús et al., 2017). Therefore, AR applications in retail can benefit consumers when they shop either in-store or online, but it is expected to provide even more valuable experiences for consumers when it is implemented in the online retail setting (e.g., mobile shopping apps).

Consumers are exposed to virtual information overlaid in the real world through AR, which can enhance consumers' experiences of their sense of presence (Farshid et al., 2018). AR is closer to reality compared to other technologies because it generates a combined view of the virtual world and the real-world, which could provide a better sense of 'being there' to the users (Farshid et al., 2018). In addition to consumers' feelings of 'being there', AR can employ additional sensory modalities to improve consumers' product shopping experiences. Previous research has found that an individual's sensory modalities (i.e., vision, touch, smell, sound, and taste) significantly impacts their experiences with products (Fenko et al., 2010). According to Fenko et al. (2010), individuals use their vision to evaluate products and make their purchases decisions. Additionally, individuals highly rely on product information that is provided through the auditory presentation when they desire to obtain functional product information (Schifferstein, 2006). Therefore, this study will examine how employing different types of modalities (i.e., visual only and visual plus auditory modality) in AR may influence consumers' product shopping experiences.

As AR can provide very close to realistic product information to consumers (i.e., utilitarian value) and enhance consumers' fun experiences with virtual products (i.e., hedonic value) in the real environment (Babin et al., 2005), AR is expected to satisfy both utilitarian and hedonic needs of consumers. Here, utilitarian needs are associated with the functionality of products, while hedonic needs address consumers' enjoyment of using products. According to Huang and Liao (2015), AR enables consumers to receive product information effectively by allowing them to investigate products closely and delivers multisensory experiences that enhance consumers' hedonic shopping experiences. In doing so, AR creates an enhanced interaction between consumers and products, providing consumers with utilitarian and hedonic experiences (Huang & Liao, 2015), ultimately improving product attitudes.

Although AR is a great marketing tool that could be implemented in the mobile shopping app, use of AR in mobile shopping apps has not been widely discussed in previous research. According to Dacko (2017), the mobile app with AR has been a growing retail sector that needs a significant attention due to the fact that consumers have fewer constraints in time and place for product shopping if they used the mobile app for shopping. Therefore, a need exists for investigating how retailers could better design AR applications to satisfy mobile consumers' needs. In an attempt to address this need, this research investigates two specific AR design factors, *AR Modality* and *User-Virtual Product (VP) Interaction*, focusing on how these AR design factors could influence consumers' product information processing and product evaluation during a mobile shopping. To be more specific, this study focuses on the role of AR Modality in helping consumers' cognitive information processing and the role of User-VP Interaction in AR display providing consumers with an additional experiential factor when shopping for products with a mobile shopping app.

Problem Statement

AR in retail has been discussed in previous research due to its recently growing use in retail (e.g., Farshid et al., 2018; Huang & Liao, 2015; Verhagen et al., 2014). Much of AR research in retail has focused on consumers' perceptions of the technology itself within the framework of the technology acceptance model (TAM), which is a well-known theory for technology-related research that discusses consumers' perceived usefulness, enjoyment, and ease of use of the technology (e.g., Huang & Liao, 2015; Pantano et al., 2017). Most of previous AR research in retail contexts has examined consumers' thoughts on AR itself, not on how consumers' product evaluation could be shaped by using AR or how different configurations of AR may produce varying results in consumers' product evaluation. Although for consumers to make an actual purchase decision, they should be able to evaluate product values, not just perceptions about the technology, consumers' perceptions of a product altered by AR has been largely neglected in existing literature. Especially, previous research has not focused on online shoppers' use of the AR-based mobile shopping app, and little research is found on how the AR-based mobile shopping app could impact consumers' product evaluations, such as their perceptions about product values and overall evaluation of the product, or product attitudes. As AR provides interactivity with both products and technology for consumers (Huang & Liao, 2015), it is expected that shopping through AR may not only influence consumers' views toward the technology itself but also consumers' product evaluations. Therefore, to fill this literature gap, this research will investigate AR use by retailers from the angle of how the way they implement AR on a mobile shopping app shapes online consumers' product perceptions and attitudes.

When consumers evaluate products, they need to process product-related information, which may occur in two different information processing systems (i.e., rational and experiential information processing systems) that may be used to varying degrees based upon the encountered situations and/or the consumer's ability (Epstein, 2003). However, little previous research examined how consumers' different information processing systems function when they shop for products using the AR mobile shopping app. AR should be effectively utilized to attract consumers' attention to the provided product-related information while preventing them from focusing on irrelevant information. If the product features are well-communicated to consumers, they would be able to assess product value better and their product attitude would change accordingly. Therefore, what AR design factors can facilitate consumers' rational or experiential information processing needs to be studied. For instance, providing product information through AR using multiple consumers' sensory modalities, as compared to a single modality, may enhance the effectiveness of AR in product evaluation by allowing consumers to process product information more easily (Schifferstein, 2006). The use of different sensory modalities may drive consumers to pay more attention to the information; thus, it may enact a rational information processing system.

In addition, incorporating user-VP interaction in the product experience design of AR (i.e., making certain body parts of users using the product visible on the AR display) may affect consumers' product perceptions and attitudes by impacting their perceived hedonic value of the product experienced during their AR use. One of the main aims of applying AR is to enhance consumers' overall shopping experiences, and AR itself is an enhanced technology tool that provides consumers with a fun shopping experience (Dacko, 2017). The AR design in which consumers do not merely see the virtual product in the real environment but also can view themselves use it in the AR display may further enhance the consumers' sense of presence, or feeling of being physically with the product, which may help them enjoy the virtual product experience and appreciate its hedonic value to help their purchase decisions. However, no previous research has conducted how the user-VP interaction in AR display impacts consumers' product information processing experientially and ultimately influences their overall product attitude.

To address the aforementioned research gaps, this research attempts to examine how consumers' different information processing systems play roles when they shop for products using the AR mobile shopping app with varying levels of modality and user-VP interaction to trigger consumers' dissimilar use of thought processes. To aid in examining the role of the modality and user-VP interaction designs of AR in affecting consumers' product evaluation through the rational and experiential systems of product information processing, this study proposes an *AR-Based Cognitive-Experiential Product Evaluation Model [AR-CEPEM],* which was developed based upon the cognitive-experiential self-theory (CEST) that introduced two information processing routes (i.e., rational and experiential routes) and will be explained further in Chapter 2.

Purpose and Objectives of the Study

To fill the aforementioned gaps in consumer research in relation to AR application in retail settings, the study examines how consumers' interaction with AR mobile shopping apps affects their product attitude by specifically examining the effects of the *AR Modality* (i.e., visual only vs. visual + auditory) and *User-VP Interaction in AR display* (i.e., yes vs. no interaction) designs of AR mobile shopping apps. Two varied information processing systems (i.e., rational system and experiential system), postulated by the CEST, are predicted to be affected by the aforementioned AR design factors to drive consumers' product attitude. More specifically, this study will investigate how consumers' levels of *cognitive attention*, or the extent to which they cognitively concentrate on one stimulus, and *sense of presence*, or consumers' subjective feeling of being with the product, are affected by the AR design factors and in turn influence consumers' *perceived utilitarian value* (i.e., the degree to which consumers perceive that they are satisfied with product functions) and *hedonic value* (i.e., the degree to which consumers perceive that they could enjoy using a product) of a product, respectively. Further, two variables describing consumers' information processing styles (i.e., *need for cognition* and *faith in intuition*) will be included as personal characteristic moderators for the proposed effects of AR Modality and User-VP Interaction on the levels of cognitive attention and sense of presence, respectively. Based upon the overall purpose of the study, the specific objectives of this research are:

1. To investigate how AR Modality (i.e., visual-only modality vs. visual + auditory modality) affects consumers' cognitive attention while using the AR mobile shopping app,
2. To investigate if consumers' level of need for cognition moderates the effect of AR Modality on the cognitive attention level,
3. To investigate how User-VP Interaction (i.e., yes vs. no VP interaction) in AR display affects consumers' sense of presence level while using the AR mobile shopping app,
4. To investigate if consumers' level of faith in intuition moderates the effect of User-VP Interaction on the sense of presence level,
5. To investigate if the amount of cognitive attention influences consumers' perceived utilitarian value of a product while using the AR mobile shopping app,
6. To investigate if consumers' sense of presence level influences their perceived hedonic value of a product while using the AR mobile shopping app,
7. To investigate if perceived utilitarian and hedonic values of a product influences consumers' product attitude while using the AR mobile shopping app,

Definition of Terms

Augmented Reality (AR): AR can be described as an interactive technology that presents virtual objects in the real world to provide users with interactions with computer-generated objects (Azuma, 1997).

AR Modality**:** Sensory modality that is incorporated in the AR mobile shopping app to better communicate product information to consumers (i.e., visual-only modality vs. visual + auditory modality). In the visual-only modality condition, users view a 3D virtual product in the actual environment (e.g., a fictitious consumer's home) with a text description of the product information displayed on the video. In the visual + auditory modality condition, users view the same visual objects (i.e., the virtual product, the actual environment, the product specification text) along with an auditory explanation of the product information displayed in the text through a virtual agent voice.

Cognitive Attention**:** An individual's focus where they cognitively concentrate on one stimulus and ignoring others (Matlin, 1994). In this study, the user's focus should be on visual and auditory information about the product shown/heard from the AR app video, while they may ignore external stimuli, such as noise in their background in the real environment or visuals on their computer screen that are not part of the AR app video, to cognitively concentrate on the provided information.

Cognitive-Experiential Self-Theory (CEST)**:** A theory that describes a dual information processing model by proposing that people have two parallel interacting modes of information processing: a rational system and an experiential system (Epstein, 1991).

Cognitive Load Theory (CLT)**:** A theory that explains "the amount of 'mental energy' required to process a given amount of information" (Feinberg & Murphy, 2000, p. 354).

Experiential Learning Theory (ELT)**:** A theory that holistically explains the role of experience in an individual's learning process (Kolb & Kolb, 2009).

Faith in Intuition (FII): An individual's tendency to primarily rely on their intuitive feelings when processing information (Epstein et al., 1996).

Need for Cognition (NFC)**:** An individual's tendency to enjoy thinking when processing information (Cacioppo & Petty, 1982).

Perceived Hedonic Value of a Product**:** The degree to which consumers perceive that they would enjoy using a product.

Perceived Utilitarian Value of a Product**:** The degree to which consumers perceive the functionality of a product is satisfactory.

Product Attitude: An individual's favorable or unfavorable reaction to a product (Ajzen & Madden, 1986).

Sense of Presence**:** Feeling of being physically with the product, which may help them enjoy the virtual product experience and appreciate its hedonic value to help their purchase decisions.

Split Attention Effect**:** The effect which explains that individuals will need to split their attention in order to effectively process information if the information is provided through more than two sources at a time (Sweller et al., 2011).

User-Virtual Product (VP) Interaction in AR Display: Whether or not users can see themselves in the AR digital display. In this study, User-VP Interaction in AR display is experimentally manipulated by using video stimuli that demonstrate a fictitious user's simulation mobile shopping using an AR-based mobile shopping app. In this video, the image of the user's body parts interacting with the VP will be incorporated in the AR display in the yes-interaction condition, whereas in the no-interaction condition, participants cannot see the user in the AR display in the video.

CHAPTER 2. REVIEW OF LITERATURE

The current chapter provides an overview of the AR use in retail settings and a review of literature regarding theoretical and conceptual frameworks leading to a research model and hypotheses tested in this study.

Augmented Reality (AR) in Retail Settings

Digital technologies (e.g., personal computers, cellular phones and tablets) have noticeably influenced individuals by providing a more convenient way of living (Suh & Lee, 2005), which resulted in the growth of the digital technology area. Although an increased number of consumers have utilized digital technologies for product shopping, they have not been able to fully experience products because consumers cannot physically interact with products when shopping online (Orús et al., 2017). As shopping through digital technologies cannot provide consumers with identical product experiences that they could have in physical stores, the ability to 'imagine' interacting with products has become critical for consumers to evaluate products and make purchase decisions when shopping online (Orús et al., 2017). Researchers have started employing advanced technologies (e.g., VR and AR) in online retails to help consumers' imagination and thus enhance product shopping experiences by creating enriched interactions between consumers and products (Suh & Lee, 2005). These advanced technologies have shown to have a positive effect on consumers' product learning by enabling consumers to understand and accept products better, which eventually influence their perceptions and attitudes toward the products (Suh & Lee, 2005). Among the advanced technologies that retailers have recently incorporated into their businesses to effectively promote brands and products, AR has been rapidly gaining attention due to its advanced features.

AR is defined as "the superposition of virtual objects (computer-generated images, texts, sounds, etc.) on the real environment of the user" (Faust et al., 2012, p. 1164). Similarly, Olsson et al. (2013) have defined AR as a combination of the "real and computer-generated digital information into the user's view of the physical world in such a way they appear as one environment" (p. 288). As the definitions of AR indicates, AR integrates virtual information in the real environment and allows consumers to have an interaction with computer-generated objects through the system (Azuma, 1997). Thus, consumers can try virtual products in their own real-world physical environment with AR when shopping online. AR provides the 'interactive' feature to consumers, and this interactivity entertains and emotionally affects consumers (Fiore et al., 2005) and help consumers like product (Zhao et al., 2011). With these advanced aspects of AR, this research aims to investigate how the two AR design factors (AR Modality and User-VP Interaction in AR display) impact consumers' product perceptions and attitudes when shopping using an AR mobile shopping app.

Theoretical and Conceptual Frameworks and Hypotheses

In this section, various theories and concepts, including cognitive-experiential self-theory (CEST), cognitive load theory (CLT), experiential learning theory (ELT), modality effect, and split attention effect, are reviewed along with how these theories inform the selection of the research constructs of this study, including cognitive attention, sense of presence, perceived utilitarian and hedonic values, product attitude, AR modality, and user-VP interaction in AR display, and predictions of their relationships.

Dual Systems of Information Processing on AR Mobile Shopping Apps: Cognitive-Experiential Self-Theory (CEST) Perspective

Cognitive-experiential self-theory (CEST) is a dual information processing model that was introduced by Epstein (1991). CEST posits that a person may use two distinguished information-processing systems: a rational system and an experiential system (Kolb & Kolb, 2009). Although the two systems are independent, they still influence and interact with each other (Epstein, 1991). The primary differences between the two systems are that the rational system operates in a logical and reason-oriented way, whereas the experiential system operates based upon an individual’s feelings and thus are more emotion-oriented (Kirkpatrick & Epstein, 1992). The rational system operates analytically for cause-and-effect analysis with logics (Epstein, 1991). Table 2.1 presents a comparison between the rational system and the experiential system by introducing how individuals process information through each of the two information processing systems.

Table 2.1

Comparison of the Rational and Experiential System

Rational System	Experiential System
Analytic	Holistic
Reason-oriented (what is sensible)	Emotion-oriented (what feels good)
Cause-and-effect analysis	Associationistic
Process-oriented	Outcome-oriented
Behavior mediated by conscious appraisal of events	Behavior mediated by “vibes” from past experiences
Encodes reality in abstract symbols (words and numbers)	Encodes reality in concrete images and metaphors
Slower processing—delayed action	Quicker processing—immediate action

Changes rapidly—can change with speed of thought	Slower to change—changes with repetitive experience, direct or vicarious
Highly differentiated; dimensional thinking	Crudely differentiated; broad generalization gradient; categorical thinking
More highly integrated	Crudely integrated—dissociative, organized into emotional complexes (cognitive-affective modules)
Experienced actively and consciously as if we are in control of our thoughts	Experienced passively and preconsciously; we are seized by our emotions
Requires justification via logic and evidence	Self-evidently valid: "Experiencing is believing"

Note. The table was adapted from Epstein (1991).

Based upon the characteristics of the two systems, previous researchers have debated whether one system is superior to the other system and whether human beings can survive with only one system over the other (e.g., Epstein, 1991; Epstein, 2003). According to Kirkpatrick and Epstein (1992), the rational system has a shorter evolutionary history compared to the experiential system because the experiential system was adapted by other animals for their living over millions of years ago, which demonstrates a more extended evolutionary history than the rational system. That is, the concept of the experiential system is more relevant to the natural system, which can be explained in a biological manner with an individual's emotions (Epstein, 1991). It has been argued that the experiential system is the basis for humans' mental process with emotions, and the rational system is the primary system for information processing because the rational system enables individuals to cognitively think. Not only that, humans also logically explain many situations (i.e., rational system) rather than judge situations merely based on their previous experiences or emotions like other animals (i.e., experiential system) (Epstein, 1991). Thus, one may think that the rational system is more developed and more related to human beings than the experiential system owing to the fact that the rational system is analytical, comprehensive, and functioning with higher complexion.

However, Epstein (1991) further discussed and compared the two systems beyond evolutionary perspective by arguing that the rational system cannot fully function without the experiential system because the experiential system is more holistic. Individuals are not able to fully process information merely with the rational system; and in some situations, the experiential system could be more helpful for humans to process information (Epstein, 2003). For instance, the experiential system can help individuals process information when it is exceedingly complex to be logically analyzed and/or when the information directly comes from feelings and past experiences (Epstein, 2003).

Therefore, CEST suggests that humans need both systems to effectively process information. Although some individuals may more frequently utilize the rational system over the experiential system, while vice versa for others, it cannot be one or the other. That is, individuals do not process information merely based upon one single system, but they utilize both systems depending upon the situations that they encounter (Epstein, 2003). Therefore, the two information processing systems should be equally discussed. This study addresses how the rational system and experiential system play a role as information processing routes when consumers learn product information while shopping using the AR mobile shopping app, and how these two information processing routes may be affected by the two AR design factors, AR modality and user-VP interaction in AR display.

Rational System of Information Processing on AR Mobile Apps

This section will discuss the rational system of information processing that may occur when consumers evaluate products using an AR mobile shopping app within the framework of cognitive load theory.

Cognitive Load Theory (CLT)

Cognitive load theory (CLT) has been utilized to better understand individuals' cognitive learning and information processing with cognitive resources (Chandler & Sweller, 1991). CLT is an instructional theory concerning a long-term memory as well as a working memory used for temporary conscious information processing (Kalyuga, 2011). In this study, cognitive load is defined as "the amount of 'mental energy' required to process a given amount of information" (Feinberg & Murphy, 2000, p. 354). According to CLT, a learner may experience difficulties in learning new and complex information because complex information requires consumption of more mental energy (i.e., bear more cognitive load) to process the information (Sweller et al., 2011). However, CLT proposes that an individual can learn information better when effective instructional material is given, such as that calling for cognitive resources relevant to the learning activity (Chandler & Sweller, 1991).

A learner's effective processing of instructional information in their working memory is affected by either *intrinsic cognitive load* or *extraneous cognitive load* (Sweller et al., 2011). Intrinsic cognitive load is the base cognitive load that is highly affected by the complexity of the task and/or the expertise and working memory capacity of the learner (Sweller et al., 2011). That is, intrinsic cognitive load is determined by the interaction between characteristics of task and learners' ability, which influences how much learners can process given information (Merrienboer & Sweller, 2005). Extraneous cognitive load is an additional type of load that is caused by the presence of unnecessary information that could affect an individual's learning effectiveness (Sweller et al., 2011). Individuals are not able to consciously process excessively complicated tasks at a time as their memory capacity is limited (Kalyuga, 2011). Therefore, it is critical to decrease extraneous cognitive load for a learner to pay their cognitive attention to the relevant information and further retain the information better. In the current study, CLT is applied to explain a consumer's rational information processing during mobile shopping with an AR app by predicting how a consumer's degree of cognitive attention influences their perceived product values as well as product attitude.

Cognitive Attention

Cognitive attention is an individual's focus where they cognitively concentrate on one stimulus while ignoring others (Matlin, 1994). Cognitive attention helps individuals adjust information processing within their sensory modalities (Mozolic et al., 2008) by centering their cognitive capacities on a specific sensory modality (Biocca et al., 2007). Roser (1990) suggested that an individual's level of involvement with a certain object or message is closely related to the degree of one's attention to the object or message; the more involved the consumer is in the provided information, the more attention he or she pays to it.

In the case of multimedia learning, an individual's attention focus could vary by their working memory capacities because multimedia consist of different sensory modalities such as visual and auditory modalities. Individuals with a higher working memory capacity are less interrupted with irrelevant information and better focus on the information that is provided for their learning through multimedia (e.g., Colflesh & Conway, 2007; Sanchez & Wiley, 2006; Schweppe & Rummer, 2014). Likewise, previous research has suggested that individuals can pay greater attention if they have higher working memory capacities because they can highly focus on the relevant information.

Perceived Utilitarian Value of a Product

Consumers may be strongly attracted to a product when they can imagine themselves personally using the product, which happens when consumers favor the product functions (i.e., utilitarian value) or enjoy using the products (i.e., hedonic value). When it comes to the discussion of an individual's perceived utilitarian or hedonic value, however, most of previous research focused on utilitarian and hedonic 'shopping value' because consumers primarily perceive both values through their overall shopping experiences (Babin et al. 1994).

Utilitarian value in shopping experiences can be described as a task-oriented and rational value that individuals perceive when their consumption needs are satisfied through shopping (Babin et al., 1994). That is, a consumer could mostly find utilitarian value if their needs are met through their shopping activities (Babin et al., 1994). In a similar sense with the utilitarian value of shopping experiences, utilitarian value of a product can be explained as the 'rational' functionality aspect of a product, such as the effectiveness and usefulness of the product. Claeys et al. (1990) distinguished utilitarian and hedonic products as 'think' and 'feel' products, respectively. According to Claeys et al. (1990), consumers are prone to process think products with more of a cognitive information processing style, which is logical and analytical. That is, think products are distinct from feel products in a sense that think products may be mostly judged based upon an individual's perceived objective and functional values of a product (Claeys et al., 1990). Following the meaning of think products, *perceived utilitarian value of a product* refers to the degree to which consumers perceive the functionality of a product is satisfactory. In other words, consumers perceive greater utilitarian value of a product when they view that the product is useful due to its features.

Cognitive Attention and Perceived Utilitarian Value of a Product

According to CLT, given certain information, an individual needs to be able to pay attention to relevant materials from the information to process it effectively (Sweller et al., 2011). Theoretically linking cognitive attention and perceived utilitarian value of a product within the CLT framework, the more an individual pays cognitive attention to the provided information, the more they will be able to perceive relevant product values. Individuals have a limited cognitive capacity; therefore, it is critical for them to be able to selectively apply their cognitive resources to process information by cognitively paying attention to the relevant information (Sweller et al., 2011). Because individuals can learn and retain the provided information better when they cognitively pay attention to the materials, they will recognize the utilitarian value of a product when they cognitively acquire knowledge on the positive product information.

Recent research has demonstrated that individuals are able to process more detailed product information when they are more involved in their product purchasing process (Behe et al., 2015) because they paid greater attention to the product information. Furthermore, it has been found that the greater the cognitive attention individuals paid, the more effective their information processing happened (Biocca et al., 2007). Therefore, individuals would be able to find more values in a product if they paid greater attention to the provided tasks. As such, it could be assumed that consumers would be able to perceive the functionality of the product if they paid greater cognitive attention to the product information without being interrupted by irrelevant information. Taken together, it is proposed that during an AR-based mobile shopping, consumers' level of cognitive attention will positively influence their perceived utilitarian value of a product as consumers will be able to find those values more by paying greater attention, as proposed in the following hypothesis:

> ***Hypothesis 1****:* The level of cognitive attention consumers pay to product feature verbal information during shopping with an AR mobile app positively influences their perceived utilitarian value of a product.

Experiential System of Information Processing on AR Mobile Apps

This section will discuss the experiential system of information processing that may occur when consumers evaluate products using an AR mobile shopping app within the framework of experiential learning theory.

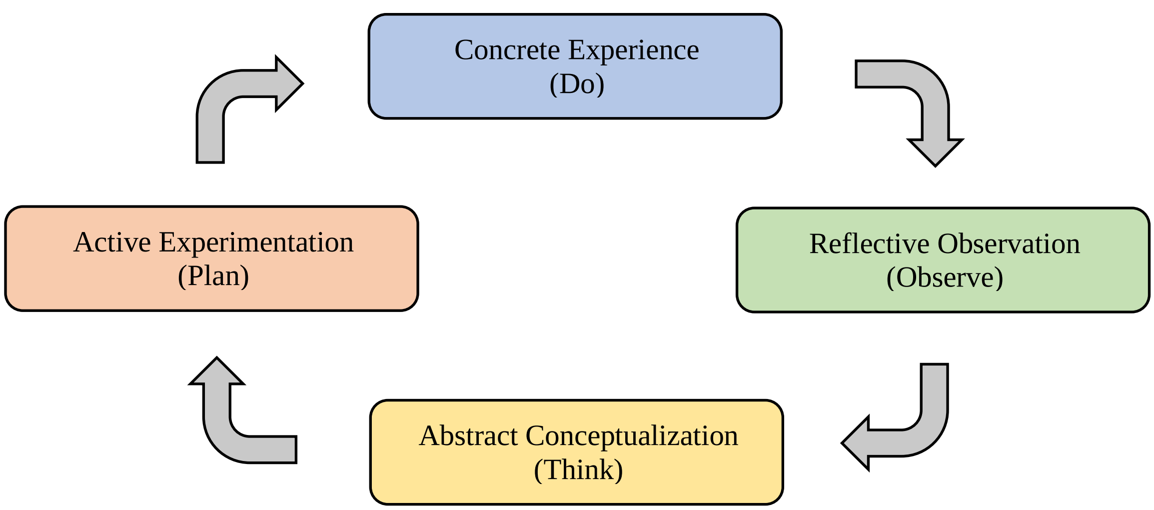
Experiential Learning Theory (ELT)

Experiential learning refers to "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p. 41). Experience is defined as an activity where an individual uses their gained knowledge and insights to their everyday lives (Huang et al., 2016). Experience mostly occurs with an interaction between an individual and either an object or environment (Li et al., 2001). Experiential learning theory (ELT) holistically explains the role of experience in an individual's learning process (Kolb & Kolb, 2009). According to Huang et al. (2016), experiential learning is centered on an individual's own judgement, thinking, and past experiences instead of relying on others to learn. Huang (2017) further supports ELT by demonstrating that learners could produce noticeably enhanced learning outcomes by engaging in experience-based learning systems instead of following the instruction that is given by instructors, which is considered as cognition-based tasks. Put simply, ELT has been developed to deeply investigate learning experiences, by positing that experience should be the basis of learning to generate the maximum effect.

According to Kolb (1984), effective learning can be produced through the experiential learning cycle consisting of four steps: 1) concrete experience, or actively experiencing an activity; 2) reflective observation, or understanding and thinking about that specific experience and what a learner observed from the experience; 3) abstract conceptualization, integrating concepts that the learner is acknowledged with the experience; and 4) active experimentation, actively applying this experience to the learner's real-life (see Figure 2.1). Based on the experiential learning cycle, ELT primarily emphasizes that 'experience' is the most critical aspect in an individual's learning process (McCarthy, 2010).

Figure 2.1

Kolb's Experiential Learning Cycle



In this research, ELT is applied to explain how consumers' product perception alters while learning about the product through an immersive shopping experience. In a physical store, consumers learn about a product when they directly *experience* and *try* it. However, when shopping online, consumers have a more limited opportunity to *experience* the product as compared to when shopping in physical stores (Katawetawaraks & Wang, 2011). In most cases of online shopping, consumers can examine products only through visual images of products and product specifications in a text format. This lack of direct experiences reduces consumers' *sense of presence,* or feeling like physically being with the product, which can negatively affect product learning. AR may help consumers overcome this limitation of online shopping by offering an opportunity for an enhanced immersive shopping experience without actually being in physical stores. Through AR, online consumers can acquire product knowledge, particularly experiential values of the product by allowing them to experience the virtual product in the consumers' real-world environment. AR may help generate an immersive product learning experience by boosting online consumers' sense of presence, or feeling like they are with the product. Therefore, ELT offers a perspective to understand this experiential system of product information processing in the context of mobile shopping using an AR app.

Sense of Presence

User experience is commonly discussed in the VR and AR studies because the primary purpose of providing a virtual environment to users is to enrich their overall experience. Here, user experience refers to "how people use an interactive product: the way it feels in their hands, how well they understand how it works, how they feel about it while they are using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it" (Alben, 1996, p. 5). Specifically, in the advanced technology use context, a critical aspect of user experience to be explored is a sense of presence and immersion (North & North, 2016). In this study, *sense of presence* is feeling of being physically with the product, which may help them enjoy the virtual product experience and appreciate its hedonic value to help their purchase decisions. When it comes to media and technology uses, users need to feel the sense of presence in order to receive more enriched experiences. In this study, we regard the user's sense of presence as *being involved in the reality* by mentally integrating the virtual object into the real world, rather than as the user's *being entirely immersed* in the virtual world. Therefore, the term 'sense of presence' will be utilized in this paper to explain how much users feel as if they were experiencing the product in their real world (e.g., consumer's own home, office, outside).

Perceived Hedonic Value of a Product

Consumers tend to be satisfied with the holistic shopping experience when both of their utilitarian and hedonic values are satisfied (Poncin & Mimoun, 2014). Previous research has suggested that the hedonic value perception can be enriched when consumers enjoy their overall shopping experience, which helps consumers to perceive the product from a pleasure perspective through the multisensory and affective inputs (Holbrook & Hirschman, 1982). As it was discussed earlier in the utilitarian value of a product section, not many previous studies have focused on the hedonic value of a product itself; however, a plethora of literature has discussed hedonic values of overall shopping experiences. For example, Babin et al. (1994) argue that the hedonic value of shopping experiences is associated with an individual's enjoyment and pleasure obtained from the shopping experiences. The shopping activity can be entertaining to consumers who perceive a high hedonic value of shopping and thus consider the shopping activity as a fun experience rather than an errand that they need to accomplish (Babin et al., 1994). Similarly, hedonic value of a product could be approached from a more intuitive and emotional aspect that comes from the intangible product feature (Claeys et al., 1990). Claeys et al. (1990) described hedonic products as 'feel' products that emphasize the emotional aspect than the rational aspect (i.e., 'think' products). That is, subjective feelings that consumers experience with a product is critical for them to perceive the hedonic value of the product.

As an interchangeable term, perceived *experiential value* has been discussed in previous research. Jeong et al. (2009) emphasized that consumers' perceived experiential value (e.g., pleasure) could differ depending upon how products are presented to consumers. Specifically, consumers' perceived experiential value was greater when a product was presented in a richer way (e.g., moving animations) compared to when a simple image of a product was provided because the former way of product presentation was more visually appealing to consumers, which eventually enhanced their perceived experiential value of the product (Jeong et al., 2009). Furthermore, Jeong et al. (2009) found that consumers' perceived experiential values were enhanced when they favored the product presentation and experienced sensory appeals from the product presentation. Likewise, consumers would emotionally value the product when they find the product shopping experience 'new' and 'fun.' Based upon previous research of hedonic value of shopping experiences and experiential value toward a product, *perceived hedonic value of a product* is defined in this study as the degree to which consumers perceive that they could enjoy using a product or how well consumers could imagine themselves enjoying using a product.

Sense of Presence and Perceived Hedonic Value of a Product

As discussed in an earlier section, ELT emphasizes the importance of 'experience' for effective learning (Kolb, 1984; McCarthy, 2010). That is, individuals learn information better when they are engaged in the actual experience, as compared to when they merely follow the provided instructions (Huang et al., 2016). By applying ELT in the current context of the linkage between sense of presence and perceived hedonic value of a product, it is predicted that consumers will be able to perceive their enjoyment of using a product if their level of sense of presence is heightened. When individuals engage in a learning activity, and experience a higher level of sense of presence, they will be able to learn and retain the provided information more effectively, according to ELT. Therefore, the level of sense of presence can lead to positive hedonic valuation when it comes to an individual's value perception. In other words, individuals will perceive hedonic value of a product when they feel a higher sense of being physically with the product, which may help them enjoy the virtual product experience. A recent study found that consumers would be able to engage in a more pleasurable and fun product shopping experience if they experienced a higher sense of presence (Huang & Liao, 2015). Similar to the consumers' perceived hedonic value of their shopping experiences, it is expected that consumers will perceive hedonic value of a product when they feel like they are physically with the product. Therefore, the following hypothesis is proposed:

> ***Hypothesis 2:*** The level of sense of presence consumers felt during shopping with an AR mobile app positively influences their perceived hedonic value of a product.

Perceived Values and Product Attitude

Attitude can be explained with how an individual reacts to certain objects and situations, which stems from an individual's mindset (Ajzen & Madden, 1986). An individual's attitude could demonstrate whether they either favorably or unfavorably evaluate situations, objects, and behaviors based upon their beliefs and motivations, ultimately influencing their intentions to experience those aspects, which is suggested by the theory of reasoned action (Ajzen & Madden, 1986). The theory of reasoned action has been used to explain consumer attitudes toward various consumption-related behaviors (Ajzen & Madden, 1986). Attitude has been widely studied in consumer research because it could demonstrate whether an individual formed beliefs and evaluations toward objects (e.g., products, brands) or behaviors (e.g., purchase, use). In this research, the theory of reasoned action is applied to predict how consumers form a positive or negative product attitude based on their product value perceptions (i.e., beliefs).

Among previous studies that examined a consumer's product attitude, Kim and Morris (2007) have demonstrated that an individual's cognitive and affective responses are critical when forming their attitudes toward product under product-trial circumstances. That is, a consumer's product attitude can be formed differently depending on the consumer's perceptions and previous experiences with the product. Similarly, Chi and Kilduff (2011) found that consumers had more favorable attitudes toward a fashion product when they perceived positive values in it. In the retail technology context, Kim and Forsythe (2007) found that perceived utilitarian and hedonic values of a specific virtual technology had positive influences on consumers' attitudes toward using virtual technologies while shopping for products. Similarly, Yim et al. (2017) found that consumers formed more positive attitudes toward the AR technology when they found it more effective and efficient for make their purchase decisions (i.e., utilitarian value of the AR technology) as well as when they enjoyed using the technology while shopping for products (i.e., hedonic value of the AR technology). The findings of Yim et al. (2017) demonstrate that consumers perceived values of using the retail technology as an assistive technology for their product shopping, which enhanced their attitude formation. More recent research has demonstrated that consumers were able to form their attitudes more easily toward a product when the product was introduced with a retail technology, such as AR, as compared when such technology was not used, because they could more vividly experience the product and enjoyed using the technology (Park & Yoo, 2020). Following previous findings, the researcher suggests that consumers will form a more positive product attitude as they perceive greater utilitarian and hedonic values of a product, specifically in the context of product evaluation by using an AR mobile app. Therefore, the next hypothesis is proposed:

> ***Hypothesis 3***: Consumers' **a)** perceived utilitarian value of a product and **b)** perceived hedonic value of a product positively influence their product attitude during shopping with an AR mobile app.

AR Modality

People use different sensory modalities depending on their encountered situations (Schifferstein, 2006). Stimulating multisensory is essential for consumers' product experience because all sensory modalities (i.e., vision, touch, smell, sound, and taste) have significant influences on consumers' product experiences (Fenko et al., 2010). For instance, consumers rated that the visual modality was the most important sensory modality when evaluating products, followed by touch, smell, audition, and taste (Schifferstein, 2006). Similarly, Fenko et al. (2010) found that consumers utilized the visual and touch modalities the most frequently when they made product purchase decisions although they still considered other sensory modalities as important. Consumers further commented that the visual modality was the most critical sensory modality at the moment of purchasing products (Fenko et al., 2010). The interaction between consumers and products mostly occurs through the visual sensory modality because vision brings consumers necessary product information for purchase decision-making (Fenko et al., 2010).

In mobile shopping settings, only limited sensory modalities are applicable including visual and auditory sensory modalities. Therefore, the effectiveness of product information communication in mobile commerce can be discussed with consideration of these two sensory modalities. As previously mentioned, vision has been the dominantly used sensory modality when consumers shop for products (Fenko et al., 2010). However, consumers indicated that they would strongly rely on their auditory sense (i.e., information that they hear) if they needed to pay attention to the functional aspects of products (Schifferstein, 2006). Thus, we expect that consumers may be able to process product specifications more easily and consistently when the information is presented auditorily than visually.

Further, it also has been suggested that using the integration of the two sensory modalities helps individuals' information learning (e.g., Macklin, 1994; Orús et al., 2017). For example, Macklin (1994) examined whether children absorbed and understood information more effectively through a visual or auditory presentation and found that they learned information equally through the two presentation modalities, but most effectively when both presentation modalities were integrated together. Macklin's (1994) findings demonstrate the importance of the dual-sensory modality use for an individual's effective learning. Similarly, Orús et al. (2017) demonstrated that product information could be well-communicated when it was an audiovisual format (i.e., visual + audio modalities). Orús et al. (2017) emphasized the importance of *vividness* of information to intrigue consumers' attention and encourage them to create imagination, especially in the online environment. Orús et al. (2017) also found that online product presentation videos (OPPV) with the audiovisual product contents increased consumers' quality of product-related thoughts and allowed consumers to easily imagine themselves using products. Therefore, reflecting the findings of Orús et al. (2017), it is suggested that the AR mobile shopping app could enhance consumers' learning of the product information when it presents the product information through the dual-sensory modality (i.e., visual + auditory modalities). Considering the online shopping environment, it is not possible to provide other sensory modalities such as touch and taste, and yet visual and auditory modalities could be effectively utilized to enhance consumers' shopping experiences. For example, AR can enrich consumers' interaction with products by allowing them to view a virtual product in the real environment (i.e., visual sensory modality) while hearing product information explained by a virtual agent on the AR mobile shopping app (i.e., auditory sensory modality). In this research, *AR modality* is defined as sensory modality that is incorporated in the AR mobile shopping app and will be operationalized as a manipulated variable with two levels—single (or visual-only) modality versus dual (or visual + auditory) modality. The following section will explain how the use of dual-sensory modality of the AR mobile shopping app could affect consumers' product perceptions and attitudes by comparing it with the single sensory modality.

Modality Effect on the Cognitive System

CLT literature has suggested that communication modality impacts the amount of cognitive load experienced in processing of information communicated, which is referred to as the modality effect. According to the modality effect (Mayer & Moreno, 2003), using dual-sensory modality (e.g., visual + auditory modality) can reduce an individual's cognitive load as compared to using a single modality (e.g., visual-only modality) because the individual can employ two available capacities that can be separately used for their information processing, which enables the individual to pay increased cognitive attention to the relevant material when processing information and thus absorb information more effectively (Feinberg & Murphy, 2000). To be more specific, previous studies suggested that when information is provided via pictorial presentation (i.e., visual channel) and verbal presentation (i.e., auditory channel), it is the most effective if both channels are simultaneously used for individuals' information processing because each channel contains relatively limited capacities, which could constrain individuals' information processing if utilized by itself (e.g., Brünken et al., 2004; Mayer &

Moreno, 2003). Therefore, if a single modality creates an extremely complex case, this may not be effective for some individuals' information processing because this requires them to use excessive mental energy, leading to a high cognitive load. For instance, if information is provided in images and texts, both of which are visual, at the same time, it may not be as efficient for individuals to process the information because it could create a complex scene (Feinberg & Murphy, 2000). However, when the learning materials were provided in dual-sensory modality (e.g., visual + auditory modality), the amount of cognitive capacity increases, which enables individuals to process the information with greater ease compared to when the information is provided in single sensory modality (e.g., visual-only modality) (Brünken et al., 2004; Rummer et al., 2011).

Applying the aforementioned modality effect in the context of shopping with an AR mobile app, the modality of AR, or whether the AR display uses only the visual modality (i.e., virtual product image + product specification text) or a dual-sensory modality incorporating the auditory modality (i.e., a virtual agent's voice) along with the visual modality, may impact the extent to which the cognitive system of information processing is activated. Cognitive attention plays a significant role for individuals to absorb information and/or process tasks in the AR environment as individuals have to focus on both the real and virtual environments (Biocca et al., 2007). Individuals must use their cognitive capacity to effectively pay attention to the provided relevant information (Biocca et al., 2007); higher working memory capacities would allow them to focus on the given task by being less interrupted with irrelevant information (Schweppe & Rummer, 2014). It has been known that a dual-sensory modality presentation allows individuals to use higher working memory capacities, as compared to a single-sensory modality presentation, and thus increases the amount of cognitive capacity (Brünken et al., 2004; Feinberg & Murphy, 2000). Therefore, dual-sensory modality application in the AR mobile shopping app will create an environment where consumers can pay greater attention to the provided product information and easily process it, as compared to the single modality application.

The dual-sensory modality use in the AR mobile shopping app not only impacts consumers' cognitive attention, but it also is likely to allow consumers to learn and retain the provided information better with their increased amount of cognitive capacity. As compared to the visual-only modality presentation, the dual modality presentation, in which a three-dimensional (3-D) virtual product and text-based product specification information are presented through the AR display while a virtual agent speech that auditorily introduces the product specification information is simultaneously provided, would improve consumers' understanding and retention of the product specification information given the consumers' improved cognitive capacity. This improved understanding of the product specifications is likely to allow the consumers to better appreciate the functionality offered by the product specifications, thereby leading to an improved perception of the utilitarian value of a product. Considering that the utilitarian value of a product is grounded in the functional features of a product, it is predicted that the utilitarian aspects need to be introduced to consumers in a more analytical way to better communicate. As consumers are able to view virtual objects in the real environment through the AR mobile shopping app that is more visual imagery-based with moving animations, providing product features through a textual presentation would not be effective to deliver the utilitarian value of a product to consumers as it uses the same modality (i.e., visual) as the product images which compete for the same cognitive capacity, according to the modality effect literature (Brünken et al., 2004; Feinberg & Murphy, 2000). Specifically, if product features are provided through a textual presentation, the entire information will be delivered through the visual modality as a single modality, which limits an individual's information processing capacities (Brünken et al., 2004; Feinberg & Murphy, 2000). As suggested by the modality effect, the use of dual-sensory modality would better communicate the utilitarian aspects of a product as it allows a greater amount of mental capacity along with consumers' significant attention (Brünken et al., 2004; Feinberg & Murphy, 2000).

Furthermore, if the dual-modality AR mobile shopping app can create the environment for consumers to pay greater cognitive attention to product feature information and enhance their perceived utilitarian value of the product, the consumers will be likely to form a more positive attitude toward the product, as compared to when a single-modality AR mobile shopping app is used. Product attitude refers to one's favorable or unfavorable overall product evaluation (Ajzen & Madden, 1986). Much literature has discussed the role of the cognitive system of information processing in attitude formation. According to Zhao et al. (2011), individuals' cognitive responses during purchase decisions tend to be focused on goal achievement such as functionally-oriented information which leads to a favorable product evaluation (Zhao et al., 2011). More recent research by Fan et al. (2020) revealed that consumers formed more positive product attitudes and were able to make a purchase decision more easily when they smoothly processed product information with less cognitive load. As suggested by the modality effect, dual-sensory modality (vs. single-sensory modality) could significantly help consumers easily process the product information with less cognitive load by improving the consumers' amount of cognitive capacity (Brünken et al., 2004; Feinberg & Murphy, 2000). Therefore, in this study, it is predicted that if the product information is provided with the dual-sensory modality, consumers would be able to better acknowledge the product information, more successfully evaluate the product, and thus have a more positive product attitude.

Based on the aforementioned discussion in relation to the modality effect on the constructs constituting the cognitive system of information processing, including cognitive attention, perceived utilitarian value, and product attitude, in the context of shopping with an AR mobile app, the following hypotheses are proposed:

Hypothesis 4: **a)** Consumers' level of cognitive attention is greater, **b)** perceived utilitarian value is higher, and **c)** product attitude is more favorable when a mobile AR app employs a dual (visual + auditory) modality than when it employs only a visual modality.

User-Virtual Product (VP) Interaction in AR Display

AR offers enjoyable experiences to consumers by enabling them to feel like they are physically trying products in the real environment (Farshid et al., 2018). This interactive aspect of AR enhances consumers' product shopping experiences. Similar to AR, VR has been considered as one of the advanced technologies that enhance consumers' shopping experience as it enables consumers to involve in their shopping experience by providing the virtual environment beyond just the static objects (Suh & Lee, 2005). However, AR is generally considered a superior technology to VR in the aspect that AR can create an interwoven scene of the virtual product and the real environment, which may add realism to user experience (Farshid et al., 2018). In addition to interweaving the real environment in which the user is, some AR mobile shopping apps also enable the live video of the user to be integrated into the AR display, which is referred in this study as *user-VP interaction in AR display*, creating the visual illusion as if the user were interacting with the product in the real environment. It is predicted that this added realism factor would further enrich user experience by allowing the users to *feel the enjoyment of using the product* in addition to the enriched user experience from the integration of the virtual product with the user's real environment. To examine this prediction, the current research investigates whether the user-VP interaction in AR display could enhance consumers' level of sense of presence compared to non-user-VP interaction in AR display. In this study, therefore, *user-VP interaction in AR display* is operationalized as whether or not users can see themselves in the display. More specifically, in the user-VP interaction in AR display condition, the AR display allows a consumer to view themselves using a virtual object in the real environment; whereas the *non-user-VP interaction in AR display* would not feature the user and merely show a virtual product in the real environment. Therefore, when users use the AR mobile shopping app with the user presence feature, a user may try a virtual product by viewing themselves using the product on the mobile screen. For instance, users could virtually try on a watch on their wrist by viewing the combined scene of the virtual watch on their wrist in their room (i.e., the real environment). By viewing themselves in the AR display, consumers may be able to experience a greater sense of presence, or feeling as if they were physically with the product, and perceive a greater 'fun' of using the product (i.e., hedonic value of the product), thereby positively influencing their overall product attitude. Next section delves into the literature discussion around this phenomenon.

User-Virtual Product (VP) Interaction Effect on the Experiential System

According to ELT, experience is the primary source of an individual's effective learning processes (Roussou, 2004). Kolb (1984) noted that individuals learn by doing, which means that individuals should actively engage in the given learning task for effective learning to occur. The interactive feature of AR provides consumers with opportunities for active engagement with the product (i.e., virtual product), allowing their experiential learning of the product at a level that would not be achieved without AR. For instance, Sung and Cho (2012) compared consumers' varied experiences with AR advertisements and 2-D advertisements and found that consumers experienced were more inclined to value their interaction with the advertisement when AR was used because the AR advertisements provided an active, direct, and lively interaction experience to consumers, which they could not have through the 2-D advertisements.

The user-VP interaction feature in the AR mobile shopping app is expected to enrich consumers' experiential learning even further by heightening the consumers' sense of presence. User-VP interaction in AR display would provide a higher level of interactivity, as compared to the non-user-VP interaction condition because viewing themselves in the display would enhance users' involvement in the shopping activity. This increased involvement through the user-VP interaction feature will lead consumers to experience a higher level of sense of presence because it enriches consumers' experiences by allowing them to feel like they are physically using the product as they see themselves in the AR display.

Generally, consumers' product value perception and their overall purchase decisions are made not only based on the product itself, but consumers holistically consider the overall product purchase experience (Milliman, 1986). That is, the entire process of consumers' product shopping plays a significant role in their product value perceptions. According to Kim and Forsythe (2007), the main purpose of implementing virtual technologies for online apparel shopping is to enhance consumers' perceived hedonic values such as fun, excitement, and enjoyment. Similarly, Lai et al. (2009) have found that consumers perceived greater hedonic value toward a product when the products were introduced through a moving animation along with the static product information as compared to when static product info contents were presented by themselves. Lai et al. (2009) attributed this result to an idea that the moving animation generally consists of more vivid product aspects than do static images, and thus enhances the entertainment of the product experience. Consumers are able to perceive a strong hedonic value of an online shopping experience when they interact with AR (Poncin & Mimoun, 2014). This hedonic shopping experience afforded by AR may more easily transfer to the hedonic value of the product in the minds of consumers when the product is experienced through the user-VP interaction feature of the AR app where users can see themselves use a virtual product as a lively moving animation.

According to Greifeneder et al. (2011), an individual's judgement is not made based upon just the content-related information, but it highly relies on the individual's feelings or emotional experience. That is, an individual's affective feeling plays a critical role in the formation of favorable or unfavorable attitudes toward an experience or object. Zhao et al. (2011) found that by focusing on the experiential aspects of the overall process, individuals were able to evaluate the process and their final outcomes favorably (Zhao et al., 2011). Therefore, the overall product shopping process to arrive the purchase decision-making is important in order for individuals to form their product attitudes. As the user-VP interaction feature provides more realistic and fun experiences to consumers, they are likely to have more favorable attitudes toward a product when they see themselves use it in the AR display. A recent study supports this idea by reporting that consumers had a more favorable attitude toward a product when they enjoyed using the AR mobile shopping app for product shopping (Park & Yoo, 2020). The user-VP interaction feature on the AR mobile shopping app could provide consumers more realistic shopping experiences, making the shopping activity more interesting, which in turn may enhance the consumers' product attitude. Based on the aforementioned discussion pertaining to the user-VP interaction effect on the experiential system, the following hypotheses are proposed:

Hypothesis 5: **a)** Consumers' level of sense of presence is greater, **b)** perceived hedonic value is higher, and **c)** product attitude is more favorable when AR display incorporates (vs. dose not incorporate) user-VP interaction.

The Interaction Effect of AR Modality and User-VP interaction on Consumers' Product Attitude

CLT literature has further suggested that individuals will need to split their attention in order to effectively process information if the information is provided through more than two sources at a time, which is referred to as the split attention effect (Sweller et al., 2011). Attention split is necessary with more complicated tasks involving multiple sources of information because people are not able to simultaneously process the separated information, which hinders maximum learning (Sweller et al., 2011). Providing more than required/needed information could overwhelm individuals' information processing owing to their limited cognitive capacity (Sweller et al., 2011). Therefore, individuals might have to utilize the inessential cognitive load if the information is presented through a split-source format (Sweller et al., 2011). The split attention effect could frequently occur in multimedia learnings because multimedia contain at least two information sources, and individuals need to integrate information from the multiple sources to effectively process it to lessen their cognitive load (Sweller et al., 2011). Therefore, utilizing additional sources (more than two sources) may not be always beneficial for individuals' learning according to the split attention effect. Taken together, the use of dual-sensory modality with the visual and auditory presentations could enhance an individual's effective learning based on the modality effect. However, according to the split attention effect, incorporating additional sources such as the user-VP interaction aspect in the AR mobile shopping app display with the visual plus auditory modality could overwhelm an individual's capacity of processing the provided information. Therefore, this study incorporates the modality effect to support the use of dual-sensory modality for more effective communication and applies the split attention effect to suggest using adequate amount of resources to prevent consumers' confusion.

The use of dual sources could be implemented for individuals to effectively process information (Mayer & Moreno, 2003); however, it may overwhelm individuals if the information is provided with several different sources according to the split attention effect. Therefore, providing multiple sources concurrently on the AR mobile shopping app might make consumers encounter difficulties in processing the product information, which in turn could have a negative impact on their overall product attitude.

If the AR mobile shopping app functions based upon the dual-sensory modality, it contains the visual presentation of a virtual product and auditory product information simultaneously. In addition to incorporating the dual-sensory modality, if the user-VP interaction feature is employed at the same time, it provides three different sources, including the virtual product, moving animation of users, and auditory product information. Because of the consumers' limited capacity for information processing, they may have difficulties to process the three varied types of information simultaneously based on the split attention effect (Sweller et al., 2011). Given that, it is expected that when the dual-sensory modality is applied to the AR mobile shopping app, consumers would be able to more effectively process the product information when AR display does not incorporate the user-VP interaction feature. By preventing this overwhelming situation, consumers will be able to successfully process the product information while they shop for products with the AR mobile shopping app, which would further enable them to have more positive product attitude. Based on the aforementioned discussion regarding the interaction effect of AR modality and user-VP interaction in AR display on consumers' product attitudes based on the split attention effect, the next hypothesis is proposed:

Hypothesis 6*:* The effect of AR modality on consumers' product attitude is greater when AR display does not incorporate (vs. incorporates) user-VP interaction.

Personal Characteristic Moderators

Need for cognition (NFC) and *faith in intuition* (FII) are personal characteristics variables that describe individuals' propensity to prefer the rational system or the experiential system of information processing, respectively. Therefore, in this study, NFC is predicted to moderate the effect of the AR modality on cognitive attention; whereas FII is to moderate the effect of the user-VP interaction in AR display on sense of presence. The following two subsections discuss literature around these two moderating effects.

Need for Cognition (NFC)

NFC refers to an individual's tendency to primarily focus on and enjoy thinking when processing information (Cacioppo & Petty, 1982). Cacioppo and Petty (1982) found that high-NFC individuals tended to utilize central processing, whereas individuals with low-NFC tended to use peripheral processing. That is, high-NFC individuals are more likely to rely on deliberative thinking and enjoy the cognitive thinking process as compared to low-NFC individuals. Furthermore, high-NFC individuals were found to be more willing to invest their efforts to process complicated tasks as compared to low-NFC individuals (Cacioppo & Petty, 1982). That is, high-NFC individuals put greater efforts to process information when they are engaged in complicated tasks which require their significant effort, whereas low-NFC individuals are wary of encountering tasks requiring excessive cognitive resources (Cacioppo & Petty, 1982). As discussed earlier in the CEST section, Epstein's (1991) CEST suggests two parallel and yet interactive information processing systems: the rational system and experiential system. Given that the rational system is analytic and logical, whereas the experiential system is bounded in emotion (Epstein, 1991), it is understandable that people with higher NFC tend to show a higher propensity to utilize the rational system of information processing. To capture individual tendencies to rely on the two systems of information processing, Epsteinet al. (1996) developed a measurement called the Rational-Experiential Inventory (REI) which consists of the NFC and FII subscales, where the NFC subscale is used to assess an individual's tendency to engage in the rational system, while the FII subscale measures an individual's tendency to engage in the experiential system of information processing (Epstein et al., 1996). FII will be deeply explained in the later section to explore its role in the experiential system.

Previous research has studied consumers' NFC in the virtual experience context. For instance, Li et al. (2003) suggested that consumers' cognitive evaluations were reported noticeably more when they interacted with three-dimensional (3-D) products in the virtual environment as compared to the two-dimensional (2-D) products, meaning that consumers were prone to process information more analytically and pay greater cognitive attention to products when products appeared in the virtual environment. Similarly, Daugherty (2009) found that high-NFC consumers generally had a more positive attitude toward brands when they experienced products in both virtual and direct experiences compared to low-NFC consumers. Also, high-NFC consumers had significantly more positive brand attitudes when they experienced the products through the virtual environment compared to the direct experience

(Daugherty, 2009). These findings combined suggest that consumers may need to engage in more cognitive information processing and thus use more cognitive capacity in the virtual environment as compared to the physical environment.

Shopping with an AR mobile shopping app may require a considerable amount of mental energy because it is a combined environment of the virtual and real worlds. As suggested by the modality effect, the user may be able to easily process product information when it is provided with a dual-sensory modality because it allows larger cognitive capacity (Brünken et al., 2004; Feinberg & Murphy, 2000; Rummer et al., 2011). This modality effect may be more profound for low-NFC users. In other words, the visual-only modality condition, where the virtual product image and text format of product features both require the use of visual-based cognitive resources, can be more overwhelming for low-NFC users than for high-NFC users because low-NFC users are less willing to process information that requires excessive cognitive resources (Cacioppo & Petty, 1982). Further, low-NFC users may be helped by receiving dual-sensory modality-based information, which extends users' working memory capacities as compared to single modality information, to a greater extent than are high-NFC users. As compared to low-NFC users, high-NFC users may be able to more effectively process information provided by the single sensory modality because high-NFC users are able to pay higher cognitive attention to the information (Brünken et al., 2004; Cacioppo & Petty, 1982). Therefore, it can be suggested that the difference in cognitive attention between the single and dual modality conditions is greater for low-NFC consumers than for high-NFC consumers. Based on the aforementioned discussion, the following hypothesis is proposed:

Hypothesis 7*:* The effect of AR modality on cognitive attention is weaker for high-NFC consumers than for low-NFC consumers.

Faith in Intuition (FII)

According to CEST (Epstein, 1991), the experiential system of information processing is primarily related to an individual's experiences and affective feelings. FII can be defined as an individual's tendency to primarily rely on their own intuitive feelings (Epstein et al., 1996). Therefore, high-FII individuals tend to focus on experiential values more than low-FII individuals (Epstein et al., 1996). That is, individuals with high FII are more likely to rely on affective and intuitive resources when they make judgements as compared to low-FII individuals. Giesen et al. (2015) argue that individuals tend to rely highly on their intuitive feelings when exposed to unfamiliar objects because it is easier for them to intuitively process those objects rather than using cognitive resources such as earlier experiences with objects, which do not exist for unfamiliar objects. High-FII consumers engage in experiential aspects of objects because they tend to use intuitive resources, rather than cognitive resources, to process information. Therefore, it can be expected that high-FII consumers would view and judge their product shopping experience with the AR mobile app based more on their intuitive feelings compared to low-FII consumers, and this phenomenon will occur more through the user-VP interaction in AR display.

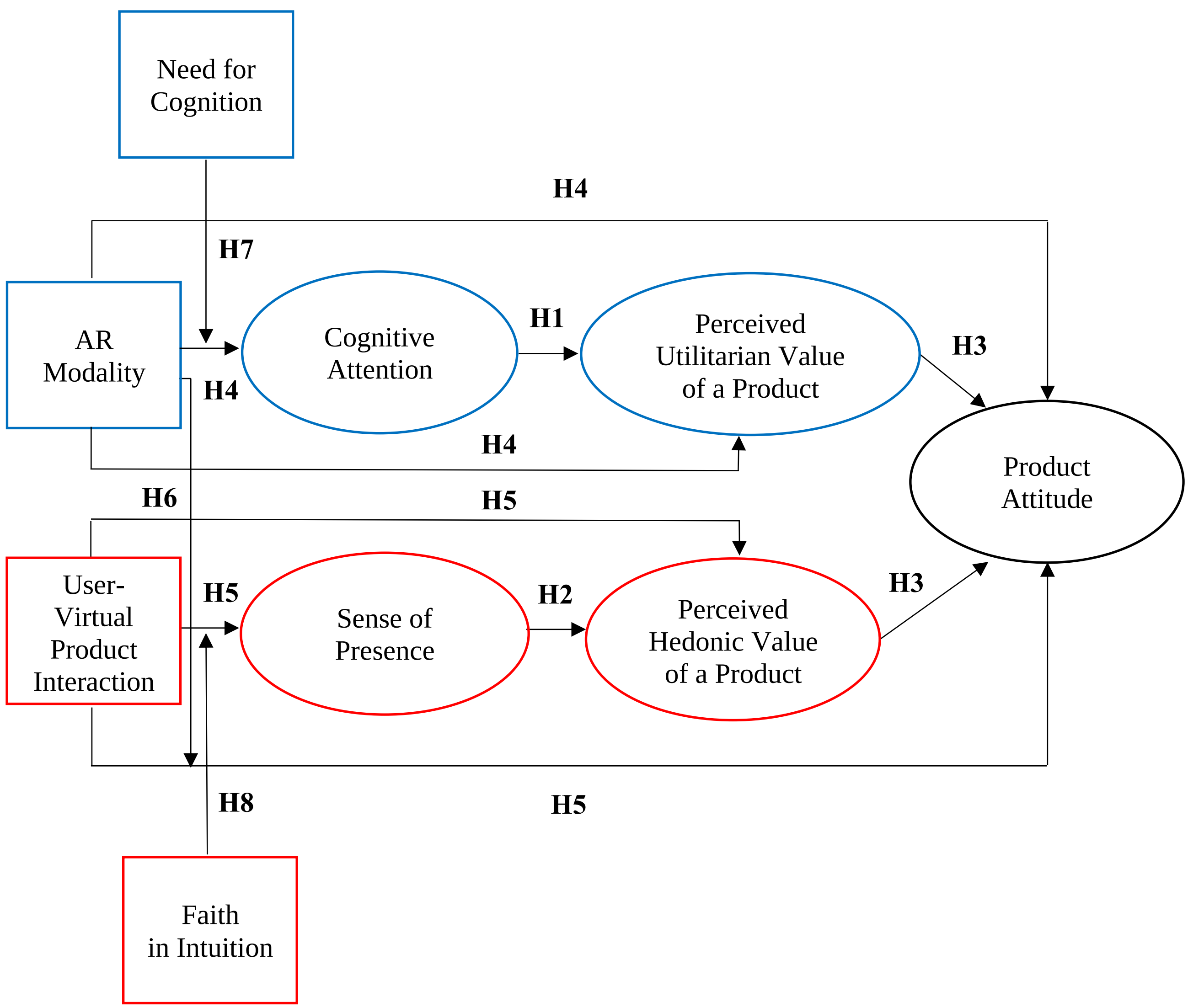
As discussed earlier, user-VP interaction in AR display would enhance consumers' sense of presence, or feeling as if they are with the product, which boosts the hedonic value of the product perceived by the consumers. This user-VP interaction effect is expected to be more profound for high-FII consumers than for low-FII consumers because high-FII consumers tend to focus more on their feelings, emotions, and experiences when processing information (Epstein, 1991). Based upon the aforementioned discussion, the following hypothesis is proposed:

Hypothesis 8*:* The effect of user-VP interaction in AR display on sense of presence is stronger for high-FII consumers than for low-FII consumers.

A conceptual model that depicts all effects and relations hypothesized in this study is presented in Figure 2.2 and named as the AR-based cognitive-experiential product evaluation model (AR-CEPEM).

Figure 2.2

The AR-Based Cognitive-Experiential Product Evaluation Model (AR-CEPEM) and Hypotheses



CHAPTER 3. PILOT TESTS

Purpose

Two pilot tests were conducted in order to calibrate the stimuli (i.e., simulation videos) to be used to manipulate the two independent variables: AR Modality (visual-only modality vs. visual plus auditory modality) in Pilot Test 1 and User-VP Interaction in AR display (yes user- vs. no user-VP interaction) in Pilot Test 2. Furthermore, the validity and reliability of the dependent measures (i.e., cognitive attention, sense of presence, perceived utilitarian/hedonic value of a product, and product attitude) and measures of the personal moderators (i.e., need for cognition and faith in intuition) were also checked in Pilot Test 3. All three pilot tests were conducted simultaneously in a single data collection.

Method

Sampling

The target population of this study consisted of male and female mobile shoppers, aged between 18 and 54 years old, who lived in the United States. Older consumers (55 years old and above) were excluded from the target population because mobile apps are more widely used among younger consumer groups for product shopping. A recent survey study reported that only 11% of consumers in the 55-64 group and 6% of the 65 years or older group made purchases via mobile phones; while approximately 38% of the 25-34 years group, 28% of the 35-44 years group, and 17% of the 45-54 age group used mobile phone for product shopping (Socratic, 2017). Although the survey (Socratic, 2017) did not include the age group of 18-24 years, the present study included this group because younger consumers tend to be more ready to accept newly introduced technologies (Natarajan et al., 2018).

Respondents for the two pilot tests were recruited via *The Sample Network*, a third-party consumer panel sampling company, to reach to a more diverse U.S. population. The participants were offered a monetary compensation at the amount agreed by *The Sample Network*. A link to a brief information webpage (see Appendix A.1) for the pilot tests was shared with the panel service provider who then shared it with potential participants among their panel members. Those who read the brief study information and clicked on the link to the pilot test website first read the information letter (see Appendix A.2). If they agreed to participate, they proceeded to the next page and answered screening/quota questions with respect to gender, age, their experience with a mobile app for product shopping, and country of residence. Respondents indicated their gender by selecting either “Male” or “Female” for the gender quota question, “What is your gender?” For the age quota question, participants were asked to indicate which age group they belonged to among six age categories: younger than 18 years, 18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, and 65 years or above. Respondents who were in the groups of younger than 18 years, 55-64 years, and 65 years or above were screened out because they did not meet the age criteria of the study. Besides the age and gender quota screening questions, the mobile shopping experience question (Yes/No) and country of residence of the participants were asked to screen out one without a mobile shopping experience or ones who are not U.S. residents. Participants who failed to meet the screening or quota criteria of the study were terminated as soon as the respective questions were answered. Those who successfully passed the screening/quota questions continued to the pilot test page.

Data Collection Procedure

Participants who passed the screening and quota criteria were randomly assigned to one of the two products (i.e., a watch or a flower vase). With regard to the assigned product, participants were exposed to the four different simulation videos (i.e., visual-only, visual plus auditory, yes user-VP interaction, and no user-VP interaction). The order of the four simulation videos was randomized for each participant. After viewing each stimulus video, participants completed the manipulation check items for the respective independent variables, followed by selected dependent measure items which were included for preliminary investigation of the measurement properties. Dependent measure items were interspersed throughout the eight stimuli and participants were exposed to only four out of the eight stimuli. Therefore, each participant completed only part of the dependent measure items so that each item would be responded by about a half of the pilot test participants. Finally, participants responded to the prior mobile shopping and AR experience questions and demographic questions.

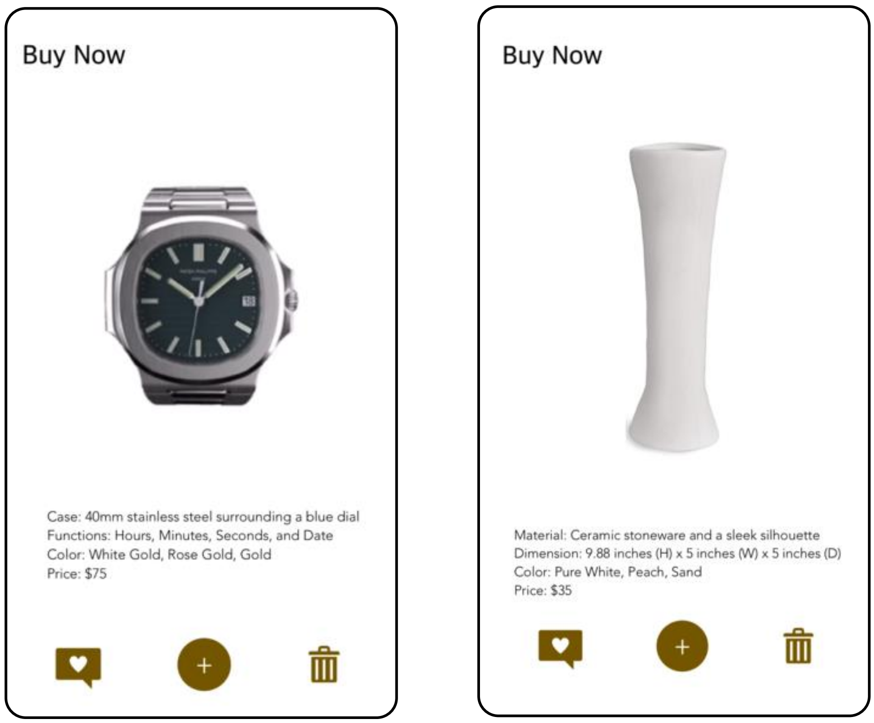
Pilot Test 1: Stimuli and Measures

Stimuli

Through Pilot Test 1, AR Modality manipulation was calibrated. For each of the two products, watch and flower vase, two stimuli were developed by the researcher, one for the visual-only modality and the other for the visual plus auditory modality, to manipulate AR Modality. Participants were directed to imagine themselves shopping for a product using a mobile app. For the visual-only modality video, a text format of product specification information was displayed; whereas in the visual plus auditory modality video, a text format of product specifications as well as a female virtual agent’s voice telling the product specifications displayed in text was included. The videos were controlled to be constant in terms of their duration and the structure of the shopping simulation. More specifically, the video duration was set to be 47 seconds and the structure of the mobile app (e.g., app menu and text formats) was the same for all simulation videos. Figure 3.1 presents example screenshots of the simulation mobile shopping video stimuli for the two products, and Table 3.1 presents the links to the video stimuli used for the two AR Modality conditions for each of the two products.

Figure 3.1

Example Screenshots of Stimulus Videos for AR Modality Manipulation in Pilot Test 1



(a) Watch (b) Flower Vase

Table 3.1

URLs to AR Modality Video Stimuli for Pilot Test 1

Product	Conditions	URLs
Watch	Visual-Only	https://youtu.be/5-TLzz2tRpo
	Visual + Auditory	https://youtu.be/A7AASh1D5GU
Flower Vase	Visual-Only	https://youtu.be/BVi3mMM6DZg
	Visual + Auditory	https://youtu.be/rtbNCCnS6oY

Measures

One question ("*What was the product that you saw in the video?*") was asked to check whether pilot test participants accurately sensed the visual modality used in the stimulus videos. Seven response options were given: "a watch," "a flower vase," "a mug cup," "a ring," "a table lamp," "a pair of shoes," or "I did not see any product"). Further, two questions were used to check whether participants correctly sensed the auditory modality used (or not used) in the stimulus videos. The first question, "*Did you hear any voice while you were watching the video?*" was responded as a Yes or No; and the second question, "*If you heard any voice, was it a female voice or a male voice?*" was given with three response options: "female voice," "male voice," or "I did not hear anything*"*.

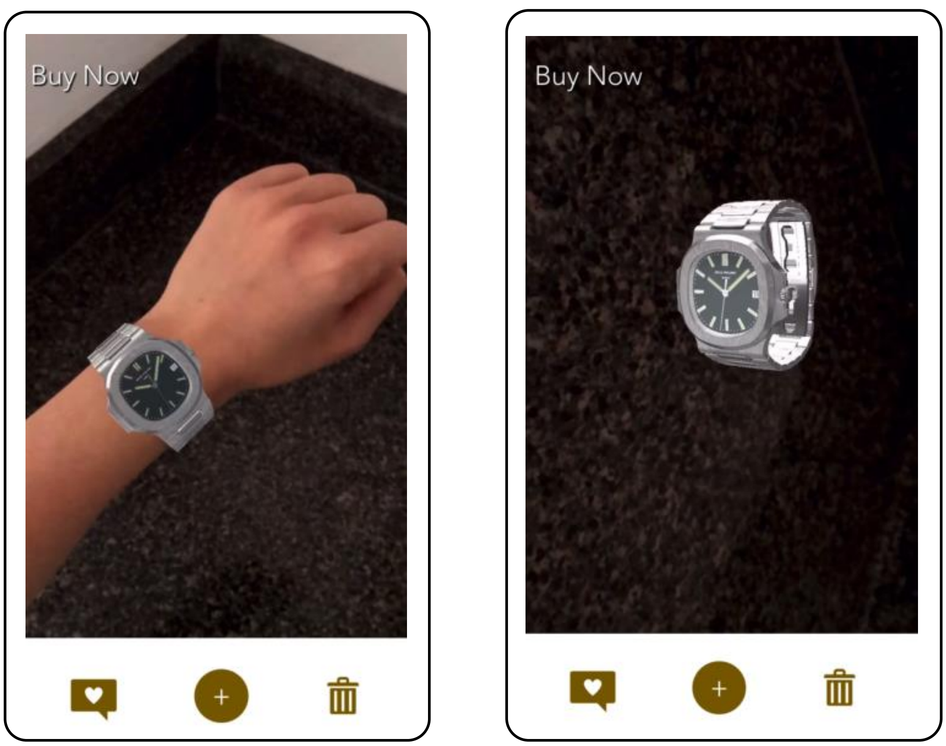
Pilot Test 2: Stimuli and Measure

Stimuli

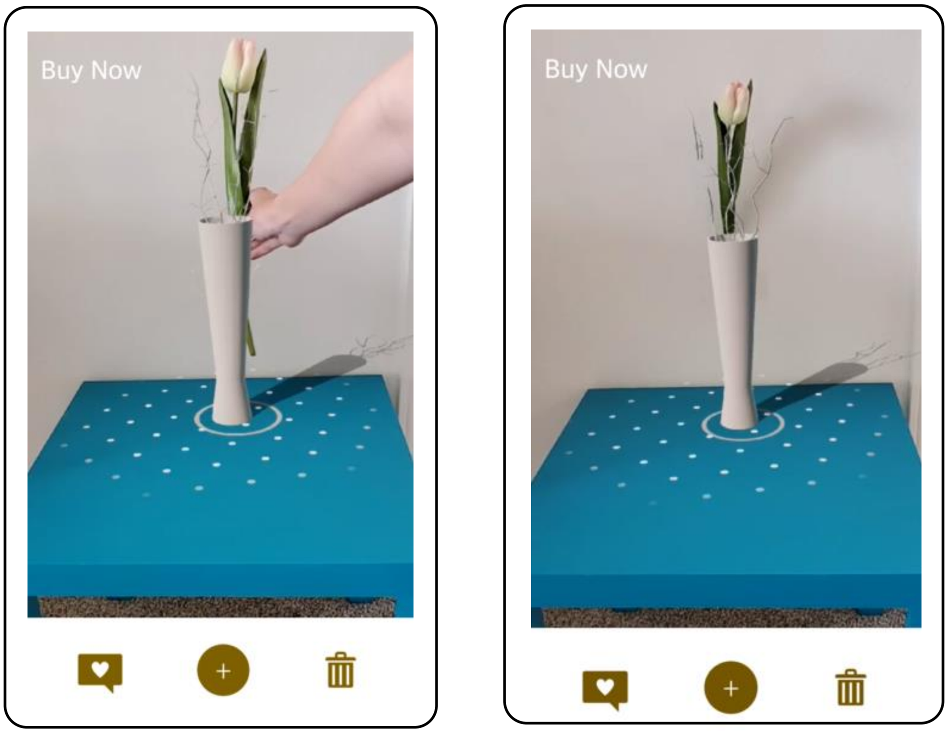
In Pilot Test 2, manipulations of the User-VP Interaction factor were calibrated. Similar to Pilot Test 1, Pilot Test 2 utilized two videos (yes vs. no user-VP interaction) for each of the two products (i.e., a watch and a flower vase). Participants viewed and rated both yes and no user-VP videos for one of the two products randomly assigned to them. In the yes user-VP interaction condition video, a screen capture of a fictitious consumer's AR-based shopping on a mobile shopping app was shown including a body part of the consumer was displayed as the consumer was interacting with the virtual product in the AR display on the app screen. Specifically, in the watch video, the fictitious user was wearing the virtual watch on the user's wrist, while in the flower vase video, the user was holding flowers to place them in a vase. In the no user-VP interaction condition, the videos showed the same AR-based mobile shopping simulations except that no user body parts were displayed in the AR display. The videos were controlled to be constant. Specifically, similar to the Pilot Test 1, the video duration was set to be 47 seconds and the structure of the mobile app (e.g., app menu and text formats) was the same between the two user-VP interaction conditions as well as the two products. Figure 3.2 presents example screenshots of the simulation mobile shopping video stimuli for the two User-VP Interaction conditions for each of the two products, and Table 3.2 presents the links to these video stimuli.

Figure 3.2

Example Screenshots of Stimulus Videos for User-VP Interaction Manipulation in Pilot Test 2



(a) Yes User-VP Interaction / Watch (b) No User-VP Interaction/Watch



(c) Yes User-VP interaction / Flower Vase (d) No User-VP Interaction / Flower Vase

Table 3.2

URLs to User-VP Interaction Video Stimuli for Pilot Test 2

Product	Conditions	URLs
Watch	Yes User-VP Interaction	https://youtu.be/o0P-mWRjdOc
	No User-VP Interaction	https://youtu.be/9O45JCXgF9Y
Flower Vase	Yes User-VP Interaction	https://youtu.be/uw8ivuRkqEY
	No User-VP Interaction	https://youtu.be/XZ3cdoG7Bi8

Measure

Success of the User-VP Interaction manipulations was checked with one item "*Did you see any body part of the user in the mobile app screen while you were watching the video?*" This item was answered with yes/no options.

Pilot Test 3: Preliminary Measurement Property Check for Dependent Measures

In Pilot Test 3, a preliminary analysis was performed on the properties, such as dimensionality and reliability, of the measures for the dependent and moderating variables. As noted earlier in the Data Collection Procedure section earlier, the measurements of the dependent and moderating variables were interspersed across the pilot test questionnaire so that each measure could be completed by about a half of the pilot test participants. The detailed descriptions of the measures pilot-tested are as follows.

Dependent Measures

Cognitive Attention. Cognitive attention refers to an individual's focus where they cognitively concentrate on one stimulus (i.e., visual and auditory information about the product shown/heard from the AR app video) and ignoring others (e.g., external stimuli, such as noise in the participant's background in the real environment or visuals on the participant's computer screen that are not part of the AR app video). To measure cognitive attention, six items of cognitive efforts were adapted from Reynolds (1997) (see Table 3.3). The items were measured on a five-point Likert scale (i.e., 1 = strongly disagree to 5 = strongly agree).

Table 3.3

Cognitive Attention Measurement Items

Item	Item Abbreviation
While I was watching the video…	
I attempted to analyze the product information.	Cogn_1
I deeply thought about the product information.	Cogn_2
I extended my effort to evaluate the product information.	Cogn_2
I did my best to think about the product information.	Cogn_4
I reflected on the product information.	Cogn_5

I searched my mind to evaluate the product information.	Cogn_6

Sense of Presence. Sense of presence refers to feeling of being physically with the product, which may help them enjoy the virtual product experience. To measure the participants' sense of presence, two items were adapted from Hendrix's (1994) realism scale, which measured "the fidelity in which the user is able to interact with the virtual environment" (p. 57). As the current study examines the user's feeling of being with the product while watching the AR mobile shopping app video, which is related to the realism, this study adapted two items from Hendrix (1994). The wording of the items was modified to ensure that the items capture participants' sense of presence while viewing the AR mobile shopping video assigned to them. For instance, the original item "*How strong was your sense of presence, 'being there', in the virtual environment?*" was modified to "*How strongly did you sense as if the product was physically in front of you while you were watching the video?*" in this study (see Table 3.4). The items from Hendrix (1994) were measured with a five-point Likert scale (i.e., 1 = not strong at all to 5 = extremely strong; 1 = not realistic at all to 5 = extremely realistic).

Table 3.4

Sense of Presence Measurement Items

Items	**Item Abbreviation**
How strongly did you sense as if the product was physically in front of you while you were watching the video? (1 = not strong at all to 5 = extremely strong)	Sense_1
How realistic did you feel as if you were with the product when you were watching the video? (1 = not realistic at all to 5 = extremely realistic)	Sense_2

Perceived Utilitarian Value of a Product. Perceived utilitarian value of a product refers to the degree to which consumers perceive the functionality of a product is satisfactory. To measure utilitarian value of a product, a total of six items were adapted and modified from Kim (2010). The original measurement was developed to measure consumers' perceived apparel quality, which was modified to fit in the context of the consumers' perceived utilitarian value toward the product in this study. For instance, the original item "*The sweaters seem to be well-constructed*" was modified to "[*The watch or the flower vase shown in this video*] *seems to be well-constructed*" to ensure that the items specifically measure the utilitarian features of the watch and the flower vase in this study. The original scale by Kim (2010) had three factors, including construction/materials, style/design, and durability/performance, all of which remained in the current study. However, one of the construction/material items, three of style/design items, and two of the durability/performance items were omitted because they did not fit in the context of perceived utilitarian value of the products in this study (i.e., a watch and a flower vase). All items were measured with a five-point Likert scale (i.e., 1 = strongly disagree to 5 = strongly agree) (see Table 3.5).

Table 3.5

Perceived Utilitarian Value of a Product Measurement Items

Items	**Item Abbreviation**
[The watch or the flower vase] shown in this video seems to be well-constructed.	Util_1
The workmanship of [the watch or the flower vase] shown in this video seems to meet high standards.	Util_2
[The watch or the flower vase] shown in this video appears to be made of high-quality materials.	Util_3

[The watch or the flower vase] shown in this video is likely to be good quality.	Util_4
The overall appearance of [the watch or the flower vase] shown in this video is attractive.	Util_5
[The watch or the flower vase] shown in this video would last a long time.	Util_6

Perceived Hedonic Value of a Product. Perceived hedonic value of a product refers to the degree to which consumers perceive that they would enjoy using a product. To measure the consumers' hedonic value of a product, four items were adapted from Sweeney and Soutar (2001). The original scale includes four value dimensions including emotional value, social value, quality value, and price value to measure individuals' perceived value toward products. Among these dimensions, the emotional value dimension addresses consumers' perceived hedonic value of a product, and thus the items measuring this dimension were adapted in this study. The wording of original items was modified to fit this study. For instance, the original item "*would make me feel good*" was modified to "*[The watch or the flower vase shown in this video] would make me feel good when I use it*" in this study. All items were measured with a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree (see Table 3.6).

Table 3.6

Perceived Hedonic Value of a Product Measurement Items

Items	**Item Abbreviation**
[The watch or the flower vase] shown in this video is the one that I would enjoy.	Hedo_1
[The watch or the flower vase] shown in this video would make me want to use.	Hedo_2

[The watch or the flower vase] shown in this video would make me feel good when I use it.	Hedo_3
[The watch or the flower vase] shown in this video would give me pleasure when I use it.	Hedo_4

Product Attitude. Product attitude refers to an individual's favorable or unfavorable reaction to a product (Ajzen & Madden, 1986). For product attitude measurement, five semantic-differential scale items were adapted from Spears and Singh's (2004) attitude toward the brand scale. As this particular scale measures brand "*Please describe your overall feeling about the brand described in the ad you just read*", the direction was modified to "*Please describe your overall feelings about the product that appeared on the video*" to fit the study context (see Table 3.7).

Table 3.7

Product Attitude Measurement Items

Items	**Item Abbreviation**
The [watch or flower vase] appeared in the video is ___________________.	
Unappealing/appealing	Att_1
Bad/good	Att_2
Unpleasant/pleasant	Att_3
Unfavorable/favorable	Att_4
Unlikeable/likeable	Att_5

Personal Characteristic Moderators

Need for cognition (NFC) and Faith in Intuition (FII). Need for cognition (NFC) refers to an individual's tendency to enjoy thinking when processing information (Cacioppo &

Petty, 1982), and faith in intuition (FII) refers to an individual's tendency to primarily rely on their intuitive feelings when processing information (Epstein et al., 1996). To measure NFC and FII, 10 items were adapted from Epstein et al.'s (1996) REI scale, which consists of the 5 NFC items and 5 FII items. The original items were retained, and no further modifications were made with these items. The items were measured with a five-point Likert scale (i.e., 1 = strongly disagree to 5 = strongly agree) (see Table 3.8).

Table 3.8

Need for Cognition and Faith in Intuition Measurement Items

Items (Need for Cognition)	**Item Abbreviation**
I don't like to have to do a lot of thinking. *	NFC_1
I try to avoid situations that require thinking in depth about something.*	NFC_2
I prefer to do something that challenges my thinking abilities rather than something that requires little thought.	NFC_3
I prefer complex to simple problems.	NFC_4
Thinking hard and for a long time about something gives me little satisfaction. *	NFC_5
Items (Faith in Intuition)	
I trust my initial feelings about people.	FII_1
I believe in trusting my hunches.	FII_2
My initial impressions of people are almost always right.	FII_3
When it comes to trusting people, I can usually rely on my "gut feelings."	FII_4
I can usually feel when a person is right or wrong even if I can't explain how I know.	FII_5

* Reverse coded.

Sample Characteristics Measures

In addition to the measures of the dependent and moderating variables, demographic and mobile shopping and AR related experiences of the sample were assessed.

Demographics. Participants' demographic information was collected during the pilot tests, with regard to gender, age, ethnicity, education level, occupation, marital status, household income, and residence area.

Previous Experience. Participants' previous experiences with the mobile shopping app and the AR technology was assessed with one item created by the researcher and four items adapted from Hendrix's (1994) that measured the level of comfort, enjoyment, and ease interaction. For participants' better understanding of the term 'augmented reality,' a brief definition of the term was provided (i.e., augmented reality [AR] is a technology that allows consumers to view virtual products in the real environment [e.g., your home] through a digital display such as a computer screen or a mobile app). The researcher created an item, "*Have you used AR technology for shopping?*" which was measured with a yes/no answer. The items that were adapted from Hendrix (1994) were modified to specifically measure the participant's knowledge of a mobile shopping app (4 items) and AR (4 items). For instance, the original item "*What is your overall comfort level with computers?*" was modified to "*What is your overall comfort level with a mobile shopping app*?" and "*What is your overall comfort level with AR technology*?" in this study (see Table 3.9).

Table 3.9

Previous Experience Measurement Items

Items	Scale
Previous Experience with a Mobile Shopping App	
Are you a regular mobile shopping app user?	Yes/No
What is your overall comfort level with a mobile shopping app?	1 = Not comfortable at all to 5 = Extremely comfortable
What is your overall enjoyment level using a mobile app for product shopping?	1 = Not enjoyable at all to 5 = Extremely enjoyable
With what degree of ease are you able to navigate within the virtual environment using a mobile shopping app?	1 = Not easy at all to 5 = Extremely easy
Previous Experience with Augmented Reality	
Have you used augmented reality technology when you shopped for products? AR (augmented reality) can be explained as the retail technology that allows consumers to view virtual products in the real environment (e.g., home) in the digital display.	Yes/No
If answered 'yes' to the previous question,	
Are you a regular augmented reality technology user?	Yes/No
What is your overall comfort level with AR technology for product shopping?	1 = Not comfortable at all to 5 = Extremely comfortable
What is your overall enjoyment level using AR technology for product shopping?	1 = Not enjoyable at all to 5 = Extremely enjoyable
With what degree of ease are you able to navigate within the virtual environment using augmented reality technology?	1 = Not easy at all to 5 = Extremely easy

Analysis and Results

Sample Characteristics

A total of 63 participants who met the screening and quota requirements and answered the attention checking questions correctly constituted the final usable sample for the pilot tests.

Demographic Characteristics

As presented in detail in Table 3.10, among the 63 participants, 49.2% were male and 50.8% were female. In terms of the age groups, approximately 37% of the participants were between 25 to 34 years old, constituting the largest age group, followed by the age group of 35 to 44 years old (28.6%). As expected, the majority of the participants were non-Hispanic White (68.3%), followed by non-Hispanic Black (12.7%). Also, more than half of the participants reported that they had a college degree or higher. Regarding the participants' occupation, approximately 60% were full-time employees and 12.7% were part-time employees. The majority of the participants indicated that they were married (58.7%). The participants' income levels also varied; 25.4% indicated that their household income was between $50,001 to $75,000, while 22.2% indicated that their household income was between $125,001 to $150,000. Regarding their residence area, approximately 43% of the participants lived in the suburban area, 38.1% lived in the urban area, and 19% lived in the rural area.

Table 3.10

Pilot Test Sample Demographic Characteristics (N =63)

Variable	*Category*	*n*	*%*
Gender	Male	31	49.2
	Female	32	50.8
Age	18-24	6	9.5
	25-34	23	36.5
	35-44	18	28.6
	45-54	16	25.4
Ethnicity	Non-Hispanic White (European or Caucasian American)	43	68.3
	Non-Hispanic Black (African American)	8	12.7
	Asian/Pacific Islander	4	6.3
	Hispanic	4	6.3
	Other	3	4.8

	American Indian/Alaskan Native	1	1.6
Education	8th grade or less	0	0.0
	Some high school	1	1.6
	High school degree	10	15.9
	Some college or technical school	14	22.2
	College degree (4 years)	20	31.7
	Some graduate school	6	9.5
	Graduate degree (master's, doctorate, etc.)	12	19.0
Occupation	Full-time employment	38	60.3
	Part-time employment	8	12.7
	Unemployed	7	11.1
	Self-employed	2	3.2
	Home-maker	5	7.9
	Student	2	3.2
	Retired	1	1.6
	Other	0	0.0
Marriage	Single	18	28.6
	Married	37	58.7
	Single but living with significant other	8	12.7
Income	Under $25,000	5	7.9
	$25,000 to $35,000	3	4.8
	$35,001 to $50,000	9	14.3
	$50,001 to $75,000	16	25.4
	$75,001 to $100,000	6	9.5
	$100,001 to $125,000	3	4.8
	$125,001 to $150,000	14	22.2
	$150,001 to $175,000	2	3.2
	$175,001 to $200,000	2	3.2
	Over $200,000	3	4.8
Residence Area	Rural Area	12	19.0
	Urban Area	24	38.1
	Suburban Area	27	42.9

Among the 63 participants, 33 participants completed the pilot tests regarding the watch product, while the remaining 30 participants did the flower vase product. Demographic profiles of the samples for each product can be found in Table 3.11. As presented in detail in Table 3.11, participants' demographic characteristics were similar between the watch and flower vase samples.

Table 3.11

Pilot Test Sample Demographic Characteristics by Product

Variable	*Category*	*Watch (n = 33)*		*Flower Vase (n = 30)*	
		n	*%*	*n*	*%*
Gender	Male	18	54.5	13	43.3
	Female	15	45.5	17	56.7
Age	18-24	2	6.1	4	13.3
	25-34	13	39.4	10	33.3
	35-44	12	36.4	6	20.0
	45-54	6	18.2	10	33.3
Ethnicity	Non-Hispanic White (European or Caucasian American)	20	60.6	23	76.7
	Non-Hispanic Black (African American)	5	15.2	3	10.0
	Hispanic	3	9.1	1	3.3
	Asian/Pacific Islander	2	6.1	2	6.7
	Other	2	6.1	1	3.3
	American Indian/Alaskan Native	1	3.0	0	0.0
Education	8th grade or less	0	0.0	0	0.0
	Some high school	0	0.0	1	3.3
	High school degree	5	15.2	5	16.7
	Some college or technical school	8	24.2	6	20.0
	College degree (4 years)	11	33.3	9	30.0
	Some graduate school	3	9.1	3	10.0
	Graduate degree (master’s, doctorate, etc.)	6	18.2	6	20.0
Occupation	Full-time employment	22	66.7	16	53.3
	Part-time employment	4	12.1	4	13.3
	Unemployed	3	9.1	4	13.3
	Self-employed	0	0.0	2	6.7
	Home-maker	2	6.1	3	10.0
	Student	2	6.1	0	0.0
	Retired	0	0.0	1	3.3
	Other	0	0.0	0	0.0
Marriage	Single	8	24.2	10	33.3
	Married	20	60.6	17	56.7
	Single but living with significant other	5	15.2	3	10.0

Income	Under $25,000	2	6.1	3	10.0
	$25,000 to $35,000	2	6.1	1	3.3
	$35,001 to $50,000	4	12.1	5	16.7
	$50,001 to $75,000	9	27.3	7	23.3
	$75,001 to $100,000	6	18.2	0	0.0
	$100,001 to $125,000	1	3.0	2	6.7
	$125,001 to $150,000	7	21.2	7	23.3
	$150,001 to $175,000	0	0.0	2	6.7
	$175,001 to $200,000	1	3.0	1	3.3
	Over $200,000	1	3.0	2	6.7
Residence Area	Rural Area	6	18.2	6	20.0
	Urban Area	15	45.5	9	30.0
	Suburban Area	12	36.4	15	50.0

Prior Experience Characteristics

As presented in Table 3.12, among the 63 participants, 85.7% reported that they were a regular mobile shopping app user, and 14.3% indicated that they were not a regular mobile shopping app user. Regarding their comfort level with a mobile shopping app, 42.9% of the participants reported that they were quite comfortable with a mobile shopping app, while 36.5% of the participants reported that they were extremely comfortable with a mobile shopping app. In terms of their enjoyment level with a mobile shopping app, 36.5% reported that they considered a mobile shopping app quite enjoyable, followed by 28.6% participants who indicated that a mobile shopping app was moderately enjoyable. On the question regarding how easily they could navigate a mobile shopping app, 42.9% of them reported that they could navigate it extremely easily, while 6.3% of them thought it was not easy at all to navigate a mobile shopping app. In conclusion, the majority of participants were a regular mobile shopping app user and they were comfortable at using a mobile shopping app; enjoyed using a mobile shopping app; and were able to easily navigate a mobile shopping app. Therefore, it could be expected that participants did not have significant issues in understanding the mobile shopping simulation that was introduced in stimulus videos in this study.

With regard to participants' shopping experience with the AR technology (see Table 3.12), among the 63 participants, only 33.3% (*n* = 21) reported that they had used the AR technology for shopping. Among the 21 participants who had used AR, 52.7% reported that they were a regular AR technology user while 47.6% reported that they were not a regular AR technology user. Regarding their comfort level with the AR technology, 33.3% answered that they were quite comfortable, while 23.8% said they were extremely comfortable with the AR technology when shopping for products. Also, 38.1% found using AR technology for product shopping moderately enjoyable, while 28.6% quite enjoyable. Lastly, 38.1% of the participants reported that they could navigate within the virtual environment using the AR technology quite easily, while only 4.8% of them were not able to easily navigate within the virtual environment using the AR technology at all. Because a majority of the participants were not familiar with AR technology used in product shopping, this lack of prior experience or familiarity might have had a potential impact on their level of understanding of the AR technology used in the stimulus videos.

Table 3.12

Frequency Table for Previous Experience (n = 63)

Variable	*Category*	*n*	*%*
Mobile Shopping App Use			
Regular Mobile Shopping App User	Yes	54	85.7
	No	9	14.3
Comfort Level with a Mobile Shopping App	Not Comfortable at All	0	0.0
	Not Very Comfortable	0	0.0
	Moderately Comfortable	13	20.6
	Quite Comfortable	27	42.9

	Extremely Comfortable	23	36.5
Enjoyment Level with a Mobile Shopping APP	Not Enjoyable at All	1	1.6
	Not Very Enjoyable	6	9.5
	Moderately Enjoyable	18	28.6
	Quite Enjoyable	23	36.5
	Extremely Enjoyable	15	23.8
Easement Level with a Mobile Shopping App	Not Easy at All	0	0.0
	Not Very Easy	4	6.3
	Moderately Easy	11	17.5
	Quite Easy	21	33.3
	Extremely Easy	27	42.9
AR Technology for Shopping			
Experience with AR Technology Use for Shopping	Yes	21	33.3
	No	42	66.7
Participants Who Have Used AR Technology for Shopping (n = 21)			
Regular AR Technology User	Yes	11	17.5
	No	10	15.9
Comfort Level with AR Technology	Not Comfortable at All	1	4.8
	Not Very Comfortable	4	19.0
	Moderately Comfortable	4	19.0
	Quite Comfortable	7	33.3
	Extremely Comfortable	5	23.8
Enjoyment Level with AR Technology	Not Enjoyable at All	1	4.8
	Not Very Enjoyable	2	9.5
	Moderately Enjoyable	8	38.1
	Quite Enjoyable	6	28.6
	Extremely Enjoyable	4	19.0
Easement Level with AR Technology	Not Easy at All	1	4.8
	Not Very Easy	3	14.3
	Moderately Easy	4	19.0
	Quite Easy	8	38.1
	Extremely Easy	5	23.8

Pilot Test 1: AR Modality Manipulation Check

For the question "*Did you hear any voice while you were watching the video?*", the pilot test data must show predominantly more 'yes' responses in the visual plus auditory modality condition than in the visual-only modality condition because only the former presented auditory stimuli. As shown in Table 3.13, with regard to the watch stimuli, 32 (97%) of 33 participants in the visual-only modality condition accurately reported that they did not hear any voice, while 31 (94%) of 33 participants in the visual plus auditory modality condition correctly reported that they heard a voice for the watch videos. Similarly, for the flower vase stimuli, 29 (97%) of 30 participants in the visual-only modality condition correctly reported that they did not hear any voice, while 28 (93%) of 30 participants in the visual plus auditory modality condition accurately reported that they heard a voice. A chi-square test was performed to examine the association between the AR modality (i.e., visual-only vs. visual plus auditory) and whether the participants heard any computer-generated voice in the video. The results showed a significant association for both the watch group, χ^2 (1) = 54.60, $p < .001$, and the flower vase group, χ^2 (1) = 48.65, $p < .001$, which indicates participants heard a computer-generated voice in the visual plus auditory condition significantly more than they did in the visual-only condition for both products. Therefore, the AR modality manipulation check was successful with regard to the first manipulation check question.

Table 3.13

Cross Tabulation for the AR Modality Manipulation Check: Whether Voice Was Heard

Product	**AR Modality**	**Did you hear any voice?**		χ^2	***df***	***p***
		Yes	No			
Watch	Visual only	1	32	54.60	1	<. 001

	Visual + Auditory	31	2			
Flower Vase	Visual only	1	29	48.65	1	< .001
	Visual + Auditory	28	2			

Participants' responses to the second question "*If you have heard any voice, was it a female voice or a male voice?*" (see Table 3.14) revealed that they heard a female voice in the visual plus auditory condition for both products. For watch, 31 (93%) of 33 participants in the visual-only modality condition correctly reported that they did not hear anything, while 32 (97%) of 33 participants in the visual plus auditory modality condition correctly reported that they heard a female voice. Similarly, for flower vase, 29 (97%) of 30 participants in the visual-only modality condition correctly reported that they did not hear anything, while 27 (90%) of 30 participants in the visual plus auditory modality condition correctly reported that they heard a female voice. There were no participants who responded that they had heard a male voice. Results from a chi-square test showed that the association between the AR modality (i.e., visual-only vs. visual plus auditory) and the gender of the voice that they heard in the video (i.e., female voice vs. male voice vs. I did not hear anything) was significant for both the watch group, $\chi^2(1) = 54.60$, $p < .001$, and the flower vase group, $\chi^2(1) = 45.27$, $p < .001$. Therefore, the AR Modality manipulation was successful with regard to the second question as well.

Table 3.14

Cross Tabulation for the AR Modality Manipulation Check: Voice Gender

Product	**AR Modality**	**Heard a female voice**	**Heard a male voice**	**Did not hear anything**	χ^2	***df***	***p***
Watch	Single	2	0	31	54.60	1	< .001

	Dual	32	0	1			
Flower Vase	Single	1	0	29	45.27	1	< .001
	Dual	27	0	3			

Pilot Test 2: User-VP Interaction Manipulation Check

For the question "*Did you see any body parts of the user in the mobile app screen while you were watching the video?*", there should be a higher number of 'yes' responses in the yes-interaction condition than in the no-interaction condition, whereas there should be a higher number of 'no' responses in the no-interaction condition than in the yes-interaction condition in order to verify a successful manipulation of the user-VP interaction factor. The results supported these requirements (see Table 3.15). For watch, 28 (85%) of 33 participants in the yes-interaction condition reported that they saw body parts of the user in the mobile app screen, while 27 (81%) of 33 participants in the no-interaction condition reported that they did not see any body parts of the user in the mobile app screen. Similarly, with regard to the flower vase stimuli, 24 (80%) of 30 participants in the yes-interaction condition reported that they saw body parts of the user in the mobile app screen, while 26 (87%) of 30 participants in the no-interaction reported that they did not see any body parts of the user in the mobile app screen. Results from the chi-square tests for the association between the user-VP interaction (i.e., yes vs. no interaction) and whether they saw any user's body parts in the video were significant for both watch, χ^2 (1) = 29.36, $p < .001$, and flower vase, χ^2 (1) = 26.79, $p < .001$. Therefore, the User-VP Interaction manipulation was successful.

Table 3.15

Cross Tabulation for the User-VP Interaction Manipulation Check: Whether User's Body Parts Were Seen

Product	User-VP Interaction	Did you see any body parts?		χ^2	*df*	*p*
		Yes	No			
Watch	Yes interaction	28	5	29.36	1	< .001
	No interaction	6	27			
Flower Vase	Yes interaction	24	6	26.79	1	< .001
	No interaction	4	26			

Pilot Test 3: Measurement Property Preliminary Results

To obtain preliminary results of the dimensionality of multi-item measurements for dependent and moderator variables to be used in the main experiment, exploratory factor analysis (EFA) was conducted for their pilot test data. The EFAs were conducted for each of 1) the dependent measures, including cognitive attention, sense of presence, perceived utilitarian/hedonic values of a product, and product attitude, and 2) personal moderators, including need for cognition and faith in intuition, via SPSS 28. using the principal component analysis procedure with varimax rotation. A separate EFA was run for each measurement scale, except that for perceived utilitarian value of a product and perceived hedonic value of a product, a single EFA was run with items from both scales together to ensure their dimensionality. Based on the result of factor analyses, items were eliminated if they had lower than .50 factor loadings and/or if high cross-loadings (i.e., loadings differences < .20) were present to ensure clarity of the factors (Campbell & Fiske, 1959). To determine the number of factors appropriate for each factor analysis, Kaiser's Criterion was used by eliminating a factor with eigenvalues greater than 1.0. After the dimensionality of the measures were examined, reliability tests were performed with Cronbach's α for the items constituting each factor

As presented in Table 3.16, the initial EFA results showed that each of cognitive attention, sense of presence, product attitude, need for cognition, and faith in intuition was unidimensional; thus, no further EFA was necessary for these measures. However, the first EFA result of perceived values showed that one of the utilitarian items was cross-loading on both perceived value factors (see Table 3.17). Therefore, a second EFA was performed after eliminating the problematic utilitarian value item. The second EFA results showed that the items were clearly loading onto their respective factors.

Table 3.16

Results of EFA and Cronbach's α of Measures of the Dependent and Moderating Variables in Pilot Test 3

Item[a]	**Factor Loadings**				
	Cognitive Attention	Sense of Presence	Product Attitude	Need for Cognition	Faith in Intuition
Cogn_1	.66				
Cogn_2	.80				
Cogn_3	.70				
Cogn_4	.82				
Cogn_5	.88				
Cogn_6	.83				
Sense_1		.92			
Sense_2		.92			
Att_1			.83		
Att_2			.77		
Att_3			.94		
Att_4			.88		
Att_5			.88		
NFC_1				.73	
NFC_2				.82	
NFC_3				.62	
NFC_4				.61	

NFC_5				.58	
FII_1					.78
FII_2					.84
FII_3					.77
FII_4					.82
FII_5					.79
Eigenvalue	3.709	1.687	3.721	2.284	3.719
% of Variance	61.82%	84.37%	74.42%	45.69%	63.58%
Cronbach's α	.87	.81	.91	.70	.86

[a] *See Tables 3.3 through 3.8 for the wording of the items.*

Table 3.17

Results of EFA and Cronbach's α of Perceived Utilitarian and Hedonic Values in Pilot Test 3

Item[a]	**First EFA**		**Second EFA**	
	Perceived Values		Perceived Values	
	Utilitarian Value of a Product	*Hedonic Value of a Product*	*Utilitarian Value of a Product*	*Hedonic Value of a Product*
Util_1	.84		.85	
Util_2	.83		.83	
Util_3	.79		.80	
Util_4	.80		.80	
Util_5	.67		.68	
Util_6	.57	.71		
Hedo_1		.83		.81
Hedo_2		.80		.80
Hedo_3		.74		.79
Hedo_4		.80		.77
Eigenvalue	3.834	3.689	3.574	3.152
% of Variance	38.34%	36.98%	39.71%	35.02%
Cronbach's α	.93	.88	.92	.88

[a] *See Tables 3.5 and 3.6 for wording of the items.*

CHAPTER VI. MAIN EXPERIMENT

Based on the results of the pilot tests, the main experiment stimuli and measures were finalized. The research design, procedure of the stimulus development, measures, sampling procedure, data analysis and results from the main experiment are explained in this chapter.

Method

Research Design

The main experiment was conducted as an online experiment employing a 2 (AR Modality: visual-only modality vs. visual + auditory modality) × 2 (User-VP Interaction in AR Display: yes vs. no interaction) × 2 (Product: a watch vs. a flower vase) mixed design. Product is a within-subjects factor, whereas AR modality and user-VP interaction are between-subjects factors. A watch and a flower vase were chosen for this research. There are no hypotheses on the product effect; therefore, product is not a variable of interest in this study but is included in the design 1) to enhance the generalizability of findings of this study across product categories by using two different products instead of one and 2) to explore potential product-based differences in the hypothesized AR modality and user-VP interaction effects. For example, the difference in the proximity of the product to human body of the two products when they are being used could have potential effects. Specifically, people directly wear a watch on their wrist; whereas a flower vase is likely to be used independently from one's body. Therefore, consumers may have different product experiences on the AR mobile shopping app depending on the products in different categories. Dependent measures include cognitive attention, sense of presence, perceived utilitarian and hedonic values of a product, and product attitude. Additionally, need for cognition (NFC) and faith in intuition (FII) were employed as personal characteristic moderators.

Stimulus Development

The experimental manipulation was done using simulation video stimuli featuring an AR mobile shopping app screen captured while a fictitious consumer uses the app for evaluating a product (either a watch or a flower vase) during mobile shopping. Participants were directed to watch their assigned video of a consumer shopping for a product using the mobile shopping app and imagine themselves using the app (see Table 4.1 for the participant directions).

Table 4.1

Participant Directions

Below is a short video of a customer shopping for [a watch / a flower vase] using a mobile app. Please watch the video and **imagine yourself using the app in the video at home to virtually experience [a watch / a flower vase] that you are considering buying**. Then, answer the questions on next pages regarding your experience with the video.

In the beginning of the videos, another direction (i.e., "*You are about to watch a video on a smartphone screen of a consumer who is using an app to examine a product virtually. Please IMAGINE yourself shopping on your smartphone and doing what you see in this video*") was displayed on the screen to help participants imagine the shopping activity. The functions of the app demonstrated in the video varied depending on the AR Modality and User-VP Interaction conditions, while the product shown on the video varied depending on the Product conditions.

Table 4.2 presents the links to the simulation mobile shopping video stimuli used for the eight experimental conditions. For the AR Modality manipulation, the visual-only modality condition videos displayed a 3-D virtual product in the actual environment (e.g., a fictitious consumer's home) with a text description of the product specifications displayed on the screen (see example screen shots in Figure 4.1). On the other hand, the visual plus auditory modality condition videos displayed the same visual objects (i.e., the virtual product, the actual environment, and the product specification text) along with an auditory explanation of the product attribute information (i.e., a female virtual agent voice telling the product specifications displayed in text). To manipulate the User-VP Interaction factor, the mobile app screen captured a fictitious user's body part operating a 3D virtual product in his or her home in the yes-interaction condition; whereas the no-interaction condition did not show the user, but merely presented the 3D virtual product in the actual environment (see Figure 4.1). To create the equivalent conditions among the eight videos, the video duration was set to be 47 seconds for all simulation videos and the app structure was maintained the same for different conditions as well as for different products.

Table 4.2

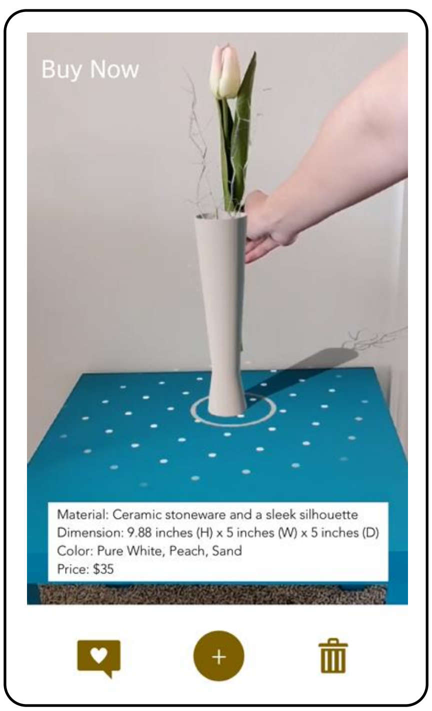
URLs to Multimedia Files for All Eight Experimental Conditions

Product	AR Modality	User-VP Interaction	URLs
Watch	Visual-Only	Yes Interaction	https://youtu.be/ZD48iRrv6kc
	Visual-Only	No Interaction	https://youtu.be/816VRrPX6Kg
	Visual + Auditory	No Interaction	https://youtu.be/G55o5h2VfYc
	Visual + Auditory	Yes Interaction	https://youtu.be/CbCZN8wSKmo
Flower Vase	Visual-Only	Yes Interaction	https://youtu.be/DDdxjxL7l_I
	Visual-Only	No Interaction	https://youtu.be/fWh0rCFIC6I
	Visual + Auditory	No Interaction	https://youtu.be/-T_bWBNenFY
	Visual + Auditory	Yes Interaction	https://youtu.be/qi7R18aIDTc

Figure 4.1

Example Screenshots of the Simulation Videos Used for Experimental Manipulations

(a) Yes User-VP Interaction / Watch (b) No User-VP Interaction / Watch



(c) Yes User-VP Interaction / Flower Vase (d) No User-VP Interaction / Flower Vase

Sampling

For the main experiment, a total of 480 consumers participated with 120 subjects in each of the four experimental conditions. Participants were recruited from a consumer panel of a sampling company, *The Sample Network*, using a quota sampling procedure. Participants were compensated at the amount agreed by *The Sample Network*.

Consumer panel members received an invitation email by the sampling company (see Appendix A.1). Those who were interested in participating in the study followed the provided link included in the invitation email, leading them to the screening/quota questions page where the age, gender, mobile shopping experience, and country of residence questions were asked. Respondents who selected the age groups of younger than 18 years, 55-64 years, and 65 years or above were screened out because they did not meet the age criteria of this study. Also, respondents who did not have any mobile shopping experiences or resided in a non-U.S. country were screened out. The ineligible respondents based on their responses to the screening/quota questions were taken to the termination page where they were explained their ineligibility and thanked for their interest. Those who passed the screening were directed to the information letter page that described the research purpose, participation procedure and duration, confidentiality statement, and the contact information of the researchers (see Appendix A.2). If respondents decided to participate after reading the information letter, they clicked on the "Next" button at the bottom of the information letter page to move to the online experiment site (see Appendix A.3), where respondents viewed one of the four stimuli videos for each product, which were randomly assigned to them. Respondents were directed to watch the assigned video for the first product and then completed the manipulation check measures, followed by the dependent measures for the product. The participants repeated the same process for the second product. The order of the two products was randomized across participants. The AR Modality × User-VP Interaction condition assigned to each participant were identical for both products. For example, if a participant was assigned to the visual-only and yes-interaction condition for the first product, he/she was again assigned to the same condition for the second product. After completing the measures regarding both products' stimulus videos, participants completed the personal moderator measures, and demographic and mobile shopping and AR experience measures. Throughout the measures, attention check questions were interspersed to assure that the participants actually read the questions before answering them. Participants who successfully completed the experiment were compensated of a certain amount of the monetary compensation that was determined by the sampling company.

Measures

In this section, measures which were used in the main experiment are explained, including manipulation check measures, dependent measures, personal moderating variables, and sample characteristics measures.

Manipulation Check Measures

The manipulation check items used in the main experiment were similar to those used in the pilot tests. In the main experiment, two manipulation check items for AR Modality were included: 1) "*What was the product that you saw in the video?*" (with seven response options: "a watch," "a flower vase," "a mug cup," "a ring," "a table lamp," "a pair of shoes," or "I did not see any product"); and 2) "*Did you hear any computer-generated voice in the video? If yes, was it a female voice or a male voice?*" (with three response options: "female voice," "male voice," or "I did not hear any computer-generated voice"). For the User-VP Interaction manipulation check, one item was asked, "*Did you see any body parts of the user in the mobile app screen while you were watching the video?*" (Yes or No).

Dependent Measures

Cognitive Attention. All six items of cognitive attention from the pilot test, which were adapted from Reynolds' (1997) cognitive efforts scale, remained for the main experiment (see Table 4.3). The items were measured on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Table 4.3

Cognitive Attention Measurement Items in the Main Study

Item	Item Abbreviation
While I was watching the video…	
I attempted to analyze the product information.	Cogn_1
I deeply thought about the product information.	Cogn_2
I extended my effort to evaluate the product information.	Cogn_2
I did my best to think about the product information.	Cogn_4
I reflected on the product information.	Cogn_5
I searched my mind to evaluate the product information.	Cogn_6

Sense of Presence. The two items adapted from Hendrix (1994) that were used in the pilot test were again used in the main experiment. Each item was measured on a five-point scale as presented in Table 4.4.

Table 4.4

Sense of Presence Measurement Items for the Main Study

Items	Item Abbreviation
How strongly did you sense as if the product was physically in front of you while you were watching the video? (1 = not strong at all to 5 = extremely strong)	Sense_1
How realistic did you feel as if you were with the product when you were watching the video? (1 = not realistic at all to 5 = extremely realistic)	Sense_2

Perceived Utilitarian Value of a Product. All six items used to measure perceived utilitarian value of a product in the pilot test remained in the main study (see Table 4.5). The items were measured with a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Table 4.5

Perceived Utilitarian Value of a Product Measurement Items for the Main Study

Items	Item Abbreviation
[The watch or the flower vase] shown in this video seems to be well-constructed.	Util_1
The workmanship of [the watch or the flower vase] shown in this video seems to meet high standards.	Util_2
[The watch or the flower vase] shown in this video appears to be made of high-quality materials.	Util_3
[The watch or the flower vase] shown in this video is likely to be good quality.	Util_4
The overall appearance of [the watch or the flower vase] shown in this video is attractive.	Util_5

[The watch or the flower vase] shown in this video would last a long time.	Util_6

Perceived Hedonic Value of a Product. The four items measuring perceived hedonic value of a product used in the pilot test remained in the main study (see Table 4.6). The items were measured with a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

Table 4.6

Perceived Hedonic Value of a Product Measurement Items for the Main Study

Items	**Item Abbreviation**
[The watch or the flower vase] shown in this video is the one that I would enjoy.	Hedo_1
[The watch or the flower vase] shown in this video would make me want to use.	Hedo_2
[The watch or the flower vase] shown in this video would make me feel good when I use it.	Hedo_3
[The watch or the flower vase] shown in this video would give me pleasure when I use it.	Hedo_4

Product Attitude. The product attitude measurement remained the same in the main experiment. The items took the form of a semantic differential scale with five pairs of bipolar adjectives (see Table 4.7).

Table 4.7

Product Attitude Measurement Items for the Main Study

Items	Item Abbreviation
The [watch or flower vase] appeared in the video is ___________________.	
Unappealing/appealing	Att_1
Bad/good	Att_2
Unpleasant/pleasant	Att_3
Unfavorable/favorable	Att_4
Unlikeable/likeable	Att_5

Personal Characteristic Moderators

Need for cognition (NFC) and Faith in Intuition (FII). For the pilot tests, shortened REI scale was adapted from Epstein (1996), which consisted of five NFC items and five FII items. For the main experiment study, the extended REI scale, including 19 NFC items and 12 FII items, instead of the abridged version used in the pilot test, was adopted from Epstein (1996) (see Table 4.8). The original item wordings were retained without modifications. The items were measured with a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Table 4.8

Need for Cognition and Faith in Intuition Measurement Items for the Main Study

Items (Need for Cognition)	Item Abbreviation
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. *	NFC_1
I don’t think to have the responsibility of handling a situation that requires a lot of thinking. *	NFC_2

I would prefer complex to simple problems.	NFC_3
I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something. *	NFC_4
I find little satisfaction in deliberating hard and for long hours. *	NFC_5
Thinking is not my idea of fun. *	NFC_6
The notion of thinking abstractly is not appealing to me. *	NFC_7
I prefer my life to be filled with puzzles that I must solve.	NFC_8
Simply knowing the answer rather than understanding the reasons for the answer to a problem is fine with me. *	NFC_9
I don't reason well under pressure. *	NFC_10
The idea of relying on thought to make my way to the top does not appeal to me. *	NFC_11
I prefer to talk about international problems rather than to gossip or talk about celebrities.	NFC_12
Learning new ways to think doesn't excite me very much. *	NFC_13
I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.	NFC_14
I generally prefer to accept things as they are rather than to question them. *	NFC_15
It is enough for me that something gets the job done, I don't care how or why it works. *	NFC_16
I tend to set goals that can be accomplished only by expending considerable mental effort.	NFC_17
I have difficulty thinking in new and unfamiliar situations. *	NFC_18
I feel relief rather than satisfaction after completing a task that required a lot of mental effort. *	NFC_19
Items (Faith in Intuition)	
My initial impressions of people are almost always right.	FII_1
I trust my initial feelings about people.	FII_2

When it comes to trusting people, I can usually rely on my "gut feelings."	FII_3
I believe in trusting my hunches.	FII_4
I can usually feel when a person is right or wrong even if I can't explain how I know.	FII_5
I am a very intuitive person.	FII_6
I can typically sense right away when a person is lying.	FII_7
I am quick to form impressions about people.	FII_8
I believe I can judge character pretty well from a person's appearance.	FII_9
I often have clear visual images of things.	FII_10
I have a very good sense of rhythm.	FII_11
I am good at visualizing things.	FII_12

* Reverse coded.

Sample Characteristics Measures

Demographic Measures. Demographic information of each participant was collected with the questionnaire about their gender, age, ethnicity, education level, occupation, marital status, household income, and residence area.

Previous Experience. All the items that measured participants' previous experience with the mobile shopping app as well as the AR technology for product shopping in the pilot test remained in the main study (see Table 4.9). The items adapted from Hendrix (1994) were modified to specifically measure the participant's knowledge of a mobile shopping app (four items) and AR (four items). After conducting the pilot tests, the question asking about participants' experience with the AR technology was modified. More specifically, the wordings of the question were modified from "*Have you used augmented reality technology when you shopped for products? AR (augmented reality) can be explained as the retail technology that* *allows consumers to view virtual products in the real environment (e.g., home) in the digital display*" to "*Augmented reality (AR) is a technology that allows consumers to view virtual products in the real environment (e.g., your home) through a digital display such as a computer screen or a mobile app. Have you used augmented reality technology when you shopped for products?*" in the main experiment study. Also, questions asking participants' degree of ease with the mobile shopping app and the AR technology questions were modified in the main experiment study. The questions were modified from '*With what degree of ease are you able to navigate within the virtual environment using a mobile shopping app?*' to '*How easily can you navigate on a mobile shopping app?'* and from *'With what degree of ease are you able to navigate within the virtual environment using augmented reality technology?*' to '*How easily can you navigate within the virtual environment using AR technology?*'

Table 4.9

Previous Experience Measurement Items for the Main Study

Items	**Scale**
Previous Experience with a Mobile Shopping App	
Are you a regular mobile shopping app user?	Yes/No
What is your overall comfort level with a mobile shopping app?	1 = Not comfortable at all to 5 = Extremely comfortable
What is your overall enjoyment level using a mobile app for product shopping?	1 = Not enjoyable at all to 5 = Extremely enjoyable
How easily can you navigate on a mobile shopping app?	1 = Not easy at all to 5 = Extremely easy
Previous Experience with Augmented Reality	
Augmented reality (AR) is a technology that allows consumers to view virtual products in the real environment (e.g., your home) through a digital display such as a computer screen or a mobile app. Have you	Yes/No

used augmented reality technology when you shopped for products?	
If answered ‘yes’ to the previous question,	
Are you a regular augmented reality technology user?	Yes/No
What is your overall comfort level with AR technology?	1 = Not comfortable at all to 5 = Extremely comfortable
What is your overall enjoyment level using AR technology for product shopping?	1 = Not enjoyable at all to 5 = Extremely enjoyable
How easily can you navigate within the virtual environment using AR technology?	1 = Not easy at all to 5 = Extremely easy

Analysis and Results

For data analysis, Statistical Package for the Social Sciences (SPSS) and AMOS were utilized. Data analysis consisted of three phases, including preliminary analyses (i.e., sample profiling, measurement validity and reliability checks), manipulation check, and hypothesis tests.

Sample Characteristics

For the main study, a total of 1,466 individuals participated in the main study. Among the 1,466 responses, 314 participants did not pass the screening/quota questions and 650 participants failed to answer the attention check questions correctly although they met the quote requirements, leaving 502 respondents which met the quota requirements and answered the attention checking questions correctly. Among the 502, 16 respondents who did not answer correctly the first manipulation check question (i.e., *what was the product that you saw in the video?*) were further eliminated as it was highly likely that they did not watch the simulation videos. Furthermore, 6 respondents whose responses showed straight-lining tendencies (e.g., selecting the same answer, such as “strongly agree,” for all questions on the same page) and gave wrong answers to other manipulation check questions concurrently were also eliminated for further analyses due to a suspicion of the lack of attention during their participation. At the end, 480 responses were used for further analyses, including 120 participants in each condition. Sample characteristics were analyzed with the following groups: 1) 480 participants as a whole (see Table 4.9); and 2) 120 participants in each condition to compare sample characteristics of each condition (see Table 4.10).

Demographic Characteristics

As presented in detail in Table 4.10, the sample (n = 480) included 230 male (47.9%) and 250 female (52.1%) participants. The average age of the participants was 35.03 years (SD = 10.03). The number of respondents for each age category were set to reflect the U.S. mobile app users for product shopping (Socratic, 2017). The usable sample age proportions were slightly different from the previous report by Socratic (2017) because the report did not include the age group of 18 to 24. Therefore, 32.5% of the participants were in the 35-44 age group, followed by 25-34 age group (28.3%), 18-24 age group (19.6%), and 45-54 age group (19.6%). The majority of the people were non-Hispanic White (64.6%), followed by non-Hispanic Black (11.3%) and Hispanic (11.3%). More than a half of the participants reported that they had some college degree or higher. Regarding the occupation of the participants, approximately 60% of the participants were full-time employees, followed by part-time employees (10%) and home-makers (8.3%). A majority (56%) of the participants were married or living with significant others. Participants' income levels were well distributed. Approximately 18% of the participants indicated that their household income was between $75,001 to $100,000, followed by $50,000 to $75,000 (16.5%). Regarding their residence area, approximately 43% of the participants lived in the suburban area; 40% lived in the urban area; and 20% lived in the rural area. As presented in detail in Table 4.11, participants were well-distributed across the experimental conditions in terms of their demographic characteristics, including gender, age, ethnicity, education, occupation, marriage status, income, and their residence area.

Table 4.10

Main Study Sample Demographic Characteristics (N = 480)

Variable	*Category*	*n*	*%*
Gender	Male	230	47.9
	Female	250	52.1
Age	18-24	94	19.6
	25-34	136	28.3
	35-44	156	32.5
	45-54	94	19.6
Ethnicity	American Indian/Alaskan Native	13	2.7
	Asian/Pacific Islander	35	7.3
	Hispanic	54	11.3
	Non-Hispanic Black (African American)	54	11.3
	Non-Hispanic White (European or Caucasian American)	310	64.6
	Other	14	2.9
Education	8th grade or less	1	.2
	Some high school	15	3.1
	High school degree	81	16.9
	Some college or technical school	134	27.9
	College degree (4 years)	139	29.0
	Some graduate school	26	5.4
	Graduate degree (master’s, doctorate, etc.)	84	17.5
Occupation	Full-time employment	284	59.2
	Part-time employment	48	10.0
	Unemployed	30	6.3
	Self-employed	36	7.5
	Home-maker	40	8.3
	Student	28	5.8
	Retired	5	1.0
	Other	9	1.9
Marriage	Single	211	44.0
	Married	224	46.7
	Single but living with significant other	45	9.4

Income	Under $25,000	57	11.9
	$25,000 to $35,000	60	12.5
	$35,001 to $50,000	70	14.6
	$50,001 to $75,000	79	16.5
	$75,001 to $100,000	84	17.5
	$100,001 to $125,000	34	7.1
	$125,001 to $150,000	37	7.7
	$150,001 to $175,000	27	5.6
	$175,001 to $200,000	12	2.5
	Over $200,000	20	4.2
Residence Area	Rural Area	97	20.2
	Urban Area	177	36.9
	Suburban Area	206	42.9

Table 4.11

Main Study Sample Demographic Characteristics by Condition (n = 480)

Variable	*Category*	*Condition 1 (n = 120)*		*Condition 2 (n = 120)*		*Condition 3 (n = 120)*		*Condition 4 (n = 120)*	
		f	%	*f*	%	*f*	%	*f*	%
Gender	Male	53	44.2	55	45.8	65	54.2	60	50.0
	Female	67	55.8	65	54.2	55	45.8	60	50.0
Age	18-24	27	22.5	27	22.5	19	15.8	21	17.5
	25-34	38	31.7	36	30.0	27	22.5	35	29.2
	35-44	29	24.2	37	30.8	48	40.0	42	35.0
	45-54	26	21.7	20	16.7	26	21.7	22	18.3
Ethnicity	American Indian/Alaskan Native	5	4.2	4	3.3	2	1.7	2	1.7
	Asian/Pacific Islander	8	6.7	5	4.2	16	13.3	6	5.0
	Hispanic	14	11.7	16	13.3	10	8.3	14	11.7
	Non-Hispanic Black (African American)	13	10.8	14	11.7	14	11.7	13	10.8
	Non-Hispanic White (European or Caucasian American)	76	63.3	79	65.8	74	61.7	81	67.5
	Other	4	3.3	2	1.7	4	3.3	4	3.3

Education	8^{th} grade or less	0	0.0	1	0.8	0	0.0	0	0.0
	Some high school	5	4.2	4	3.3	5	4.2	1	0.8
	High school degree	20	16.7	20	16.7	19	15.8	22	18.3
	Some college or technical school	36	30.0	38	31.7	35	29.2	25	20.8
	College degree (4 years)	32	26.7	29	24.2	38	31.7	40	33.3
	Some graduate school	7	5.8	6	5.0	8	6.7	5	4.2
	Graduate degree (master's, doctorate, etc.)	20	16.7	22	18.3	15	12.5	27	22.5
Occupation	Full-time employment	77	64.2	68	56.7	69	57.5	70	58.3
	Part-time employment	11	9.2	15	12.5	11	9.2	11	9.2
	Unemployed	7	5.8	7	5.8	8	6.7	8	6.7
	Self-employed	6	5.0	11	9.2	10	8.3	9	7.5
	Home-maker	10	8.3	9	7.5	14	11.7	7	5.8
	Student	6	5.0	6	5.0	7	5.8	9	7.5
	Retired	0	0.0	1	0.8	0	0.0	4	3.3
	Other	3	2.5	3	2.5	1	0.8	2	1.7
Marriage	Single	54	45.0	55	45.8	50	41.7	52	43.3
	Married	57	47.5	52	43.3	57	47.5	58	48.3
	Single but living with significant other	9	7.5	13	10.8	13	10.8	10	8.3
Income	Under $25,000	9	7.5	13	10.8	16	13.3	19	15.8
	$25,000 to $35,000	11	9.2	18	15.0	15	12.5	16	13.3
	$35,001 to $50,000	24	20.0	17	14.2	15	12.5	14	11.7
	$50,001 to $75,000	22	18.3	17	14.2	24	20.0	16	13.3
	$75,001 to $100,000	24	20.0	18	15.0	25	20.8	17	14.2
	$100,001 to $125,000	10	8.3	8	6.7	6	5.0	10	8.3
	$125,001 to $150,000	10	8.3	10	8.3	8	6.7	9	7.5
	$150,001 to $175,000	5	4.2	12	10.0	6	5.0	4	3.3

	$175,001 to $200,000	2	1.7	2	1.7	2	1.7	6	5.0
	Over $200,000	3	2.5	5	4.2	3	2.5	9	7.5
Residence Area	Rural Area	27	22.5	24	20.0	24	20.0	22	18.3
	Urban Area	33	27.5	49	40.8	45	37.5	50	41.7
	Suburban Area	60	50.0	47	39.2	51	42.5	48	40.0

Note. Condition 1 = Visual-only + Non-user-VP interaction; Condition 2 = Visual plus auditory + Non-user-VP interaction; Condition 3 = Visual-only + User-VP interaction; Condition 4 = Visual plus auditory + User-VP interaction

Previous Experience

As for their previous experiences (see Table 4.12), among the 480 participants, 87.7% of the participants reported that they were a regular mobile shopping app user, and 12.3% indicated that they were not a regular mobile shopping app user. Regarding their comfort level of the mobile shopping app use, 40.4% of the participants reported that they were extremely comfortable with a mobile shopping app while 39.2% of the participants reported that they were quite comfortable with a mobile shopping app. Only 0.2% of them indicated that they were not comfortable with a mobile shopping app at all. The results demonstrated that the majority of participants were comfortable with using a mobile app for product shopping. In terms of their enjoyment level with a mobile shopping app, 38.5% reported that they considered a mobile shopping app quite enjoyable, and 32.7% indicated that a mobile shopping app was extremely enjoyable. Again, only 0.2% of the participants indicated that they did not enjoy a mobile shopping app at all. On the question regarding how easily they could navigate a mobile shopping app, 43.1% of them reported that they could navigate it extremely easily, while 1% of them thought it was not easy at all to navigate a mobile shopping app. As almost half of the participants indicated that they could navigate a mobile shopping app easily, it can be expected that the participants were able to easily understand the simulation videos of shopping for products with a mobile shopping app.

Among the 480 participants, 39.6% reported that they had used AR technology for shopping. As less than half participants had experiences with the AR technology for product shopping, some participants might have had difficulties in understanding how to use the AR technology for product shopping. Among those who had shopping experience with AR technology (*n* = 190), 66.8% reported that they were a regular AR technology user, and 33.2% were not regular AR technology users. Regarding their comfort level with the AR technology, 36.8% answered that they were quite comfortable with the AR technology when shopping for products, followed by 36.3% who were extremely comfortable with it. Also, 37.9% reported that they extremely enjoyed using the AR technology and another 37.9% also quite enjoyed using the AR technology for product shopping. Lastly, 41.1% of the participants reported that they could navigate within the virtual environment using the AR technology quite easily, while only 1.1% of them were not able to easily navigate within the virtual environment using the AR technology at all.

Table 4.12

Experience Characteristics of the Main Study Sample (n = 480)

Variable	Category	*n*	%
Mobile Shopping App Use			
Regular Mobile Shopping App User	Yes	421	87.7%
	No	59	12.3%
Comfort Level with a Mobile Shopping App	Not Comfortable at All	1	0.2%
	Not Very Comfortable	15	3.3%
	Moderately Comfortable	82	17.1%
	Quite Comfortable	188	39.2%
	Extremely Comfortable	194	40.4%
Enjoyment Level with a Mobile Shopping APP	Not Enjoyable at All	1	0.2%
	Not Very Enjoyable	15	3.1%
	Moderately Enjoyable	122	25.4%

	Quite Enjoyable	185	38.5%
	Extremely Enjoyable	157	32.7%
Easement Level with a Mobile Shopping App	Not Easy at All	5	1.0%
	Not Very Easy	8	1.7%
	Moderately Easy	80	16.7%
	Quite Easy	180	37.5%
	Extremely Easy	107	43.1%
AR Technology for Shopping			
Experience with AR Technology Use for Shopping	Yes	190	39.6%
	No	290	60.4%
Participants Who Have Used AR Technology for Shopping (n = 190)			
Regular AR Technology User	Yes	127	66.8%
	No	63	33.2%
Comfort Level with AR Technology	Not Comfortable at All	1	0.5%
	Not Very Comfortable	5	2.6%
	Moderately Comfortable	45	23.7%
	Quite Comfortable	70	36.8%
	Extremely Comfortable	69	36.3%
Enjoyment Level with AR Technology	Not Enjoyable at All	2	1.1%
	Not Very Enjoyable	7	3.7%
	Moderately Enjoyable	37	19.5%
	Quite Enjoyable	72	37.9%
	Extremely Enjoyable	72	37.9%
Easement Level with AR Technology	Not Easy at All	2	1.1%
	Not Very Easy	5	2.6%
	Moderately Easy	40	21.1%
	Quite Easy	78	41.1%
	Extremely Easy	65	34.2%

Manipulation Check

AR Modality

In response to the question, "*Did you hear any computer-generated voice in the video? If yes, was it a female voice or a male voice?*", with regard to the watch stimuli, 209 (87%) of 240 participants in the single AR modality condition correctly reported that they did not hear any computer-generated voice, while 221 (92%) of 240 participants in the dual AR modality condition correctly reported that they heard a female voice. Similarly, with regard to the flower vase stimuli, 217 (90%) of 240 participants in the single AR modality condition correctly reported that they did not hear any computer-generated voice, while 216 (90%) of 240 participants in the dual AR modality condition correctly reported that they heard a female voice (see Table 4.13). A chi-square test was performed to examine the association between the AR modality conditions (i.e., visual-only vs. visual plus auditory) and the responses (i.e., female voice vs. male voice vs. I did not hear any computer-generated voice). The result showed a significant association for both watch, χ^2 (2) = 343.42, $p < .001$, and flower vase, χ^2 (2) = 334.06, $p < .001$. Therefore, the manipulation of the AR modality factor was successful.

Table 4.13

Cross Tabulation for the AR Modality Manipulation Check in the Main Study: Voice Gender

Product	**AR Modality**	**Heard a female voice**	**Heard a male voice**	**Did not hear any computer-generated voice**	χ^2	***df***	***p***
Watch	Visual only	19	12	209	343.42	2	< .001
	Visual + Auditory	221	5	14			
Flower Vase	Visual only	19	4	217	334.06	2	< .001
	Visual + Auditory	216	6	18			

User-Virtual (VP) Interaction in AR Display

In response to the question, "*Did you see any body parts of the user in the mobile app screen while you were watching the video?*", for the watch stimuli, 229 (95%) of 240 participants in the yes-interaction condition correctly reported that they saw body parts of the user in the mobile app screen, while 220 (92%) of 240 participants in the no-interaction condition correctly reported that they did not see any body parts of the user in the mobile app screen (see Table 4.14). Similarly, for the flower vase stimuli, 225 (94%) of 240 participants in the yes-interaction condition accurately reported that they saw body parts of the user in the mobile app screen, while 228 (95%) of 240 participants in the no-interaction condition correctly reported that they did not see any body parts of the user in the mobile app screen for the flower vase videos (see Table 4.14). A chi-square test was performed to examine the association between the user-VP interaction conditions (i.e., yes vs. no interaction) and whether they saw the user's body parts in the video. The result showed a significant association for both watch, χ^2 (1) = 364.52, $p < .001$, and flower vase, χ^2 (1) = 378.13, $p < .001$. Therefore, the manipulation of the user-VP interaction factor was successful.

Table 4.14

Cross-Tabulation for the User-VP Interaction Manipulation Check in the Main Study

Product	**User-VP Interaction**	**Did you see any body parts?**		χ^2	***df***	***p***
		Yes	No			
Watch	Yes interaction	229	11	364.52	1	< .001
	No interaction	20	220			
Flower Vase	Yes interaction	225	15	378.13	1	< .001
	No interaction	12	228			

Measurement Validity and Reliability

In order to determine the dimensionality and construct validity of the measurements, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), respectively, were utilized. Between the two datasets for the two products from the same sample, the watch data were used for the EFA, and the flower vase data were used for the CFA.

First, EFA was performed through SPSS 28 using principal component analysis with varimax rotation. Items were eliminated if they had lower than .50 factor loadings and/or if cross-loadings (loading differences of .20 or less across two or more factors) were present based on the result of factor analyses to ensure the cohesiveness of each factor (Campbell & Fiske, 1959). Table 4.15 shows the results from the initial EFA of cognitive attention, sense of presence, and product attitude, each of which was run separately. According to the results, cognitive attention, sense of presence, and product attitude were all unidimensional with all items with satisfactory factor loadings (> .70), and thus, no further EFA analyses were necessary. Table 4.16 shows the initial EFA as well as the second EFA results of the perceived value measures (i.e., perceived utilitarian value of a product and hedonic value of a product). The initial EFA results showed that one of the perceived utilitarian value items had a higher loading onto the perceived hedonic value factor than onto the intended factor. Therefore, a second EFA was run after eliminating it to ensure the conceptual cohesiveness of each factor, which revealed all items loading onto their respective perceived value factors. Also, results from the initial EFA with the NFC/FII items showed low factor loadings (< .70) for nine NFC items and five FII items and thus were eliminated. A second EFA was conducted after eliminating the low-loading items, which showed that the items were loading onto their respective factors (see Table 4.17).

Table 4.15

Results of EFA and Cronbach's αs for Measures in the Main Study

Item[a, b, c]	**Factor Loadings**		
	Cognitive Attention	Sense of Presence	Product Attitude
Cogn_1[a]	.79		
Cogn_2[a]	.83		

Cogn_3[a]	.79		
Cogn_4[a]	.79		
Cogn_5[a]	.80		
Cogn_6[a]	.80		
Sense_1[b]		.93	
Sense_2[b]		.93	
Att_1[c]			.90
Att_2[c]			.88
Att_3[c]			.91
Att_4[c]			.92
Att_5[c]			.91
Eigenvalue	3.836	1.732	4.081
% of Variance	63.93%	86.59%	81.62%
Cronbach's α	.89	.89	.94

The full item wordings corresponding to each of the abbreviated item names in this table can be found in
[a] The full item wording can be found in Table 4.3.
[b] The full item wording can be found in Table 4.4.
[c] The full item wording can be found in Table 4.7.

Table 4.16

EFA and Cronbach's α of Utilitarian and Hedonic Values for the Main Study

Item[a, b]	**First EFA**		**Second EFA**	
	Perceived Values		Perceived Values	
	Utilitarian Value of a Product	*Hedonic Value of a Product*	*Utilitarian Value of a Product*	*Hedonic Value of a Product*
Util_1[a]	.80		.88	
Util_2[a]	.79		.90	
Util_3[a]	.82		.86	
Util_4[a]	.81		.87	
Util_5[a]	.49	.68		
Util_6[a]	.74		.81	
Hedo_1[b]		.84		.91
Hedo_2[b]		.85		.91
Hedo_3[b]		.82		.90
Hedo_4[b]		.82		.90
Eigenvalue	3.851	3.834	3.645	3.376
% of Variance	38.51%	38.34%	40.50%	37.51%
Cronbach's α	.92	.93	.91	.93

The full item wordings corresponding to each of the abbreviated item names in this table can be found in
[a] The full item wording can be found in Table 4.5.
[b] The full item wording can be found in Table 4.6.

Table 4.17

Second EFA and Cronbach's α of Personal Moderators for the Main Study

	First EFA		Second EFA	
Item [a]	Need for Cognition	Faith in Intuition	Need for Cognition	Faith in Intuition
NFC_1	.75		.76	
NFC_2	.75		.75	
NFC_3	-.06			
NFC_4	.74		.75	
NFC_5	.69			
NFC_6	.73		.75	
NFC_7	.79		.81	
NFC_8	-.15			
NFC_9	.74		.75	
NFC_10	.63			
NFC_11	.76		.77	
NFC_12	.01			
NFC_13	.76		.79	
NFC_14	-.06			
NFC_15	.72		.74	
NFC_16	.69			
NFC_17	-.21			
NFC_18	.75		.74	
NFC_19	.59			
FII_1		.75		.76
FII_2		.77		.80
FII_3		.73		.78
FII_4		.71		.75
FII_5		.71		.75
FII_6		.76		.76
FII_7		.69		.70
FII_8		.55		
FII_9		.63		
FII_10		.66		
FII_11		.61		
FII_12		.63		
Eigenvalue	7.401	5.646	5.766	4.041
% of Variance	38.96%	47.05%	57.66%	57.74%
Cronbach's α	.88	.89	.92	.88

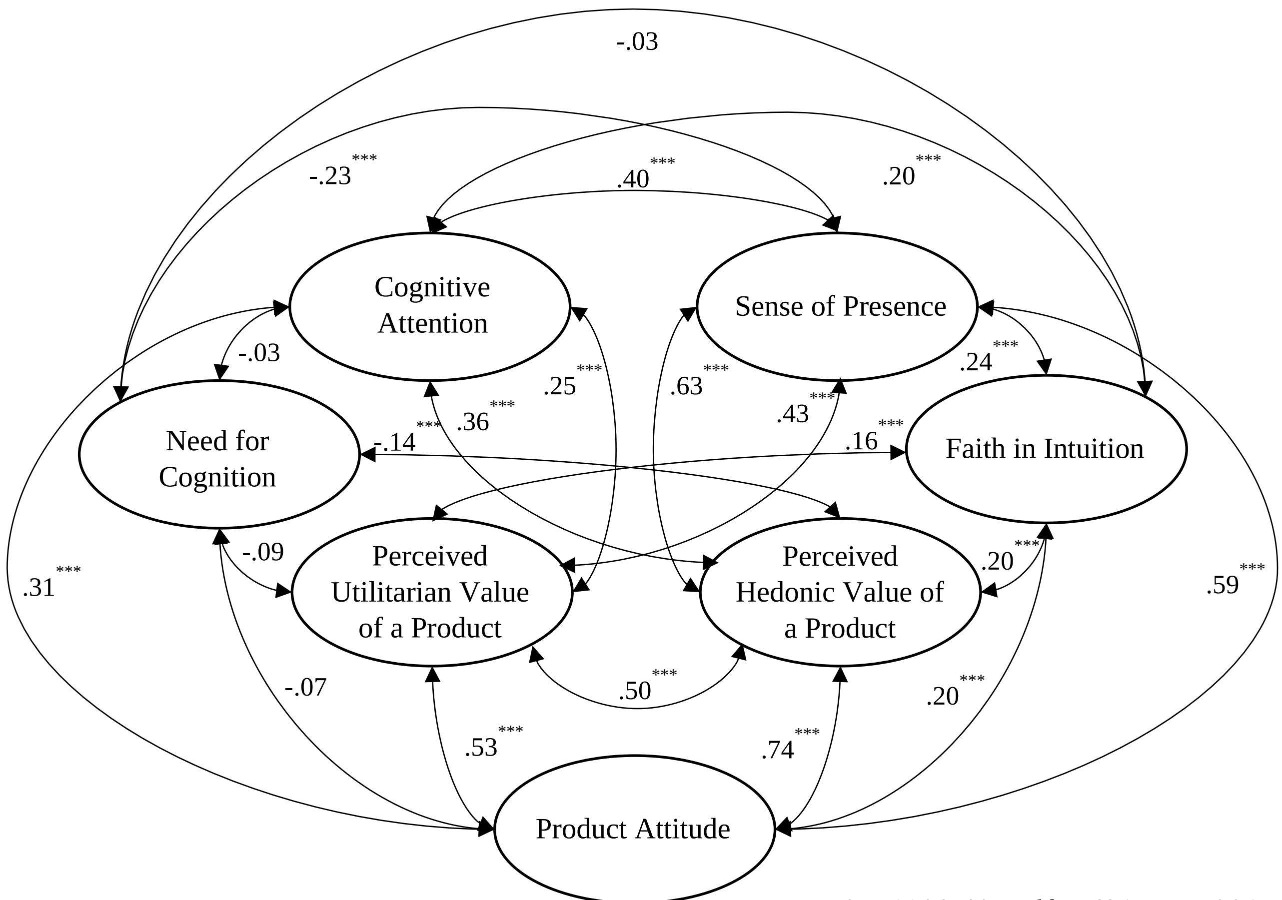
[a] The full item wording corresponding to each of the abbreviated item names in this table can be found in Table 4.8.

Next, prior to the hypotheses and model testing, CFA was conducted to confirm the dimensionality and construct validity of all of the multi-item measures with the flower vase data through AMOS 21. The fit of the CFA models was assessed with comparative fit index (CFI), Tucker-Lewis Index (TLI), Bentler-Bonett Normed Fit Index (NFI), and root mean square error of approximation (RMSEA). A model fit is considered good if CFI and TLI are greater than .90 (Hu & Bentler, 1999), and acceptable if RMSEA is below .080 (Browne & Cudeck, 1992). Based upon CFA results, items were removed from the scales if they had lower than .60 of factor loadings (Hair et al., 2015). Then, values of average variance extracted (AVE) and composite reliability (CR) were calculated to establish the convergent validity. The AVEs and CRs that are greater than .50 suggest convergent validity (Fornell & Larcker, 1981). Also, discriminant validity was established when the AVE of a measure is greater than the values of all of the shared variances (SVs) between the measure and the other measures (Fornell & Larcker, 1981).

The CFA was run for all dependent measures and personal moderators together, in a single first-order factor model based on the items retained in the final EFAs conducted with the watch data (see Figure 4.2). The result of the chi-square statistic was $\chi^2 = 1109.405$, $df = 681$, $p < .001$, which indicated a good model fit with the ratio between chi-square and df being less than the suggested threshold of 5. The incremental fit indices (CFI = .96, TLI = .96, NFI = .91) suggested a good model fit, which were all above the suggested threshold of .90 (Hu & Bentler, 1999). The RMSEA value (RMSEA = .036) suggested a good model fit as the value was below the suggested threshold of .080 (Browne & Cudeck, 1992). Table 4.18 displays the factor loadings from the CFA model, as well as their composite reliability (CR) statistics.

Figure 4.2

CFA Model of the Main Study



$\chi^2 = 1109.405$, $df = 681$, $p < .001$
CFI = .96, TLI = .96, NFI = .91
RMSEA = .036

Note. Factor loadings and their associated error terms are not included in this figure. $^{**}p < .05$, $^{***}p < .001$

Table 4.18

CFA Results: Loadings and CRs

Factor and Item	CFA standardized factor loading	CR
Perceived Utilitarian Value of a Product		
The flower vase shown in this video seems to be well-constructed. (Util_1)	.78	.93

The workmanship of the flower vase shown in this video seems to meet high standards. (Util_2)	.81	
The flower vase shown in this video appears to be made of high-quality materials. (Util_3)	.84	
The flower vase shown in this video is likely to be good quality. (Util_4)	.87	
The flower vase shown in this video would last a long time. (Util_6)	.73	
Perceived Hedonic Value of a Product		
The flower vase shown in this video is the one that I would enjoy. (Hedo_1)	.85	.91
The flower vase shown in this video would make me want to use. (Hedo_2)	.84	
The watch flower vase shown in this video would make me feel good when I use it. (Hedo_3)	.84	
The flower vase shown in this video would give me pleasure when I use it. (Hedo_4)	.83	
Cognitive Attention		
I attempted to analyze the product information. (Cogn_1)	.73	.87
I deeply thought about the product information. (Cogn_2)	.72	
I extended my effort to evaluate the product information. (Cogn_3)	.74	
I did my best to think about the product information. (Cogn_4)	.67	
I reflected on the product information. (Cogn_5)	.76	
I searched my mind to evaluate the product information. (Cogn_6)	.75	
Sense of Presence		
How strongly did you sense as if the product were physically in front of you while you were watching the video? (Sense_1)	.86	.85
How realistic did you feel as if you were with the product when you were watching the video? (Sense_2)	.85	
Product Attitude		
The flower vase that appeared in the video is…		
Unappealing – Appealing (Att_1)	.89	.94
Bad – Good (Att_2)	.85	
Unpleasant – Pleasant (Att_3)	.85	
Unfavorable – Favorable (Att_4)	.87	

Unlikeable – Likeable (Att_5)	.88	
Need for Cognition		
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. (NFC_1)	.73	.92
I don't think to have the responsibility of handling a situation that requires a lot of thinking. (NFC_2)	.71	
I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something. (NFC_4)	.72	
Thinking is not my idea of fun. (NFC_6)	.71	
The notion of thinking abstractly is not appealing to me. (NFC_7)	.78	
Simply knowing the answer rather than understanding the reasons for the answer to a problem is fine with me. (NFC_9)	.71	
The idea of relying on thought to make my way to the top does not appeal to me. (NFC_11)	.74	
Learning new ways to think doesn't excite me very much. (NFC_13)	.76	
I generally prefer to accept things as they are rather than to question them. (NFC_15)	.70	
I have difficulty thinking in new and unfamiliar situations. (NFC_18)	.71	
Faith in Intuition		
My initial impressions of people are almost always right. (FII_1)	.72	.88
I trust my initial feelings about people. (FII_2)	.77	
When it comes to trusting people, I can usually rely on my "gut feelings." (FII_3)	.73	
I believe in trusting my hunches. (FII_4)	.70	
I can usually feel when a person is right or wrong even if I can't explain how I know. (FII_5)	.70	
I am a very intuitive person. (FII_6)	.72	
I can typically sense right away when a person is lying. (FII_7)	.64	

Based upon the CFA results, both convergent validity and discriminant validity were assessed to ensure that indicators of one construct share a higher proportion of variance in common while they share a lower variance with indicators of other constructs. Convergent validity was established with the AVE estimate for each factor as well as CR values, and discriminant validity was conducted by comparing the AVEs and shared variances (SVs) among the factors (Fornell & Larcker, 1981). As shown in Table 4.19, the AVEs from the CFA model were greater than the suggested threshold of .50 for all factors (Bagozzi & Yi, 1991). All factors' AVEs being above .50 and their items having high factor loadings (mostly > .70 except for a few that were > .60) provided evidence of convergent validity. Also, CR values being above .50, which is the threshold of the CR values, also provided evidence of convergent validity. None of the SVs between the factors were greater than the AVEs of the respective factors, which provided evidence of discriminant validity (Fornell & Larcker, 1981).

Table 4.19

CFA Results: AVEs and SVs

Constructs[c]	AVEs[a] and SVs[b]						
	Util	Hedonic	CA	Sense	Attitude	NFC	FII
Util	**.65**						
Hedonic	.60	**.71**					
CA	.25	.29	**.53**				
Sense	.37	.64	.28	**.73**			
Attitude	.58	.41	.42	.29	**.76**		
NFC	.02	.03	.18	.05	.00	**.53**	
FII	.12	.10	.18	.12	.08	.00	**.51**

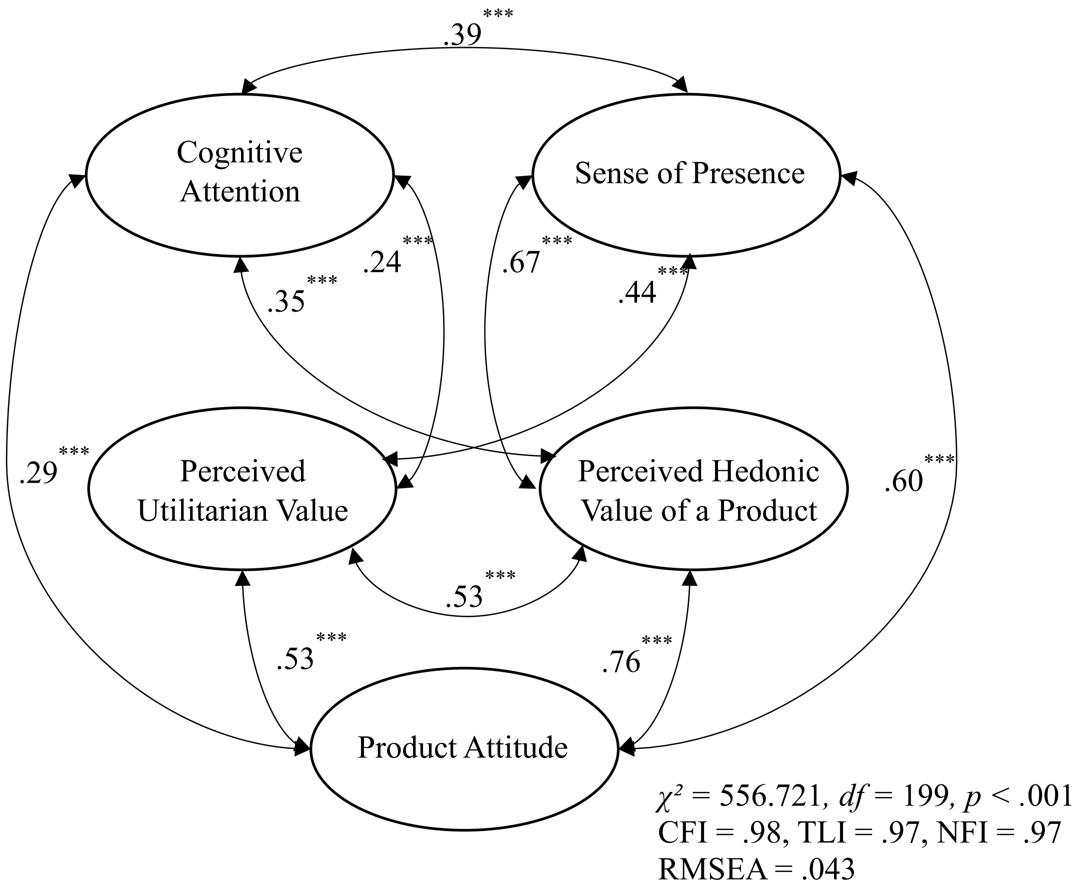
[a] Average variance extracted (AVE) estimates are bolded.
[b] The off-diagonal cells present shared variances.
[c] Util = perceived utilitarian value of a product, Hedonic = perceived hedonic value of a product, CA = cognitive attention, Sense = sense of presence, Attitude = product attitude, NFC = need for cognition, FII = faith in intuition.

Additional CFA Analysis

Since the above CFA was conducted with only the flower vase data, to assure the convergent and discriminant validity of the dependent measures from the data for both products, an additional CFA was conducted with the dependent measures using a single dataset by pooling the two products' data. As personal moderators were answered only once by each participant, those moderators were not included in this additional CFA analysis. According to this additional CFA results (see Figure 4.3 and Table 4.20), the chi-square statistic was χ^2 = 556.721, *df* = 199, *p* < .001, which indicated a good model fit with the ratio between chi-square and df being less than the suggested threshold of 5. The incremental fit indices (CFI = .98, TLI = .97, NFI = .97) were above the suggested threshold of .90, suggesting a good model fit (Hu & Bentler, 1999). The RMSEA value of .043 also indicated a good model fit as it is below the suggested threshold of the .080 level (Browne & Cudeck, 1992).

Figure 4.3

CFA Model with Dependent Measures Using a Single Dataset of Watch and Flower Vase



Note. Factor loadings and their associated error terms are not included in this figure. $^{**}p < .05$, $^{***}p < .001$

Table 4.20

CFA Results of the Dependent Measures from Pooled Data: Loadings and CRs

Factor and Item	CFA standardized factor loading	CR
Perceived Utilitarian Value of a Product		
The flower vase shown in this video seems to be well-constructed.	.81	.91
The workmanship of the flower vase shown in this video seems to meet high standards.	.85	
The flower vase shown in this video appears to be made of high-quality materials.	.83	

The flower vase shown in this video is likely to be good quality.	.85	
The flower vase shown in this video would last a long time.	.74	
Perceived Hedonic Value of a Product		
The flower vase shown in this video is the one that I would enjoy.	.87	.92
The flower vase shown in this video would make me want to use.	.86	
The watch flower vase shown in this video would make me feel good when I use it.	.85	
The flower vase shown in this video would give me pleasure when I use it.	.85	
Cognitive Attention		
I attempted to analyze the product information.	.73	.88
I deeply thought about the product information.	.77	
I extended my effort to evaluate the product information.	.74	
I did my best to think about the product information.	.69	
I reflected on the product information.	.76	
I searched my mind to evaluate the product information.	.75	
Sense of Presence		
How strongly did you sense as if the product were physically in front of you while you were watching the video?	.86	.86
How realistic did you feel as if you were with the product when you were watching the video?	.89	
Product Attitude		
The flower vase that appeared in the video is…		
Unappealing - Appealing	.88	.94
Bad - Good	.85	
Unpleasant - Pleasant	.87	
Unfavorable - Favorable	.89	
Unlikeable - Likeable	.88	

With the additional CFA results, both convergent validity and discriminant validity were assessed. As shown in Table 4.21, the AVEs from the CFA model were greater than the suggested threshold of .50 of all factors (Bagozzi & Yi, 1991). All factors' AVEs being above the .50 level and their items having high factor loadings again provided evidence of convergent validity. Also, CR values being greater than the suggested threshold of .50 provided evidence of convergent validity (Fornell & Larcker, 1981). None of the SVs between the factors were greater than the AVEs of the respective factors, which provided evidence of discriminant validity (Fornell & Larcker, 1981).

Table 4.21

CFA Results of the Dependent Measures from Pooled Data: AVEs and SVs

Constructs[c]	AVEs[a] and SVs[b]				
	Util	Hedonic	CA	Sense	Attitude
Util	**.67**				
Hedonic	.60	**.74**			
CA	.25	.29	**.55**		
Sense	.37	.64	.28	**.75**	
Attitude	.58	.41	.42	.29	**.76**

[a] Average variance extracted (AVE) estimates are bolded.
[b] The off-diagonal cells present shared variances.
[c] Util = perceived utilitarian value of a product, Hedonic = perceived hedonic value of a product, CA = cognitive attention, Sense = sense of presence, Attitude = product attitude.

Hypotheses Testing

All of the hypotheses proposed in Chapter 2 are re-presented in Table 4.22. The hypotheses were tested through 1) SEM with maximum likelihood estimation using AMOS for H1, H2, H3a, and H3b; 2) three-way repeated-measure MANOVA using SPSS for H4a, H4b, H4c, H5a, H5b, H5c and H6; and 3) four-way repeated-measure ANOVA using SPSS for H7 and H8.

Table 4.22

Proposed Hypotheses of this Research

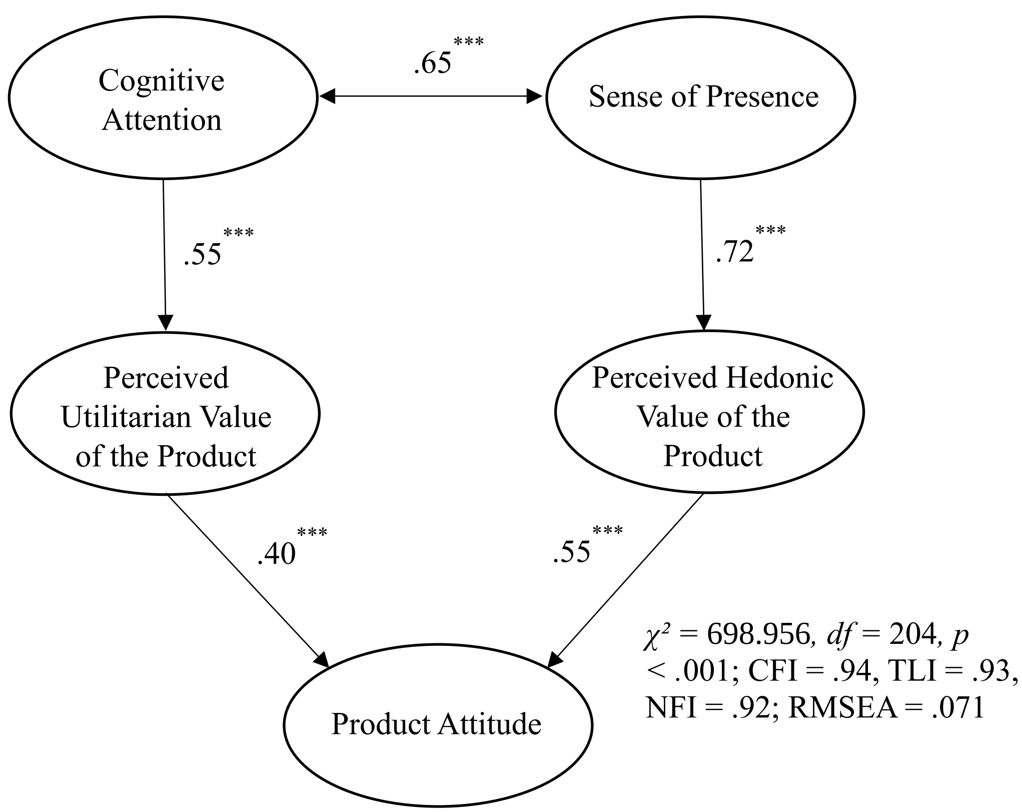
Hypothesis
Hypothesis 1*:* The level of cognitive attention consumers pay to product feature verbal information during shopping with an AR mobile app positively influences their perceived utilitarian value of a product.
Hypothesis 2*:* The level of sense of presence consumers felt during shopping with an AR mobile app positively influences their perceived hedonic value of a product.
Hypothesis 3: Consumers' **a)** perceived utilitarian value of a product and **b)** perceived hedonic value of a product positively influence their product attitude during shopping with an AR mobile app.
Hypothesis 4: **a)** Consumers' level of cognitive attention is greater, **b)** perceived utilitarian value is higher, and **c)** product attitude is more favorable when a mobile AR app employs a dual (visual + auditory) modality than when it employs only a visual modality.
Hypothesis 5: **a)** Consumers' level of sense of presence is greater, **b)** perceived hedonic value is higher, and **c)** product attitude is more favorable when AR display incorporates (vs. dose not incorporate) user-VP interaction.
Hypothesis 6*:* The effect of AR modality on consumers' product attitude is greater when AR display does not incorporate (vs. incorporates) user-VP interaction.
Hypothesis 7*:* The effect of AR modality on cognitive attention is weaker for high-NFC consumers than for low-NFC consumers.
Hypothesis 8*:* The effect of user-VP interaction in AR display on sense of presence is stronger for high-FII consumers than for low-FII consumers.

Structural Equation Modeling (SEM): H1 through H3

SEM with maximum likelihood estimation was conducted using AMOS to examine the structural relationships among the dependent measures proposed in H1 through H3 with each of the two product datasets (i.e., watch and flower vase). First, for the watch data, the model fit was assessed through chi-square statistics (χ^2 = 698.956, *df* = 204, *p* < .001), which indicated a good model fit with the ratio between chi-square and df being less than the suggested threshold of 5. The incremental fit indices (CFI = .94, TLI = .93, NFI = .92) indicated a good model fit as they were all above the suggested threshold of .90 (Hu & Bentler, 1999). RMSEA value (RMSEA = .071) also indicated an acceptable model fit with the value being below the suggested threshold of .080 (Browne & Cudeck, 1992). The SEM results indicated that a greater level of cognitive attention led to a higher perceived utilitarian value of the product (Std. β = .55, $p < .001$), supporting H1. Also, a greater level of sense of presence led to a higher perceived hedonic value of the product (Std. β = .72, $p < .001$), supporting H2. In support of H3a and H3b, significant positive influences of perceived utilitarian value (Std. β = .40, $p < .001$) and hedonic value (Std. β = .55, $p < .001$) of the product on product attitude were found. Figure 4.4 demonstrates the SEM results from the watch data.

Figure 4.4

SEM Results from the Watch Data with Standardized Regression Coefficients

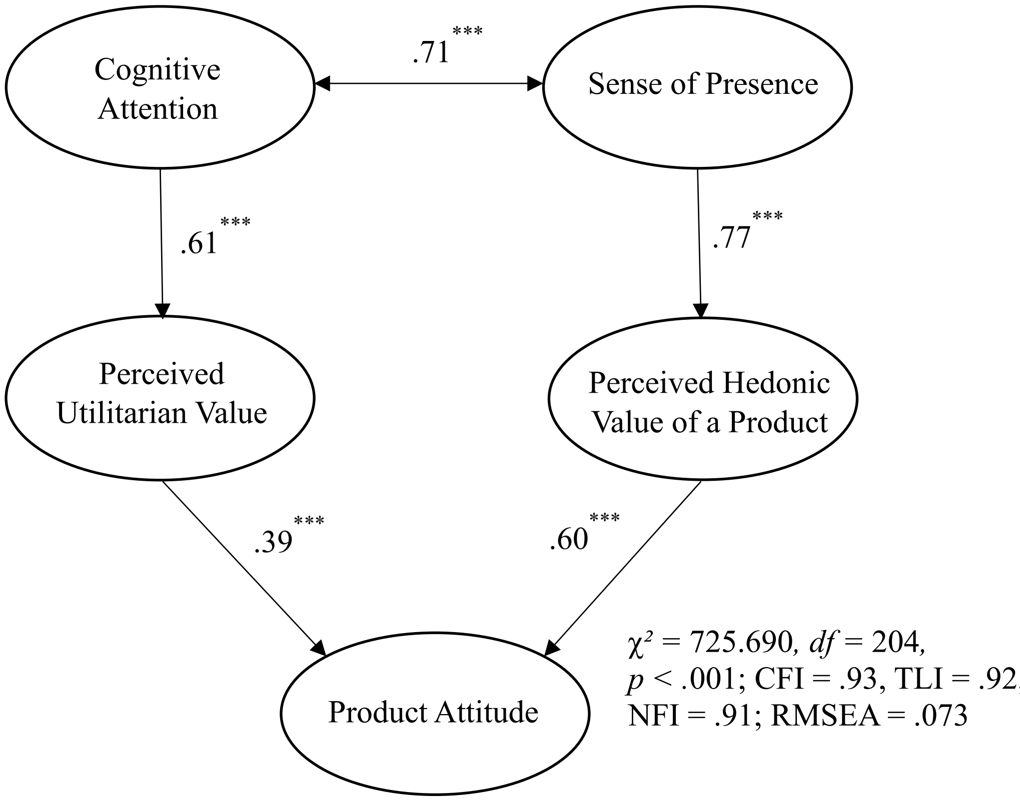


Note. The measurement model portion of the SEM model is omitted from this figure. $^{***}p < .001$

Second, the same hypotheses were tested with the flower vase database. The structural model fit was first assessed through chi-square statistics (χ^2 = 725.690, *df* = 204, *p* < .001), which indicated a good model fit with the ratio between chi-square and df being less than the suggested threshold of 5. Other fit indices indicated a good model fit (CFI = .93, TLI = .92, NFI = 91) with the values being greater than the suggested threshold of .90 (Hu & Bentler, 1999). Also, the RMSEA value was .073, indicating an acceptable model fit with the value being below the suggested threshold of .080 (Browne & Cudeck, 1992). In support of H1, the SEM results demonstrated that greater level of cognitive attention led to greater perceived utilitarian value of a product (Std. β = .61, *p* < .001). Also, greater level of sense of presence led to greater perceived hedonic value of a product (Std. β = .77, *p* < .001), which supported H2. In support of H3a and 3b, perceived utilitarian value of a product positively influenced product attitude (Std. β = .39, *p* < .001); and perceived hedonic value of a product also positively influenced product attitude (Std. β = .60, *p* < .001). Figure 4.5 demonstrates the SEM model with the flower vase database with standardized regression coefficients and their significance of the test results.

Figure 4.5

SEM Results from the Flower Vase Data with Standardized Regression Coefficients



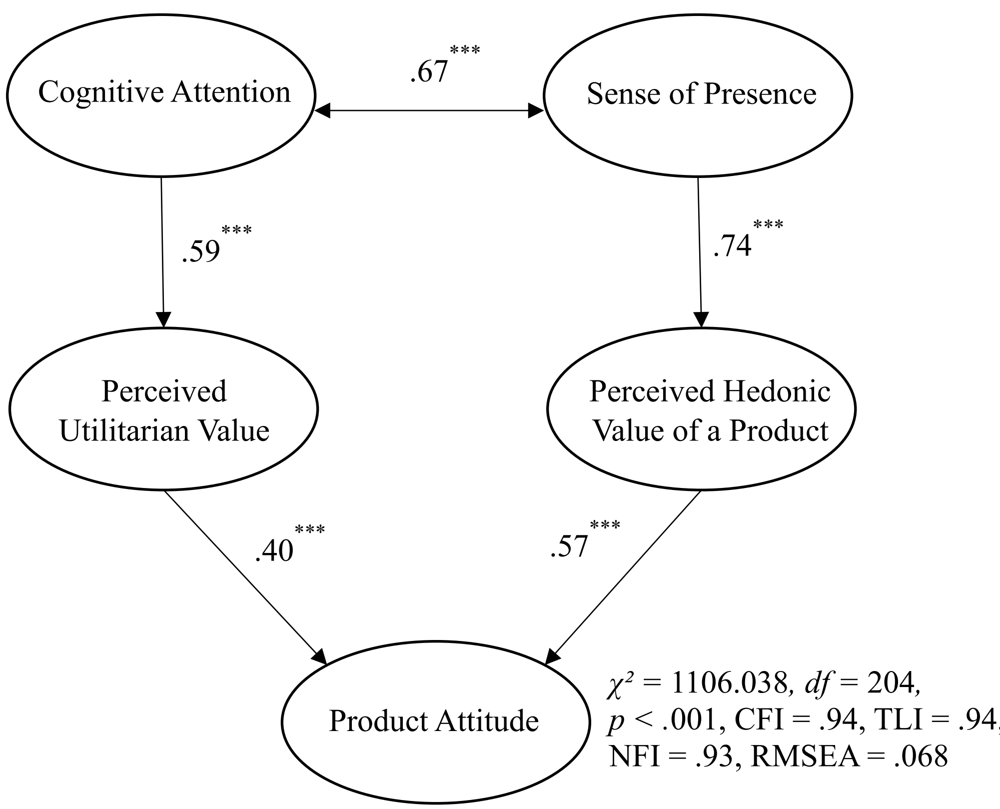
Note. The measurement model portion of the SEM model is omitted from this figure. $^{***}p < .001$

Additional SEM was conducted with a single dataset by pooling the watch and flower vase datasets. Because the SEM model had a good fit with both products, a single SEM analysis with pooled data from both products was performed to obtain a single set of coefficients that represent the model for both products together. The chi-square statistic from the pooled data was $\chi^2 = 1106.038$, $df = 204$, $p < .001$, which indicated that the model fit was not good considering that the ratio between chi-square and df was above the suggested threshold of 5. However, other incremental fit indices (CFI = .94, TLI = .94, NFI = .93) suggested a good model fit as all the values were above the suggested threshold of .90 (Hu & Bentler, 1999).

Also, the RMSEA value (.068) indicated an acceptable model fit with the value being below the suggested threshold of .080 (Browne & Cudeck, 1992). The SEM results indicated that a greater level of cognitive attention led to a higher perceived utilitarian value of the product (Std. β = .59, $p < .001$), supporting H1. Also, greater level of sense of presence led to higher perceived hedonic value of a product (Std. β = .74, $p < .001$), which supported H2. In support of H3a and 3b, significant positive influences of perceived utilitarian value a significant positive influence of perceived utilitarian value of a product (Std. β = .40, $p < .001$) and hedonic value (Std. β = .57, $p < .001$) of the product on product attitude were found. Figure 4.6 presents the SEM model from the pooled dataset.

Figure 4.6

SEM Model with a Combined Dataset



Note. The measurement model portion of the SEM model is omitted from this figure. $^{***}p < .001$

Three-Way Repeated-Measure Multivariate Analysis of Variance (MANOVA): H4 through H6

To test the effects of AR Modality (visual-only vs. visual plus auditory) and User-VP Interaction in the AR display (yes vs. no interaction) on the dependent variables, a three-way repeated-measure MANOVA was conducted with AR Modality and User-VP Interaction as the fixed factors, Product as a within-subjects factor, and cognitive attention, sense of presence, perceived utilitarian and hedonic values of the product, and product attitude as five dependent variables. The three-way repeated-measure MANOVA results indicated a non-significant main effect of AR Modality (Wilk's λ = .985, $F_{5, 472}$ = 1.404, p = .221, partial η^2 = .015), while the main effect of User-VP Interaction was significant (Wilk's λ = .974, $F_{5, 472}$ = 2.502, p < .05, partial η^2 = .026). Furthermore, there was a significant two-way interaction effect of AR Modality × User-VP Interaction (Wilk's λ = .974, $F_{5, 472}$ = 2.487, p < .05, partial η^2 = .026). In addition, the main effect of Product (Wilk's λ = .946, $F_{5, 472}$ = 3.687, p < .001, partial η^2 = .054) and the three-way AR Modality × User-VP Interaction × Product interaction effect (Wilk's λ = .972, $F_{5, 472}$ = 3.687, p < .05, partial η^2 = .028) were also significant. However, the two-way interaction effects of Product × AR Modality (Wilk's λ = .980, $F_{5, 472}$ = 1.905, p = .085, partial η^2 = .020) and Product × User-VP Interaction (Wilk's λ = .981, $F_{5, 472}$ = 1.868, p = .099, partial η^2 = .019) were not significant.

Given the significant MANOVA results related to some of the hypothesized effects, a series of follow-up three-way repeated-measure univariate analyses of variance (ANOVAs) were performed to examine the effects on each dependent variable separately. Table 4.23 presents the cell means, while Tables 4.24 and 4.25 present the ANOVA results from the between-subjects effects tests and the within-subject effects tests, respectively. Results and interpretations regarding each hypothesis are as follows.

Table 4.23

Cell Means

Dependent Variable	AR Modality	User-VP Interaction	Product		
			Watch	Flower Vase	Total
Cognitive Attention	Visual-only	Yes	3.783	3.707	7.49
		No	3.706	3.732	7.438
		Total	7.489	7.439	14.928
	Visual + Auditory	Yes	3.865	3.788	7.653
		No	3.751	3.669	7.42
		Total	7.616	7.457	15.073
	Total	Yes	7.648	7.495	15.143
		No	7.457	7.401	14.858
		Total	15.015	14.896	29.911
Sense of Presence	Visual-only	Yes	3.621	3.388	7.009
		No	3.313	3.400	6.713
		Total	6.934	6.788	13.722
	Visual + Auditory	Yes	3.371	3.429	6.8
		No	3.254	3.346	6.6
		Total	6.625	6.775	13.4
	Total	Yes	6.992	6.817	13.809
		No	6.567	6.746	13.313
		Total	13.559	13.563	27.122
Perceived Utilitarian Value of a Product	Visual-only	Yes	3.940	3.718	7.658
		No	3.838	3.888	7.726
		Total	7.778	7.606	15.384
	Visual + Auditory	Yes	3.785	3.762	7.547
		No	3.928	3.840	7.768
		Total	7.713	7.102	14.815
	Total	Yes	7.725	7.480	15.205
		No	7.766	7.728	15.494
		Total	15.491	15.208	30.699
Perceived Hedonic Value of a Product	Visual-only	Yes	3.623	3.617	7.24
		No	3.625	3.806	7.431
		Total	7.248	7.423	14.671
	Visual + Auditory	Yes	3.552	3.544	7.096
		No	3.492	3.615	7.107
		Total	7.044	7.159	14.203
	Total	Yes	7.175	7.161	14.336

		No	7.117	7.421	14.538
		Total	14.292	14.582	28.874
Product Attitude	Visual-only	Yes	4.173	4.115	8.288
		No	4.085	4.172	8.257
		Total	8.258	8.287	16.545
	Visual + Auditory	Yes	3.978	3.918	7.896
		No	4.185	4.152	8.337
		Total	8.163	8.070	16.233
	Total	Yes	8.151	8.033	16.184
		No	8.720	8.324	17.044
		Total	16.871	16.357	33.228

AR Modality Effects on the Rational System (H4). With regard to H4, which predicted the effect of AR Modality on the rational system of product information processing and product evaluation, the main effects of AR Modality on three dependent variables representing the rational system (cognitive attention, perceived utilitarian value, and product attitude) were reviewed from the between-subjects effects results (see Table 4.24). The results revealed non-significant AR Modality main effects for all of these three dependent variables; therefore, H4a, H4b, and H4c were all rejected. These results suggest that the participants' level of cognitive attention, perceived utilitarian value of a product and product attitude did not significantly differ depending upon whether the AR mobile shopping app used the visual-only modality or the visual plus auditory modality. This means that the additional auditory modality of presenting product information (i.e., a virtual agent verbally explaining product information) did not alter participants' rational system of information processing. Furthermore, the AR Modality × Product interaction effects from the within-subjects factor tests (see Table 4.25 and Figure 4.7) were also found non-significant for all of the three dependent variables representing the rational system of information processing. That is, the effect of the additional auditory modality on the rational system of product information processing was lacking consistently for both products, providing additional evidence for rejecting H4.

Table 4.24

Three-Way ANOVA Results: Between-Subject Effects

Effect	Dependent Variable	*SS*	*df1*	*df2*	*F*	*p*	partial η^2
AR Modality	Cognitive Attention	.319	1	476	.314	.575	.001
	Sense of Presence	1.544	1	476	.759	.384	.002
	Perceived Utilitarian Value of a Product	.074	1	476	.075	.784	.000
	Perceived Hedonic Value of a Product	3.296	1	476	2.266	.133	.005
	Product Attitude	1.457	1	476	1.051	.306	.002
User-VP Interaction	Cognitive Attention	1.216	1	476	1.199	.274	.003
	Sense of Presence	3.688	1	476	1.814	.179	.004
	Perceived Utilitarian Value of a Product	1.261	1	476	1.290	.257	.003
	Perceived Hedonic Value of a Product	.613	1	476	.421	.517	.001
	Product Attitude	2.501	1	476	1.804	.180	.004
AR Modality × User-VP Interaction	Cognitive Attention	.482	1	476	.475	.491	.001
	Sense of Presence	.138	1	476	.068	.795	.000
	Perceived Utilitarian Value of a Product	.353	1	476	.361	.548	.001
	Perceived Hedonic Value of a Product	.493	1	476	.339	.561	.001
	Product Attitude	3.337	1	476	2.407	.121	.005

Table 4.25

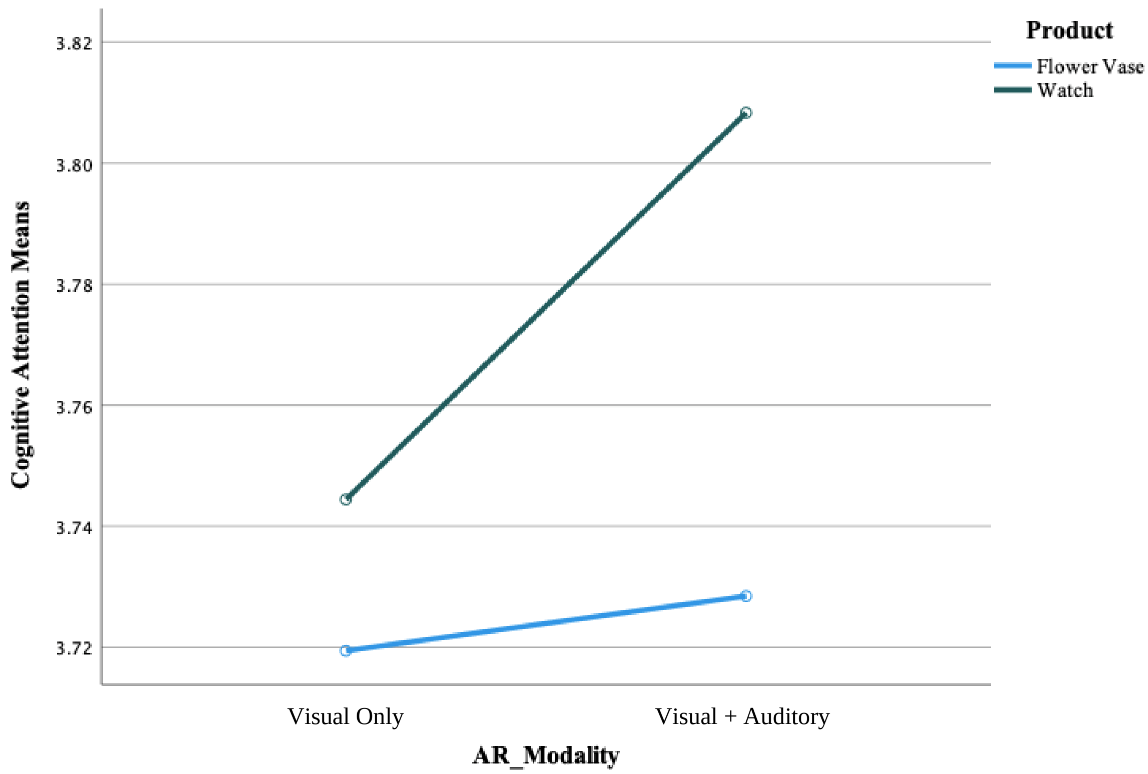
Three-Way ANOVA Results: Within-Subjects Effects

Effect	Dependent Variable	*SS*	*df1*	*df2*	*F*	*p*	partial η^2
Product	Cognitive Attention	.660	1	476	5.084	.025	.011

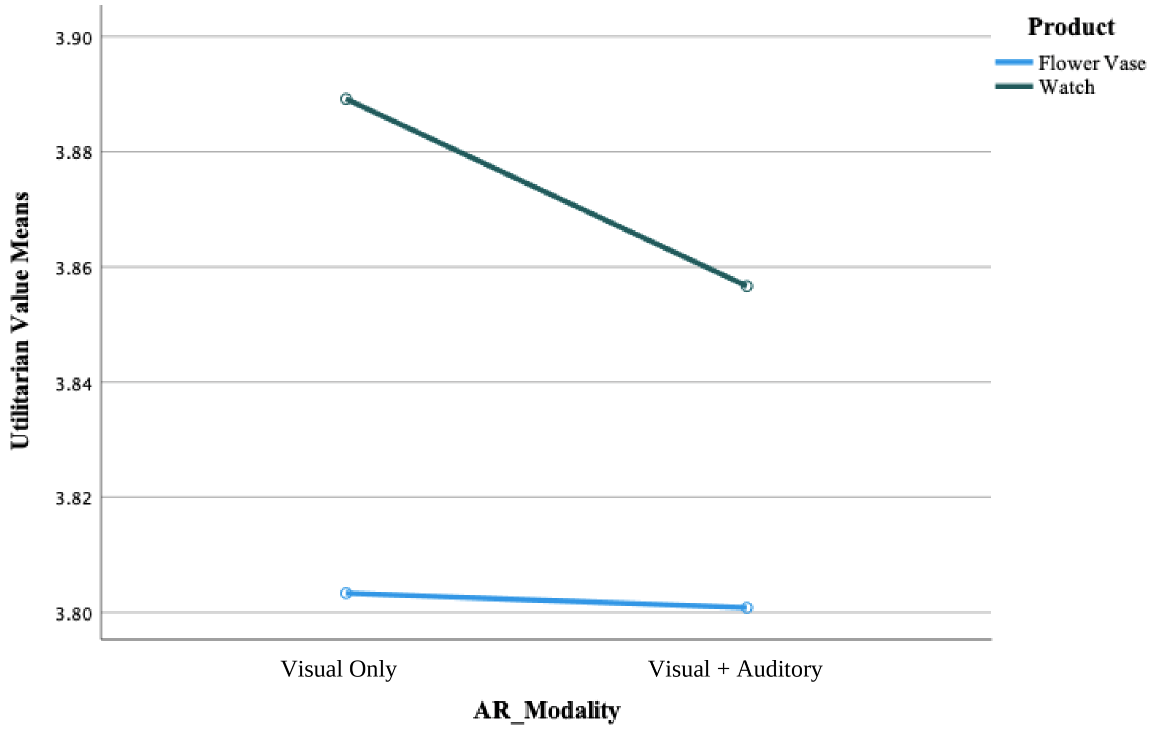
	Sense of Presence	.000	1	476	.001	.977	.000
	Perceived Utilitarian Value of a Product	1.204	1	476	5.333	.021	.011
	Perceived Hedonic Value of a Product	1.258	1	476	3.523	.061	.007
	Product Attitude	.063	1	476	.166	.684	.000
Product × AR Modality	Cognitive Attention	.181	1	476	1.392	.239	.003
	Sense of Presence	1.313	1	476	4.046	.045	.008
	Perceived Utilitarian Value of a Product	.054	1	476	.239	.625	.001
	Perceived Hedonic Value of a Product	.055	1	476	.153	.696	.000
	Product Attitude	.222	1	476	.583	.446	.001
Product × User-VP Interaction	Cognitive Attention	.146	1	476	1.124	.290	.002
	Sense of Presence	1.882	1	476	5.799	.016	.012
	Perceived Utilitarian Value of a Product	.641	1	476	2.837	.093	.006
	Perceived Hedonic Value of a Product	1.524	1	476	4.268	.039	.009
	Product Attitude	.442	1	476	1.160	.282	.002
Product × AR Modality × User-VP Interaction	Cognitive Attention	.172	1	476	1.322	.251	.003
	Sense of Presence	1.240	1	476	3.821	.051	.008
	Perceived Utilitarian Value of a Product	1.700	1	476	7.530	.006	.016
	Perceived Hedonic Value of a Product	.047	1	476	.133	.716	.000
	Product Attitude	.210	1	476	.551	.458	.001

Figure 4.7

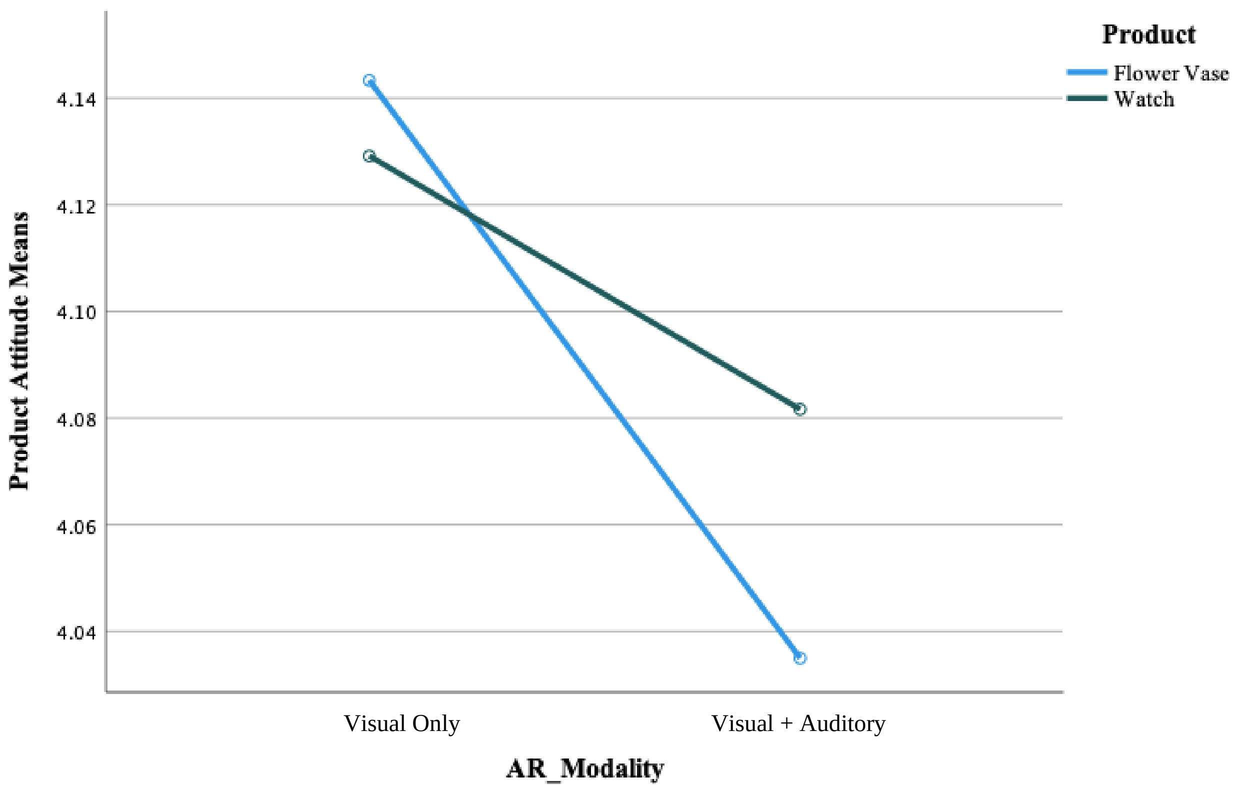
Graphs for the Interaction Effects of AR Modality × Product on Cognitive Attention, Perceived Utilitarian Value, and Product Attitude



(a) Interaction Effect of AR Modality × Product on Cognitive Attention



(b) Interaction Effect of AR Modality × Product on Perceived Utilitarian Value of a Product

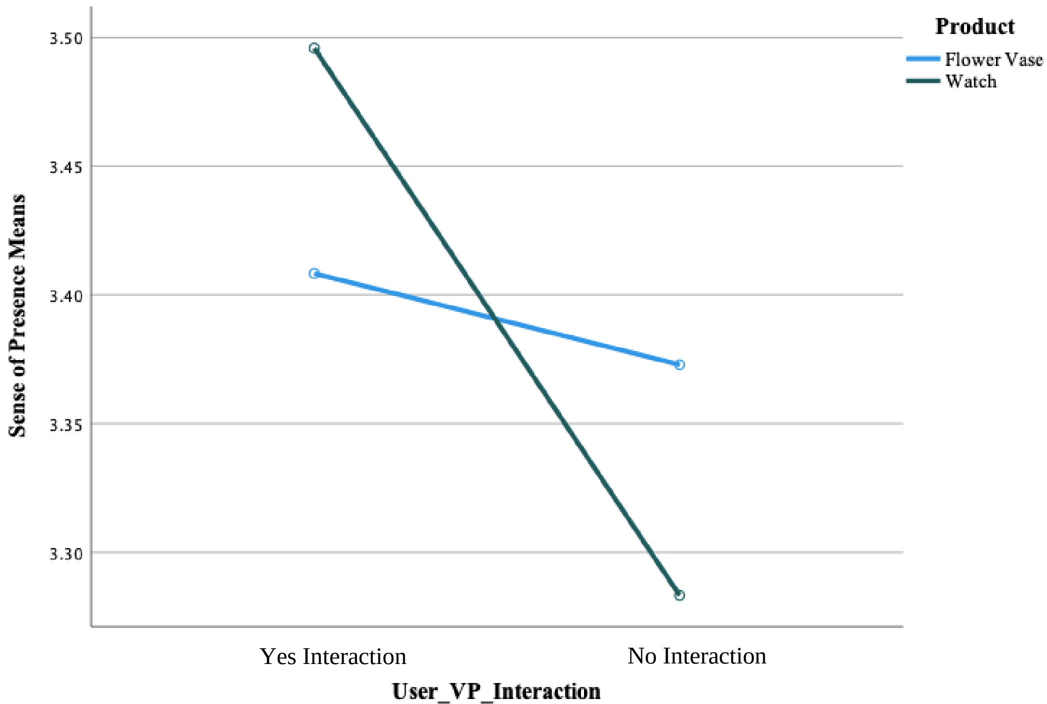


(c) Interaction Effect of AR Modality × Product on Product Attitude

User-VP Interaction Effects on Experiential System (H5). Regarding H5, which proposed the effects of User-VP Interaction on the experiential system of product information processing and product evaluation, the results of the between-subjects effects tests (see Table 4.24) demonstrated that User-VP Interaction did not have significant effects on the three dependent variables representing the experiential system of information processing including sense of presence, perceived hedonic value of a product, and product attitude; therefore, H5a, H5b, and H5c were all not supported. A further examination of H5 for each product through results regarding the two-way User-VP Interaction × Product interaction effects (see Table 4.25) revealed a significant interaction effect for sense of presence (see Figure 4.8). The graphical examination of the sense of presence cell means (see Figure 4.8 and Table 4.23) reveals a potential moderating effect of Product for the effect of User-VP Interaction hypothesized in H5a. Specifically, a significant difference in sense of presence was observed between the yes and no interaction conditions for watch (Mean Difference = .213, S.E. = .103, $p < .05$) in that participants had a greater sense of presence when the AR display integrated the image of the user interacting with the virtual product ($M = 3.496$) as compared to when the image of the user was not captured in the AR display ($M = 3.283$). However, no significant difference in sense of presence was observed between the yes ($M = 3.408$) and no ($M = 3.373$) interaction conditions for flower vase (Mean Difference = .035, S.E. = .096, $p = .711$). These results suggest that the effect of User-VP Interaction on sense of presence predicted in H5a was supported for watch but not for flower vase.

Figure 4.8

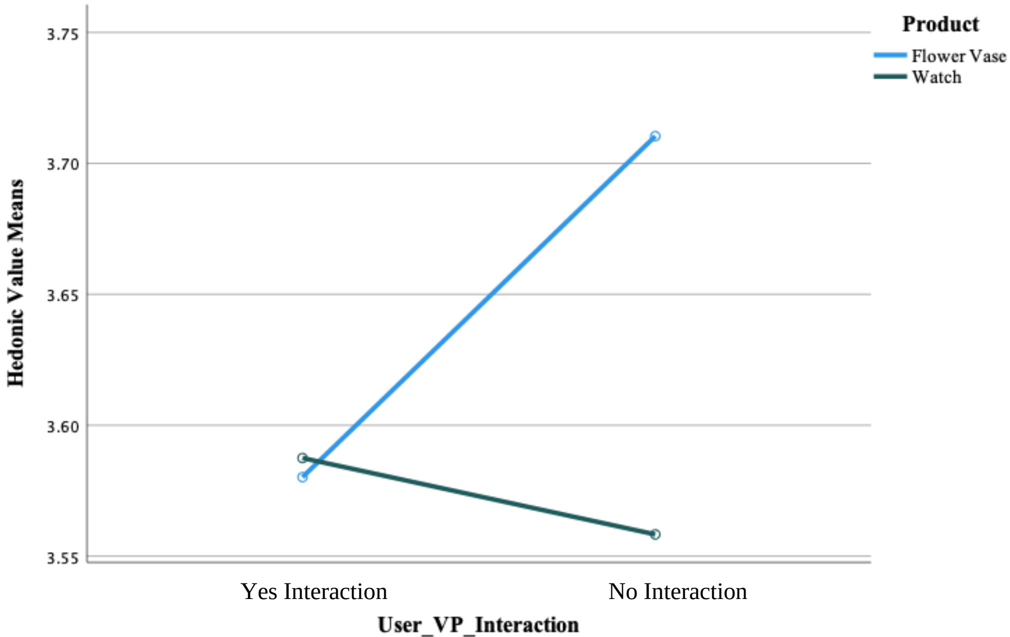
Graph for the User-VP Interaction × Product Two-Way Interaction Effect on Sense of Presence



On the other hand, the results of the univariate ANOVA also showed a significant User-VP Interaction × Product interaction effect for perceived hedonic value of a product, relevant to H5b (see Table 4.25 and Figure 4.9). However, results from simple effect analyses showed a non-significant difference in perceived hedonic value between the yes and no user-VP interaction conditions for both the flower vase (Mean Difference = .130, S.E. = .082, p = .749) and watch (Mean Difference = .021, S.E. = .073, p = .775). Therefore, although the graphical examination of this interaction effect (see Figure 4.9) suggests a potential moderating role of product for the direction of the User-VP Interaction effect (i.e., including user-VP interaction in AR display may help increase the perceived hedonic value of a watch but hurts the perceived hedonic value of a flower vase), this moderating effect was not large enough to be significantly captured through the simple effect tests.

Figure 4.9

Graph for the User-VP Interaction × Product Two-Way Interaction Effect on Perceived Hedonic Value of a Product



Moderation of User-VP Interaction for AR Modality Effect (H6). With regard to H6, which predicted the moderating effect of User-VP Interaction for the effect of AR Modality on product attitude, first, the two-way interaction effect of AR Modality × User-VP Interaction on product attitude was reviewed; the results revealed a non-significant interaction effect (see Table 4.24), rejecting H6. Further, the effect of the three-way interaction of AR Modality × User-VP Interaction × Product also was found non-significant (see Table 4.25), which demonstrates that H6 was not supported consistently for both products.

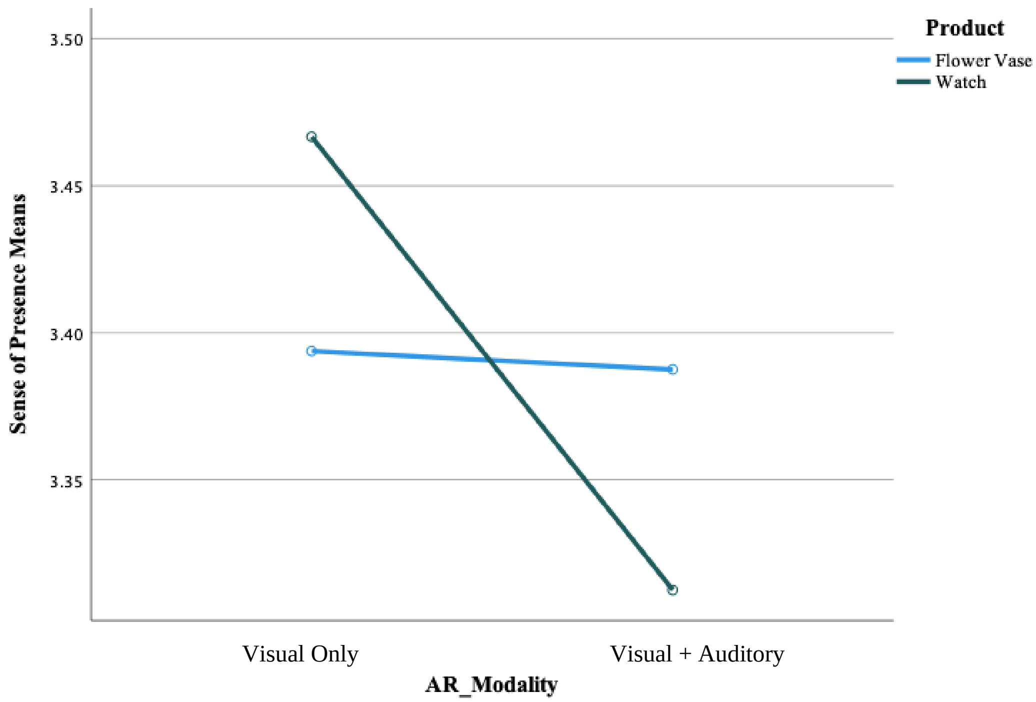
Additional Results. In addition to the results discussed above related to H4 through H6, additional non-hypothesized results which demonstrated the main effects of Product and potential moderating roles of Product for the effects of the AR characteristics factors experimentally manipulated in this study were observed from these ANOVA tests (see Table

4.25). First, the main effect of Product was significant for cognitive attention and perceived utilitarian value of a product, both of which are dependent variables representing the rational system of product information processing. Specifically, participants paid greater cognitive attention to watch (M = 3.776) than to flower vase (M = 3.724), and their perceived utilitarian value was higher for watch (M = 3.873) than for flower vase (M = 3.802). These results suggest that participants might consider that the functional aspect of watch is more critical in their purchase decision-making as compared to flower vase, which may contain less functions as compared to watch.

Second, the AR Modality × Product interaction effect was significant for sense of presence (see Table 4.25). As shown in Figure 4.10, the mean difference between the visual-only and visual-plus-auditory conditions was larger for watch than for flower vase, suggesting that including the additional auditory modality might be more helpful in boosting the sense of presence for watch than for flower vase. However, results from additional simple effect analyses showed that the mean difference in sense of presence between the two AR Modality conditions was non-significant for both watch (Mean Difference = .154, S.E. = .103, p = .134) and flower vase (Mean Difference = .006, S.E. = .096, p = .948); warranting caution in concluding the meaning of this significant but un-hypothesized interaction effect.

Figure 4.10

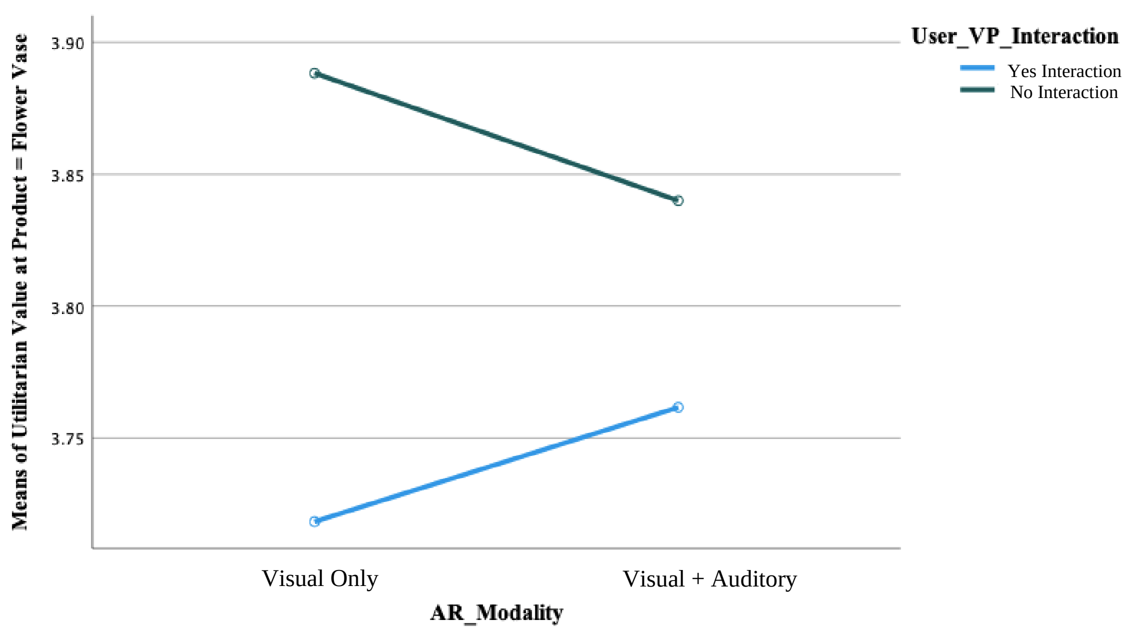
Graph for the Product × AR Modality Interaction Effect on Sense of Presence



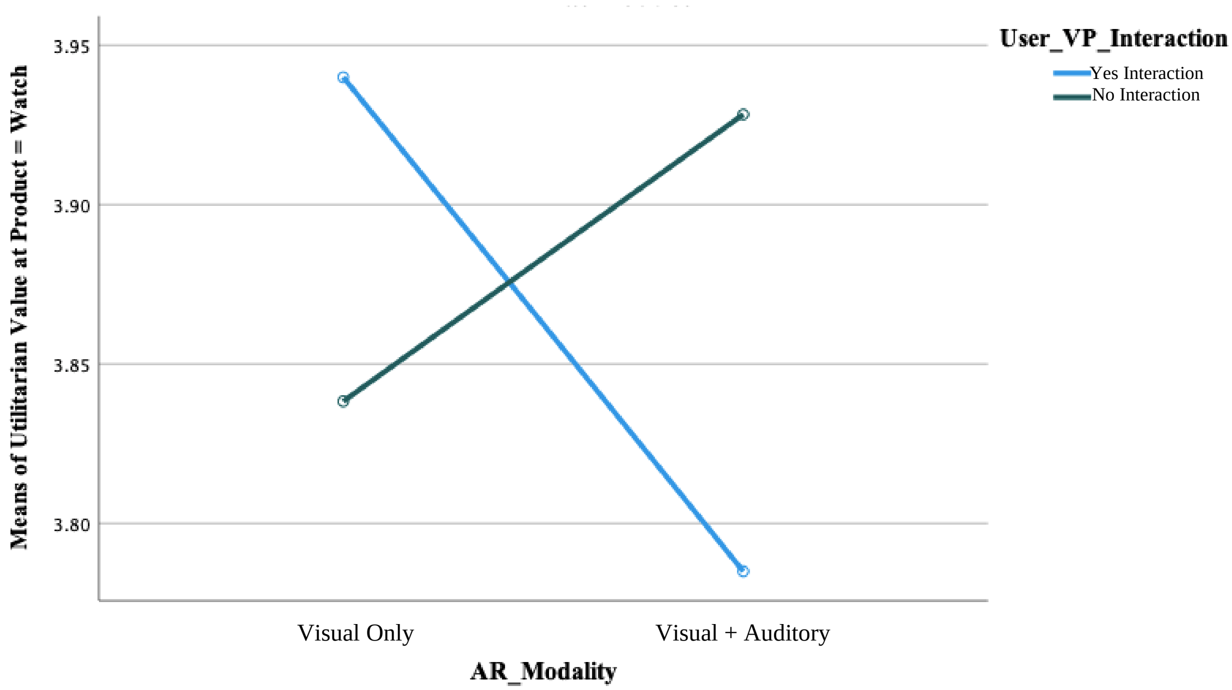
Finally, the results of univariate ANOVA tests (see Table 4.25) further revealed that the three-way interaction effect of AR Modality × User-VP Interaction × Product was significant for perceived utilitarian value of a product. The graphs of this three-way interaction effect (see Figure 4.11) show that for flower vase (see graph (a) in Figure 4.11), when user-VP interaction was displayed, participants' perceived utilitarian value appears to have increased with the addition of the auditory modality; whereas when no user-VP interaction was displayed, their utilitarian value perception appears to have decreased with the addition of the auditory modality. However, further simple effect tests revealed that these increase and decrease in perceived utilitarian value mean scores were not statistically significant in both the yes (Mean Difference = .043, S.E. = .097, p = .656) and no (Mean Difference = .048, S.E. = .097, p = .619) user-VP interaction conditions for flower vase. Similarly, although the graphical examination for the watch data (see graph (b) in Figure 4.11) suggest a possibility that participants' utilitarian value perception decreased (increased) when the AR display integrated the additional auditory modality in the yes user-VP interaction condition (in the no interaction condition); however, these decrease and increase in perceived utilitarian values were not found statistically significant through simple effect analyses in both the yes-interaction condition (Mean Difference = .155, S.E. = .103, p = .133) and the no-interaction condition (Mean Difference = .090, S.E. = .103, p = .383). Therefore, the meaning of this un-hypothesized significant three-way interaction effect is inconclusive.

Figure 4.11

Graphs for the Three-Way AR Modality × User-VP Interaction × Product Interaction Effect on Perceived Utilitarian Value



(a) AR Modality × User-VP Interaction for Flower Vase



(b) AR Modality × User-VP Interaction for Watch

Four-Way Repeated-Measure ANOVA: H7 and H8

To test each of the two hypotheses that predict the moderating effects of NFC and FII (H7 and H8, respectively), four-way repeated-measure ANOVAs were employed. First, the NFC and FII composite scores were computed by averaging the scores of the measurement items used for the respective variable. Then, based on these NFC and FII composite scores, participants were re-categorized into high versus low NFC or FII groups by using a median split method. The NFC and FII medians were 2.70 and 3.86, respectively. Therefore, participants who had a 2.70 or higher NFC composite score was categorized into the high NFC group (M = 3.52), while those who had a lower than 2.70 NFC score was included in the low NFC group (M = 2.03). Similarly, those who had a 3.86 or higher FII composite score was included in the high FII group (M = 4.32), while those who had lower than 3.86 FII score was included in the low FII group (M = 3.24). Then, two ANOVAs were run with each of the NFC and FII grouping variables as an additional fixed factor while retaining the three fixed and within-subjects factors used in the earlier MANOVA/ANOVA analyses. For the ANOVA for testing H7, the dependent variable was cognitive attention; while it was sense of presence for the ANOVA for H8.

Moderating Effects of NFC. Results of the four-way ANOVA for testing H7 revealed that the interaction of AR Modality × NFC did not have a significant effect on cognitive attention (see Tables 4.26), rejecting H7. Further, the Product × AR Modality × NFC three-way interaction was also non-significant (see Table 4.27), which suggests that the lack of the moderating effect of NFC was consistent for both products. In addition, the main effect of NFC was also found non-significant. Taken all of these results together, the effects of the AR design manipulations in this study were not impacted by participants' NFC levels.

Moderating Effects of FII. Similarly, results from the four-way ANOVA for testing H8 also revealed a non-significant two-way interaction effect of User-VP interaction × FII (see Table 4.28) and a non-significant three-way interaction effect of Product × User-VP interaction × FII (see Table 4.29) on sense of presence, rejecting H8 consistently for both products. On the other hand, the main effect of FII on sense of presence was significant. More specifically, high-FII participants felt a significantly higher sense of presence (M = 3.65) than did low-FII participants (M = 3.03). This result suggests a possibility that consumers' innate FII trait drives the level of sense of presence they feel while using AR irrespective of the kinds of AR design manipulations implemented in this study.

Table 4.26

Four-Way ANOVA Results for H7

Effect	***SS***	***df1***	***df2***	***F***	***p***	**partial η^2**
AR Modality	.389	1	472	.383	.536	.001
User-VP Interaction	.958	1	472	.942	.332	.002
NFC	1.135	1	472	1.117	.291	.002
Product	.570	1	472	4.416	.036	.009
AR Modality × User-VP Interaction	.621	1	472	.611	.435	.001
AR Modality × NFC	1.061	1	472	1.044	.307	.002
User-VP Interaction × NFC	.706	1	472	.695	.405	.001
Product × AR Modality	.183	1	472	1.416	.235	.003
Product × User-VP Interaction	.117	1	472	.909	.341	.002
Product × NFC	.625	1	472	4.837	.028	.010
AR Modality × User-VP Interaction × NFC	.189	1	472	.186	.666	.000
Product × AR Modality × User-VP Interaction	.144	1	472	1.118	.291	.002
Product × AR Modality × NFC	.009	1	472	.069	.793	.000
Product × User-VP Interaction × NFC	.163	1	472	1.264	.262	.003
Product × AR Modality × User-VP Interaction × NFC	.035	1	472	.274	.601	.001

Table 4.27

Four-Way ANOVA Results for H8

Effect	***SS***	***df1***	***df2***	***F***	***p***	**partial η^2**
AR Modality	.841	1	472	.452	.501	.001
User-VP Interaction	5.958	1	472	3.206	.074	.007
FII	89.130	1	472	47.969	< .001	.092
AR Modality × User-VP Interaction	.073	1	472	.039	.843	.000
AR Modality × FII	.559	1	472	.301	.584	.001
User-VP Interaction × FII	.875	1	472	.471	.493	.001
AR Modality × User-VP Interaction × FII	.263	1	472	.141	.707	.000
Product	.040	1	472	.123	.726	.000
Product × AR Modality	1.201	1	472	3.703	.055	.008
Product × User-VP Interaction	2.043	1	472	6.299	.012	.013
Product × FII	1.230	1	472	3.791	.052	.008
Product × AR Modality × User-VP Interaction	1.235	1	472	3.808	.052	.008
Product × AR Modality × FII	.023	1	472	.070	.792	.000
Product × User-VP Interaction × FII	.023	1	472	.070	.791	.000
Product × AR Modality × User-VP Interaction × FII	.051	1	472	.157	.692	.000

CHAPTER V. DISCUSSION AND CONCLUSIONS

In this chapter, the findings of this research are discussed in light of the theoretical framework and existing literature, followed by a discussion of the theoretical and managerial implications of the findings. Lastly, the limitation of this research, as well as recommendations for future research are explained in this chapter.

Discussion of Findings

Rational System: Cognitive Attention and Perceived Utilitarian Value of a Product

As proposed, findings of this study demonstrate that consumers who pay greater cognitive attention while shopping on the AR mobile shopping app have a higher perceived utilitarian value of products. This finding supports CLT, which postulates that cognitive learning is more effective when people pay greater cognitive attention. The current finding further supports CEST, which posits two distinguished information processing systems, including rational system and experiential system (Kolb & Kolb, 2009). Specifically, CEST suggests that the rational system operates in a logical way, which can be supported by the current finding that demonstrates the importance of consumers' use of rational system for their product information processing to perceive utilitarian value of a product. Although consumers may have difficulties in learning new product information due to the fact that it requires more mental energy to process the information (Sweller et al., 2011), this research suggests that consumers would be able to perceive functional values of the products if they pay greater attention to the product information. These findings are in line with previous findings (e.g., Behe et al., 2015; Biocca et al., 2006) where consumers learned and processed functional aspects of products better when they cognitively paid attention to the provided product information on the AR mobile shopping app. Therefore, it could be critical for consumers to be able to focus on the provided information and ignore others such as their surrounded environment when learning and absorbing the product information when shopping for products on the AR mobile shopping app. This finding demonstrates the importance of designing an AR mobile shopping app to provide an app environment where consumers can pay cognitive attention to product information to help them process product function information more effectively.

Experiential System: Sense of Presence and Perceived Hedonic Value of a Product

Consumers perceive a higher hedonic value when they experience a greater sense of presence while using the AR mobile shopping app. That is, consumers are able to imagine themselves enjoying using either a watch or a flower vase when they feel as if they are physically interacting with those products. Although consumers may not directly experience and try the products on a mobile shopping app as if they were in a physical store, this research suggests that the immersive shopping experience with the AR mobile shopping app could provide consumers a feeling of physically interacting with those products. Following ELT, which emphasizes the importance of ‘experience’ for an individual’s learning, this research demonstrates the role of the experiencing or realistically sensing the (virtual) product in boosting consumers’ enjoyment of the hedonic aspects of the product. The current finding supports CEST, which proposes the experiential system as one of the two information processing systems that people utilize (Kolb & Kolb, 2009). More specifically, the current finding confirms the importance of consumers’ use of the experiential information processing system when shopping for products to be able to better perceive hedonic value of those products. This finding supports previous findings that individuals enjoyed their product shopping experiences more when they were involved in the actual shopping experience, such as the interaction with products (e.g., Huang & Liao, 2015; Huang et al., 2016). As the AR mobile shopping app provides a shopping experience that is closer to the reality (Suh & Lee, 2005) and creates shopping environment where consumers could feel as if the products are in front of them, shopping with the AR mobile shopping app not only enriches consumers' interaction with products, but it also enhances consumers' desires to use the products.

Perceived Values and Product Attitude

In terms of the influence of perceived values (i.e., utilitarian value and hedonic value of a product) on product attitude, consumers have more favorable reactions toward a watch and a flower vase when they perceive higher utilitarian and hedonic values of those products. According to the theory of reasoned action, consumers form their product attitude based on how they perceive values in those products (Ajzen & Fishbein, 1986). Findings of this study support the prediction by this theory by demonstrating that consumers have more favorable attitudes toward a watch and a flower vase as they perceive higher utilitarian and hedonic values of these products. These findings present the importance of consumers' product value perceptions in their product evaluation and formation of a product attitude. In line with previous findings (Chi & Kilduff, 2011; Kim & Forsythe, 2007; Yim et al., 2017), the current research findings suggest that consumers had more positive attitude toward a watch and a flower vase when they found those products to be good quality and to be the products that would make them feel good when they use the products. As consumers could learn the product information more effectively as well as could imagine themselves enjoying using the products, consumers could easily form their positive attitudes toward the products (Park & Yoo, 2020). Therefore, the findings of this research suggest that it is critical for consumers to perceive higher utilitarian and hedonic values of the product itself to be able to form more favorable attitude toward products.

AR Modality Effects on the Rational System

Findings of this study fail to support the direct effect of AR modality proposed for the dependent variables representing the rational system of information processing of the CEST (i.e., cognitive attention, perceived utilitarian value of a product, and product attitude). That is, for both products used in this study, the auditory modality added to the AR mobile app with a visual modality does not make significant changes in consumers' level of cognitive attention, perceived utilitarian value of a product, and product attitude. These results may be because consumers may not experience differences in their rational information processing between the visual-only AR modality (e.g., product information is presented via visualized images and text only) and the visual-plus-auditory modality (e.g., product information is presented via visualized images and text as well as via the virtual agent's voice) when shopping on the AR mobile shopping app because the visual aspect of the AR mobile shopping app by nature dominates the user's attention, leaving minimal cognitive resources to be spared with other sensory information. In other words, the visualized information through AR already provides consumers with an effective and enriched shopping environment. Furthermore, the current research incorporated factual information of the product only in both a text description as well as the verbal description. However, focusing on the same factual product information via a virtual agent's voice that is already available on the mobile app screen might not be able to consumers' effective shopping experience, but it instead merely adds an additional format of delivering the information. Also, the virtual agent's voice was mechanical rather than a human-like voice with emotions in the simulation videos that were used in this research. This might have also impacted the results because consumers may expect to hear more human-like product information explanation when it comes to their product shopping using the mobile app.

User-VP Interaction Effects on the Experiential System

This study demonstrates potentially differential effects of user-VP interaction on the dependent variables representing the experiential system of information processing (i.e., sense of presence, perceived hedonic value of a product) depending on the product type. That is, the existence or nonexistence of the user-VP interaction feature may make significant differences in consumers' experiential learning of the product for some products but not for other products. Specifically, this study incorporates two products, watch and flower vase, and there two products have different characteristics, particularly in the level of physical interactions between the user and the product in a typical usage situation. A wristwatch is a product that is physically worn by the user and thus constant physical interactions exist between the user and the product during its use; whereas a flower vase is a product that is detached from the user's body for most of the time it is in use. This difference may have created the differential effect of the user-VP interaction factor between the two products in that consumers are more able to experience as if they are physically interacting with a watch when they see the user trying on the virtual watch in the AR display than when they do not see the user and only see the virtual watch in the AR display; however, such benefits of user-VP interaction in boosting users' sense of presence do not exist for a flower vase which is not directly physically attached to the user and thus experiencing 3-D animation of the virtual flower vase in the AR display may be sufficient for the user to imagine themselves being with the product. Also, consumers may experience stronger needs to virtually try on products that are more attached to themselves and visible in public (e.g., watches, clothes, shoes) as compared to the products that are not directly attached to themselves and privately consumed products (e.g., flower vases, furniture, home appliances). For products that are not directly attached to themselves and not visible in public, consumers may be satisfied with the non-user-VP interaction feature because the direct interaction with those products (i.e., wearing or using) may be less critical for their purchase decision-making as compared to those products that they directly wear.

Moderation of User-VP Interaction for AR Modality Effect on Product Attitude

Findings of the current research fails to demonstrate a moderating effect of User-VP Interaction for the effect of AR Modality on product attitude. That is, AR modality (i.e., visual-only and visual plus auditory) does not affect product attitude differently depending on whether user-VP interactions are employed in the AR mobile shopping app. According to the split attention effect, integrating additional sources is not always beneficial for an individual's learning process because this may overwhelm their capacity of processing the information (Sweller et al., 2011) However, this study does not support the split attention effect as the moderating effect of User-VP Interaction for the effect of AR Modality on product attitude is not significant. In the case of having the user-VP interaction as the additional source on the mobile app, consumers might not consider this as a separate source because the image of the user can be considered as a part of the visual modality. That is, incorporating the dual-sensory modality as well as the user-VP interaction might not be three different sources, but they are two different sources when it comes to consumers' information processing. Therefore, consumers might not need to further split their attention to process the information.

Moderating Roles of NFC and FII

The results of this research fail to demonstrate the moderating roles of the personal variables, NFC and FII, in altering the effectiveness of the two AR design factors (AR Modality and User-VP Interaction) examined in this study. That is, the difference in consumers' level of cognitive attention between the visual-only and visual-plus-auditory modality conditions does not differ depending on the consumers' tendency to enjoy thinking while processing information (i.e., NFC). Similarly, the difference in consumers' feelings of being with a product between the yes and no user-VP interaction conditions did not differ depending on the consumers' tendency to focus on their emotions and experiences when processing information (i.e., FII). Existing literature suggests that low-NFC users would be less willing to process information that requires excessive cognitive resources as compared to the high-NFC users. The non-significant NFC moderation effect might be due to the simplistic nature of the verbal information used in the stimuli, which might have not created sufficient cognitive load to show differences between high- and low-NFC individuals. This conjecture is further supported by the non-significant main effect of NFC on cognitive attention. On the other hand, although literature suggests that high-FII consumers would focus on their experiences when processing information (Epstein, 1991), based on which the user-VP interaction effect was proposed to be more profound for high-FII consumers than for low-FII consumers, findings of this study does not support this prediction. However, the main effect of FII on sense of presence was significant. This finding demonstrates that consumers who rely on their intuitive feelings experience a feeling of being with the product more when it comes to shopping with the AR mobile shopping app. That is, consumers may value their actual experience with the product more if they consider their 'experience' and 'emotion' as critical when processing information. As consumers' sense of presence is an experiential aspect of their information processing, this study supports Epstein et al (1996) by confirming that high-FII consumers rely highly on their intuitive feelings as compared to low-FII consumers. According to Sweller et al. (2011), an individual's effective learning process can differ depending on the working memory capacity of the learner. Therefore, consumers' levels of cognitive attention and sense of presence may differ depending on their own learning capacity rather than their preferences of how to process the provided information.

Implications

Theoretical Implications

Among different types of retail technologies, AR being as a significant part of the retail industry demonstrates the importance of studying how AR can be effectively applied to the retail industry. Findings of this study have several significant theoretical contributions advancing literature.

First, this study expands the applicability of the cognitive-experiential self-theory (CEST) to the context of AR. The AR-CEPEM model conceptualizes cognitive attention and sense of presence as the variables to represent the psychological mechanisms responsible for the rational and experiential systems of information processing, respectively, which are predicted to impact consumers' evaluations of the utilitarian and hedonic values of a product on an AR mobile shopping app. In doing so, the AR-CEPEM model expands the scope of knowledge on consumers' use of both information processing systems (i.e., the rational system and experiential system) to processing product information provided by the mobile shopping app, which has not been a focus of previous literature.

Second, this study provides implications for the AR literature by two key AR design factors (i.e., AR modality and user-VP interaction in AR display) as to how these AR design factors individually and interactively impact consumers' product evaluation both rationally and experientially. Consumers have different abilities to process information, and thus it is important to study whether consumers absorb and understand provided information differently depending upon how the information is delivered with different AR design features. Past research (e.g., Huang & Liao, 2015; Pantano et al., 2017) has narrowly focused on consumers' perceptions toward the technology (i.e., AR), leaving a large knowledge gap in how consumers' perceptions and attitudes toward a product can be shaped by using AR. The current study overcomes this limitation. Findings of this study suggest that the AR design factors impact consumers' product information processing and product evaluation differently depending on the product, which can be another critical insight of the AR use in the mobile shopping app.

Third, this study applies two learning theories, cognitive load theory (CLT) and experiential learning theory (ELT) to predict AR effects on consumer learning of product information. Specifically, CLT is applied to predict how AR modality (i.e., visual-only vs. visual plus auditory modality) impacts consumers' product perceptions and attitudes through varying their cognitive attention; whereas ELT is employed to provide an important perspective on how the use of user-VP interaction in AR display (i.e., user-VP interaction vs. non-user-VP interaction) alters consumers' product perceptions and attitudes through sense of presence. Therefore, findings of this study are expected to expand the applicability of both CLT and ELT to consumers' product learning in the AR environment, advancing the literature on learning in the virtual environment.

Lastly, the study has additional theoretical contributions in the existing consumer behavior research by specifically including personal characteristic moderators (i.e., need for cognition and faith in intuition) within the framework of the AR-CEPEM model. Considering that the AR mobile shopping app requires consumers to pay cognitive attention as well as provide a shopping environment where consumers can better interact with products, it was critical to examine whether each individual's general information processing styles play roles in their use of the AR mobile app for product shopping. Although this research did not find any significant effects of these personal characteristic moderators, this can also advance the existing literature that individual differences in processing information do not significantly change their experiences with the AR mobile app for product shopping.

Managerial Implications

Findings of this study also have several significant managerial contributions. First, marketers and retailers should consider creating the AR mobile shopping environment that can better engage their consumers and is closer to the reality for consumers to be able to perceive higher values of products. The findings of this study demonstrate that consumers can find higher utilitarian and hedonic values of a product when they can pay attention to the product information and sense as if they were physically using the product in the AR display. Furthermore, consumers form more positive attitude toward products when they perceive higher utilitarian and hedonic values of a product. As consumers' product attitude can be directly related to their final purchase decision-making, it could be extremely important for the retailers to direct consumers to form more favorable product attitudes. As the primary purpose of employing the AR technology in the mobile shopping app is to help consumers interact with the products more effectively and pleasurably, it would be critical for marketers and retailers to add features that can intrigue consumers' attention as well as create the shopping experience that is identical with the physical shopping experiences. By doing so, consumers would be able to find higher values of the products and further form their positive product attitude while shopping on the AR mobile shopping app.

Second, evaluating the effect of the two AR design factors of mobile shopping apps on consumers' product perceptions and attitudes offers critical knowledge for marketers and retailers. Past literature has mentioned that online consumers have limited experiences with a product prior to their purchases because they are not able to directly try the products (Katawetawaraks & Wang, 2011). However, previous research has largely ignored how marketers and retailers could provide their customers with enhanced mobile shopping experiences by applying different retail technologies, such as AR. This study empirically examined the role of two AR design factors (i.e., AR modality and user-VP interaction in AR display) in impacting consumers' decision-making by aiding their product evaluations and generated insights which may help practitioners evaluate the value of adopting AR technology for their m-commerce platforms. Although the main effects of AR modality and user-VP interaction on the dependent variables were not significant, the findings of this study suggest that consumers' product evaluation on an AR mobile shopping app may be impacted depending on what types of products they shop for. These findings suggest that a one-size-fits-all strategy will not be effective when retailers choose AR modality or display features; rather, retailers must determine how to design their AR technology to be beneficial for their businesses with the consideration of their products and how consumers interact with the products.

Specifically, if businesses carry products that are more physically attached to a person and are more publicly visible like watches, having their consumers virtually try on the products could help consumers' product information processing and product evaluation, which in turn might have their purchase decision-making. This study reveals that consumers can better sense as if they were physically interacting with the virtual watch (i.e., sense of presence) and attribute higher enjoyment of using the product (i.e., perceived hedonic value) when they saw the user try on the virtual watch in the simulation AR display video as compared when they saw only the virtual watch in the video. These findings may suggest that marketers and retailers should consider adding the user-VP interaction feature in their AR mobile shopping apps for products that are directly worn by consumers, such as watches, clothes, bags, shoes, and accessories. On the other hand, the result that the aforementioned positive effect of user-VP interaction in the simulation AR video did not exist when the virtual product was a flower vase, suggests a possibility that user-VP interaction is not a beneficial AR feature for products that are not attached to the user while in use. A watch is generally considered as a product that is more attached to oneself and more publicly visible to others, while a flower vase is a type of product that is usually detached from a person and more privately used at home; therefore, consumers may experience stronger needs to virtually try on a watch on their body prior to their purchases, whereas such needs do not exist for a flower vase. Therefore, marketers and retailers should carefully consider adding the user-VP interaction feature depending on what types of products they carry.

Limitations and Recommendations

Although this study was designed with utmost care, it is not without some limitations. First, this study used simulation videos to manipulate the independent variables by having participants imagine themselves shopping for a product with the AR mobile shopping app shown in the videos. This method of experimental manipulations might compromise the internal validity of the study. Due to the fact that there are limited existing AR-applied mobile shopping apps to create the same app structures across the experimental conditions and technical difficulties in creating brand-new AR apps, simulation videos were used for this study. However, we acknowledge that the best way to manipulate the AR modality and user-VP interaction would be to have participants actually use an AR mobile shopping app with the manipulated features, and thus findings must be interpreted with caution in that regard. It is recommended for future research to develop an actual AR mobile shopping app with different

AR features for participants to be able to physically interact with the AR mobile shopping app. Furthermore, by actually using the AR mobile shopping app, participants will be able to see themselves through the AR display instead of seeing someone else in the AR display, which can also impact on the findings of the study.

Second, the study design included two different products (i.e., a watch and a flower vase) as contexts to test the proposed hypotheses. Although using two products enhances the generalizability of study findings as compared to employing a single product in this study, these two products do not represent all product types that can be shopped with AR. Therefore, findings of this study may not be generalized to other product categories that were not used in this study. For future research, it is recommended to study other product categories, such as clothes, shoes, and furniture to be able to generalize the findings across other product categories. For instance, a near-environment product (e.g., chairs) may perform differently because it is used closer to the body and is highly functional.

Third, the two experimental AR design factors, AR modality and user-VP interaction in AR display, did not have significant main effects on any of the dependent variables. These effects were not significant unless product was included as a moderator. Therefore, further studies systematically examining different kinds of product type effects (e.g., effects of the proximity of the product to users' body, product use contexts such as public vs. private uses, and sensory features of the product) as moderators for the AR design factors would generate clearer insights on the interaction effects of the product factor found in this study.

Fourth, this study examines the effects of the two AR design factors on consumers' product evaluations through the rational and experiential systems of information processing. Therefore, the focal consumer response variables of this study are in the information processing and product evaluation aspects. Other potential variables can be examined in the context of AR mobile shopping app, which future research may wish to include in their studies. For example, constructs from the technology acceptance model (TAM; Huang & Liao, 2015; Pantano et al., 2017), such as consumers' perceived usefulness, enjoyment, and ease of use of the AR mobile app, may be impacted by the AR design features, which would be important to understand consumers' acceptance of AR technology for shopping, but they were not examined in this study, limiting the scope of the study.

Fifth, for the visual plus auditory condition simulation videos, female voice was used to explain product information to the participants. As both genders' voices were not used in the simulation videos, this may affect the generalizability of the study across other AR mobile shopping apps that utilize male voices to convey product information to consumers. Therefore, future studies may consider incorporating both genders' voices in the AR mobile shopping app and randomly assign the participants into different conditions to be able to better generalize the study findings. Also, in this research, the virtual agent's voice was more mechanical than being human-like, which might have impacted the results of this study. As the natural human voice may be able to deliver verbal communication better to consumers, future research may consider delivering verbal product specifications with a more human-like voice with emotions. Furthermore, product specifications in both text format and verbal format were in a factual and neutral tone in this research. As the factual product specification is already available in a text format, future study may consider adding the verbal information that is more positively valanced that clearly points out the benefits and attributes that the product have.

Sixth, this study also has limitations pertaining to the study sample. A total of 480 consumers aged between 18 to 54 who lived in the U.S. participated in this study. Although the study recruited a sample from panel members from a sampling company to enhance the representativeness of the sample for mobile shoppers in the U.S., no probabilistic sampling was used, which limits the generalizability of findings to all U.S. mobile shoppers. Further, older adults (> 55 years old) were excluded from the sample due to their generally lower participation in mobile shopping. However, as some of older consumers do use mobile shopping, excluding them may hurt the generalizability of findings of this study to all mobile shoppers in the U.S. Furthermore, including different age groups may allow other analyses, such as a comparison of age groups that allows the retailers to create AR experience that appeals to different age groups. Therefore, future research could consider including a wider range of age groups.

Finally, another limitation with the study sample is that this study recruited participants who are mobile shoppers. That is, this study did not specifically recruit participants who have shopping experiences using AR. According to the study results, only 39.6% of the participants have used AR when shopping for products, which is less than half of the entire participants in this research. Those who were not familiar with AR and had not used AR for product shopping might have had difficulties understanding the AR features shown in the provided simulation videos. Therefore, future research can inquire on the potential effects of prior AR experience or familiarity in altering the effects examined in this study.

Conclusions

Despite of the fact that AR has been widely applied in both online and offline retail settings (Suh & Lee, 2005), AR application in a mobile shopping app has not been deeply discussed in previous research. The current research addresses the literature gap by proposing the AR-CEPEM model, which was developed based on the cognitive-experiential self-theory, to explain consumers' product evaluation through the rational and experiential systems of product information processing. Although the main effects of the two key AR design factors examined in this study on cognitive attention, sense of presence, perceived utilitarian/hedonic value of a product, and product attitude were not significant, the significant findings of the interaction effect of user-VP interaction × product as well as the interaction effect of AR modality × user-VP interaction × product reveal potential effects of the AR design factors moderated by product types. Furthermore, consumers' level of cognitive attention and sense of presence influenced their perceived utilitarian/hedonic value of a product, respectively; and those perceived values further influenced consumers' product attitude. Based on the findings of this research, marketers and retailers are recommended to consider incorporating different AR features for different types of products to enhance consumers' shopping experiences, and further consider creating the shopping environment to be closer to the reality where consumers can pay attention to their shopping experiences.

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APPENDIX A.1

Study Information Shared with The Sample Network for the Pilot Test and Main Study

I am a graduate student in the Department of Consumer and Design Sciences at Auburn University. My advisor, Dr. Wi-Suk Kwon, and I are seeking participants in a survey regarding consumers' product perception when shopping with a mobile app. You were selected as a possible participant because you are a mobile shopper who are between 18 to 54 years old and live in the United States. If you decide to participate in this research study, you will be asked to complete an online survey, and your total time commitment will be approximately 20 to 25 minutes.

There are no foreseen risks or discomforts associated with participating in this study. Also, there are no direct benefits to you by participating. However, to thank you for your time, you will be offered a monetary compensation at the amount agreed by The Sample Network. A random-number ID will be assigned to you by The Sample Network and will be recorded as you submit your survey responses for compensation purposes. However, the researchers of this study will not have access to your personal identifiers associated with this random-number ID, so you can trust that your participation is completely anonymous.

If you would like to know more about this study or participate in this study, please click on this link: **LINK TO SCREEN/QUOTA PAGE**.

If you have any questions or concerns about completing the survey or this study, please contact me at jihyun.sung@auburn.edu, or my advisor, Dr. Wi-Suk Kwon, at kwonwis@auburn.edu. Thank you for your time and consideration.

Sincerely,

Jihyun Sung
Ph.D. Candidate
Department of Consumer and Design Sciences
College of Human Sciences
Auburn University

APPENDIX A.2
Information Letter for the Pilot Study and Main Study

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

INFORMATION LETTER
for a Research Study entitled
"The Effects of Augmented Reality (AR) Modality and User-Virtual Product Interaction Design on Consumers' Product Evaluation: A Cognitive-Experiential Self-Theory Perspective"

You are invited to participate in a research study to survey consumers' product perceptions when experiencing them on a mobile shopping app. The study is being conducted by Jihyun Sung, a Ph.D. candidate in the Department of Consumer and Design Sciences at Auburn University under the direction of Dr. Wi-Suk Kwon, Professor in the Department of Consumer and Design Sciences at Auburn University. You are invited to participate because you are age 18 or older and live in the United States.

What will be involved if you participate? If you decide to participate in this research study, you will be asked to answer sets of questions. Your total time commitment will be approximately 15-20 minutes.

Are there any risks or discomforts? We assure that participation in this study would put you in no physical or psychological risks other than the minimal inconvenience of completing the questionnaire. The information collected through this survey will remain completely anonymous. No identifiers will be used to link your responses to your identity.

Are there any benefits to yourself or others? There are no direct benefits to yourself by participating. However, your responses may contribute to deepening scholarly knowledge about consumers' perceptions of social media product reviews.

Will you receive compensation for participating? If you meet the participant qualifications, complete the provided online survey, and correctly answer all of the attention check questions interspersed among the survey questions, you will receive a certain amount of the monetary compensation determined and provided by the sampling company.

Are there any costs? There is no monetary cost for participation.

If you change your mind about participating, you can withdraw at any time during the study (example: closing your browser window). Your participation is completely voluntary. If you choose to withdraw, your data can be withdrawn as long as it is identifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University or the Department of Consumer and Design Sciences.

Any data obtained in connection with this study will remain anonymous. We will protect your privacy and the data you provide by not collecting any identifiable information about you (e.g., name, email address). A random participant ID number will be generated by the sampling company for each participant to record with their survey data. However, the investigators will not have access to the identifying information linked to these random participant ID numbers, while the sampling company will not have access to the survey data. Therefore, your survey data and your identity will never be linked together. Information collected through your participation may be used for publication in academic research journals and/or presentation at professional meetings.

If you have questions about this study, contact Jihyun Sung at: jihyun.sung@auburn.edu or Dr. Wi-Suk Kwon at: kwonwis@auburn.edu.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE CLICK ON THE "NEXT" BUTTON BELOW. YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.

Next

Jihyun Sung 03/15/2021
Principal Investigator Date

Wi-Suk Kwon 03/15/2021
Co-Investigator Date

APPENDIX B.1
Pilot Study Questionnaire

Screening/Quota Questions

1. What is your gender?

   ☐ Male
   ☐ Female

2. Which age group do you belong to?

   ☐ Younger than 18 years [→ Terminated]
   ☐ 18-24 years
   ☐ 25-34 years
   ☐ 35-44 years
   ☐ 45-54 years
   ☐ 55-64 years [→ Terminated]
   ☐ 65 years or above [→ Terminated]

3. Have you shopped for products using a mobile shopping app?

   ☐ Yes
   ☐ No [→ Terminated]

4. Which country do your currently reside in?

   ☐ Brazil [→ Terminated]
   ☐ Canada [→ Terminated]
   ☐ China [→ Terminated]
   ☐ France [→ Terminated]
   ☐ Germany [→ Terminated]
   ☐ India [→ Terminated]
   ☐ Italy [→ Terminated]
   ☐ South Korea [→ Terminated]
   ☐ United Kingdom [→ Terminated]
   ☐ United States of America
   ☐ Other Countries ____________ [→ Terminated]

5. Please make sure to have the computer audio on while you are completing the survey. Please play the video below and check what you hear.

   ☐ I hope you have a good day. [→ Terminated]
   ☐ What a beautiful day.
   ☐ It is such a great day. [→ Terminated]
   ☐ What did you eat for the breakfast? [→ Terminated]

PRODUCT: WATCH

Section I: Manipulation Check

DIRECTION: On this page, you will be asked to watch a short video of a customer using a mobile app to shop for a watch. While watching the video, **imagine yourself using the app in the video at home to virtually experience a watch that you are considering buying**. After carefully watching the video, please answer the questions on next pages regarding your experience with the video.

Example stimulus:

DIRCETION: We'd like to ask questions regarding **the videos that you watched on the previous page.**

1. Did you see any product on the mobile app screen in this video?

- ☐ Yes
- ☐ No

2. If you have seen any product, what was the product that you saw in the video?

- ☐ A watch
- ☐ A flower vase
- ☐ A mug cup
- ☐ A ring
- ☐ A table lamp

- ☐ A pair of shoes
- ☐ I didn't see any product.

3. Did you see any text explanation on the mobile app screen in this video?

- ☐ Yes
- ☐ No

4. Did you hear any voice while you were watching the video?

- ☐ Yes
- ☐ No

5. If you have heard any voice, was it a female voice or a male voice?

- ☐ Female voice
- ☐ Male voice
- ☐ I did not hear anything.

6. Did you see any body parts of the user in the mobile app screen while you were watching the video?

- ☐ Yes
- ☐ No

<u>Section II: Utilitarian/Hedonic Value of a Product</u>

DIRECTION: We'd like to know your **general perceptions toward the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Utilitarian Value of a Product					
The watch shown in this video seems to be well-constructed.	1	2	3	4	5
The workmanship of the watch or the shown in this video seems to meet high standards.	1	2	3	4	5
The watch shown in this video appears to be made of high-quality materials.	1	2	3	4	5
The watch shown in this video is likely to be good quality.	1	2	3	4	5
The overall appearance of the watch shown in this video is attractive.	1	2	3	4	5

The watch shown in this video would last a long time.	1	2	3	4	5
Hedonic Value of a Product					
The watch shown in this video is the one that I would enjoy.	1	2	3	4	5
The watch shown in this video would make me want to use.	1	2	3	4	5
If you are currently reading this, select Strongly Agree.	1	2	3	4	5
The watch shown in this video would make me feel good when I use it.	1	2	3	4	5
The watch shown in this video would give me pleasure when I use it.	1	2	3	4	5

Section III: Product Attitude

DIRECTION: For each line showing a pair of words below, please indicate your response to complete the following sentence about **the *PRODUCT*** you saw on the video on the previous page.

Please describe your overall feelings about the product that appeared on the video.

Unappealing (1) ___ ___ ___ ___ ___ Appealing (5)

Bad (1) ___ ___ ___ ___ ___ Good (5)

Unpleasant (1) ___ ___ ___ ___ ___ Pleasant (5)

Unfavorable (1) ___ ___ ___ ___ ___ Favorable (5)

Unlikable (1) ___ ___ ___ ___ ___ Likable (5)

Section IV: Cognitive Attention

DIRECTION: We'd like to know your general perceptions toward **the product information** that you saw on the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I attempted to analyze product information.	1	2	3	4	5
I was not very attentive to product information.*	1	2	3	4	5
I deeply thought about product information.	1	2	3	4	5

I extended my cognitive effort to evaluate product information.	1	2	3	4	5
I was distracted by other thoughts not related to product information. *	1	2	3	4	5
I did not exert my mind to evaluate product information. *	1	2	3	4	5
I did my best to think about product information.	1	2	3	4	5
I reflected on product information.	1	2	3	4	5
I rested my mind without paying attention to product information. *	1	2	3	4	5
I searched my mind to evaluate product information.	1	2	3	4	5
I took it easy without trying to evaluate product information. *	1	2	3	4	5
I was not very concerned about product information. *	1	2	3	4	5

Section V: Sense of Presence

DIRECTION: We'd like to know **your experiences with the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	**Not Strong At All**	**Not Very Strong**	**Moderately Strong**	**Quite Strong**	**Extremely Strong**
How strongly did you sense as if the product was physically in front of you while you were watching the video?	1	2	3	4	5
	Not Realistic At All	**Not Very Realistic**	**Moderately Realistic**	**Quite Realistic**	**Extremely Realistic**
How realistic did you feel like as if you were with the product when you were watching the video?	1	2	3	4	5

PRODUCT: FLOWER VASE

Section I: Manipulation Check

DIRECTION: On this page, you will be asked to watch a short video of a customer using a mobile app to shop for a flower vase. While watching the video, **imagine yourself using the app in the video at home to virtually experience a flower vase that you are considering buying**. After carefully watching the video, please answer the questions on next pages regarding your experience with the video.

Example stimulus:

DIRCETION: On this and next few pages, we'd like to ask questions regarding **the videos that you watched on the previous page.**

1. Did you see any product on the mobile app screen in this video?

 - ☐ Yes
 - ☐ No

2. If you have seen any product, what was the product that you saw in the video?

 - ☐ A watch
 - ☐ A flower vase
 - ☐ A mug cup
 - ☐ A ring
 - ☐ A table lamp

- ☐ A pair of shoes
- ☐ I didn't see any product.

3. Did you see any text explanation on the mobile app screen in this video?

- ☐ Yes
- ☐ No

4. Did you hear any voice while you were watching the video?

- ☐ Yes
- ☐ No

5. If you have heard any voice, was it a female voice or a male voice?

- ☐ Female voice
- ☐ Male voice
- ☐ I did not hear anything.

6. Did you see any body parts of the user in the mobile app screen while you were watching the video?

- ☐ Yes
- ☐ No

<u>Section II: Utilitarian/Hedonic Value of a Product</u>

DIRECTION: We'd like to know your **general perceptions toward the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Utilitarian Value of a Product					
The flower vase shown in this video seems to be well-constructed.	1	2	3	4	5
The workmanship of the flower vase shown in this video seems to meet high standards.	1	2	3	4	5
The flower vase shown in this video appears to be made of high-quality materials.	1	2	3	4	5
The flower vase shown in this video is likely to be good quality.	1	2	3	4	5

The overall appearance of the flower vase shown in this video is attractive.	1	2	3	4	5
The flower vase shown in this video would last a long time.	1	2	3	4	5
Hedonic Value of a Product					
The flower vase shown in this video is the one that I would enjoy.	1	2	3	4	5
The flower vase shown in this video would make me want to use.	1	2	3	4	5
The watch flower vase shown in this video would make me feel good when I use it.	1	2	3	4	5
The flower vase shown in this video would give me pleasure when I use it.	1	2	3	4	5

Section III: Product Attitude

DIRECTION: For each line showing a pair of words below, please indicate your response to complete the following sentence about **the *PRODUCT*** you saw on the video on the previous page.

Please describe your overall feelings about the product that appeared on the video.

Unappealing (1) ___ ___ ___ ___ ___ Appealing (5)

Bad (1) ___ ___ ___ ___ ___ Good (5)

Unpleasant (1) ___ ___ ___ ___ ___ Pleasant (5)

Unfavorable (1) ___ ___ ___ ___ ___ Favorable (5)

Unlikable (1) ___ ___ ___ ___ ___ Likable (5)

Section IV: Cognitive Attention

DIRECTION: We'd like to know your general perceptions toward **the product information** that you saw on the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I attempted to analyze product information.	1	2	3	4	5
I was not very attentive to product information. *	1	2	3	4	5
I deeply thought about product information.	1	2	3	4	5

I extended my cognitive effort to evaluate product information.	1	2	3	4	5
I was distracted by other thoughts not related to product information. *	1	2	3	4	5
I did not exert my mind to evaluate product information. *	1	2	3	4	5
If you are currently reading this, select Neutral.	1	2	3	4	5
I did my best to think about product information.	1	2	3	4	5
I reflected on product information.	1	2	3	4	5
I rested my mind without paying attention to product information. *	1	2	3	4	5
I searched my mind to evaluate product information.	1	2	3	4	5
I took it easy without trying to evaluate product information. *	1	2	3	4	5
I was not very concerned about product information. *	1	2	3	4	5

Section V: Sense of Presence

DIRECTION: We'd like to know your experiences with **the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	**Not Strong At All**	**Not Very Strong**	**Moderately Strong**	**Quite Strong**	**Extremely Strong**
How strongly did you sense as if the product was physically in front of you while you were watching the video?	1	2	3	4	5
	Not Realistic At All	**Not Very Realistic**	**Moderately Realistic**	**Quite Realistic**	**Extremely Realistic**
How realistic did you feel like as if you were with the product when you were watching the video?	1	2	3	4	5

THE FOLLOWING QUESTIONS WILL BE INCLUDED ONLY ONCE AFTER PARTICIPANTS COMPLETE THE SURVEY WITH TWO PRODUCTS

Section I: Need for Cognition/Faith in Intuition

DIRECTION: We'd like to know your **general thinking**. Please indicate your level of agreement with each of the following statements.

Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Need for Cognition					
I don't like to have to do a lot of thinking. *	1	2	3	4	5
I try to avoid situations that require thinking in depth about something.*	1	2	3	4	5
I prefer to do something that challenges my thinking abilities rather than something that requires little thought.	1	2	3	4	5
I prefer complex to simple problems.	1	2	3	4	5
Thinking hard and for a long time about something gives me little satisfaction. *	1	2	3	4	5
Faith in Intuition					
I trust my initial feelings about people.	1	2	3	4	5
I believe in trusting my hunches.	1	2	3	4	5
My initial impressions of people are almost always right.	1	2	3	4	5
When it comes to trusting people, I can usually rely on my "gut feelings."	1	2	3	4	5
I can usually feel when a person is right or wrong even if I can't explain how I know.	1	2	3	4	5

Section II: Previous Experiences

Are you a regular mobile shopping app user?

- ☐ Yes
- ☐ No

Questions	Not Comfortable At All	Not Very Comfortable	Moderately Comfortable	Quite Comfortable	Extremely Comfortable
What is your overall comfort level with a mobile shopping app?	1	2	3	4	5
	Not Enjoyable At All	**Not Very Enjoyable**	**Moderately Enjoyable**	**Quite Enjoyable**	**Extremely Enjoyable**
What is your overall enjoyment level using a mobile app for product shopping?	1	2	3	4	5
	Not Easy At All	**Not Very Easy**	**Moderately Easy**	**Quite Easy**	**Extremely Easy**
With what degree of ease are you able to navigate within the virtual environment using a mobile shopping app?	1	2	3	4	5

Have you used augmented reality technology when you shopped for products? AR (augmented reality) can be explained as the retail technology that allows consumers to view virtual products in the real environment (e.g., home) in the digital display.

- ☐ Yes [Answer the following AR-related questions]
- ☐ No [Directly go to the demographic factors page]

Are you a regular augmented reality technology user?

- ☐ Yes
- ☐ No

Questions	Not Comfortable At All	Not Very Comfortable	Moderately Comfortable	Quite Comfortable	Extremely Comfortable
What is your overall comfort level with augmented reality?	1	2	3	4	5
	Not Enjoyable At All	**Not Very Enjoyable**	**Moderately Enjoyable**	**Quite Enjoyable**	**Extremely Enjoyable**
What is your overall enjoyment level using augmented reality for product shopping?	1	2	3	4	5
	Not Easy At All	**Not Very Easy**	**Moderately Easy**	**Quite Easy**	**Extremely Easy**
With what degree of ease are you able to navigate within the virtual environment using augmented reality technology?	1	2	3	4	5

Section III: Demographic Factors

What is your gender?

____ MALE
____ FEMALE

What is your age (in number of years)? ___________years old

Which of the following ethnicity groups do you consider yourself to belong to?

____ AMERICAN INDIAN/ALASKAN NATIVE
____ ASIAN/PACIFIC ISLANDER
____ HISPANIC
____ NON-HISPANIC BLACK (African American)
____ NON-HISPANIC WHITE (European or Caucasian American)
____ OTHER (Please specify:______________________)

What is the highest degree of school you have completed?

____ 8TH GRADE OR LESS
____ SOME HIGH SCHOOL
____ HIGH SCHOOL DEGREE
____ SOME COLLEGE OR TECHNICAL SCHOOL
____ COLLEGE DEGREE (4 YEARS)
____ SOME GRADUATE SCHOOL
____ GRADUATE DEGREE (MASTER'S, DOCTORATE, ETC.)

Which of the following best describes your current occupation?

____ Full-Time Employment
____ Part-Time Employment
____ Unemployed
____ Self-Employed
____ Home-Maker
____ Student
____ Retired
____ Other (Specify:_______)

Which of the following describes your current marital status?

____ SINGLE
____ MARRIED
____ SINGLE BUT LIVING WITH SIGNIFICANT OTHER

Which of the following ranges include your total annual household income from all sources before taxes in 2020?

____ Under $25,000
____ $25,000 to $35,000
____ $35,001 to $50,000
____ $50,001 to $75,000
____ $75,001 to $100,000
____ $100,001 to $125,000
____ $125,001 to $150,000
____ $150,001 to $175,000
____ $175,001 to $200,000
____ Over $200,000

Which area do you currently live in?

____ RURAL AREA
____ URBAN AREA
____ SUBURBAN AREA

APPENDIX B.2
Main Study Questionnaire

Screening/Quota Questions

1. What is your gender?

- ☐ Male
- ☐ Female

2. Which age group do you belong to?

- ☐ Younger than 18 years [→ Terminated]
- ☐ 18-24 years
- ☐ 25-34 years
- ☐ 35-44 years
- ☐ 45-54 years
- ☐ 55-64 years [→ Terminated]
- ☐ 65 years or above [→ Terminated]

3. Have you shopped for products using a mobile shopping app?

- ☐ Yes
- ☐ No [→ Terminated]

4. Which country do your currently reside in?

- ☐ Brazil [→ Terminated]
- ☐ Canada [→ Terminated]
- ☐ China [→ Terminated]
- ☐ France [→ Terminated]
- ☐ Germany [→ Terminated]
- ☐ India [→ Terminated]
- ☐ Italy [→ Terminated]
- ☐ South Korea [→ Terminated]
- ☐ United Kingdom [→ Terminated]
- ☐ United States of America
- ☐ Other Countries ____________ [→ Terminated]

5. Please make sure to have the computer audio on while you are completing the survey. Please play the video below and check what you hear.

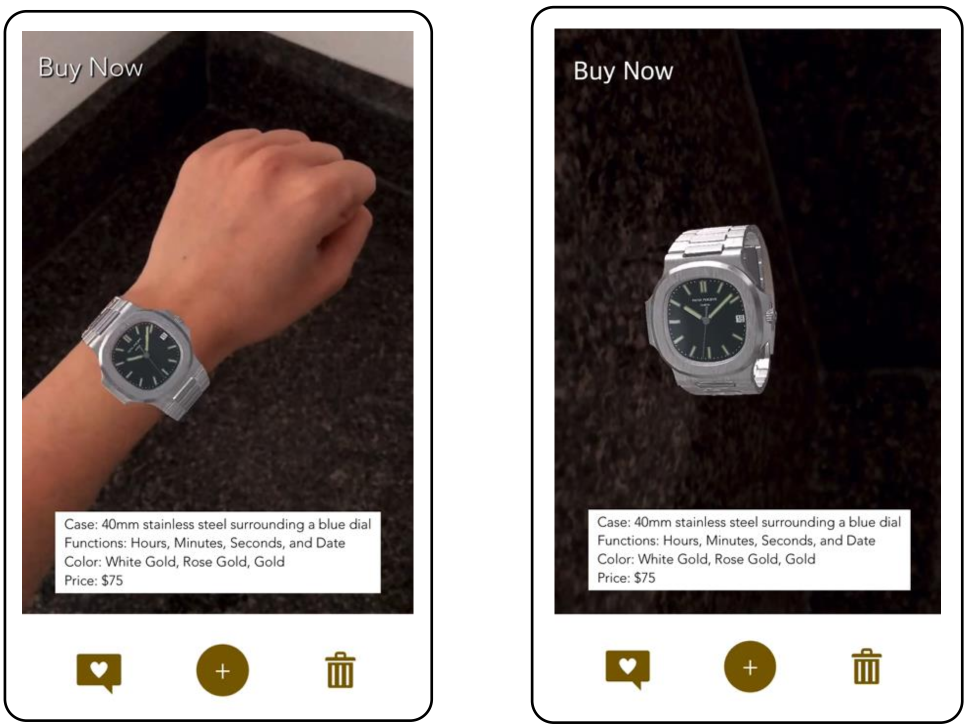
- ☐ I hope you have a good day. [→ Terminated]
- ☐ What a beautiful day.
- ☐ It is such a great day. [→ Terminated]
- ☐ What did you eat for the breakfast? [→ Terminated]

PRODUCT: WATCH

Section I: Manipulation Check

DIRECTION: Below is a short video of a customer shopping for a watch using a mobile app. Please watch the video and **imagine yourself using the app in the video at home to virtually experience a watch that you are considering buying**. Then, answer the questions on next pages regarding your experience with the video.

Example stimulus:



DIRCETION: We'd like to ask questions regarding **the video that you watched on the previous page.**

1. What was the product that you saw in the video?

- ☐ A watch
- ☐ A flower vase
- ☐ A mug cup
- ☐ A ring
- ☐ A table lamp
- ☐ A pair of shoes
- ☐ I didn't see any product.

2. Did you hear any computer-generated voice in the video? If yes, was it a female voice or a male voice?

- ☐ Female voice
- ☐ Male voice
- ☐ I did not hear any computer-generated voice.

3. Did you see any body parts of the user in the mobile app screen while you were watching the video?

- ☐ Yes
- ☐ No

Section II: Utilitarian/Hedonic Value of a Product

DIRECTION: We'd like to know your **thoughts toward the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Utilitarian Value of a Product					
The watch shown in this video seems to be well-constructed.	1	2	3	4	5
The workmanship of the watch shown in this video seems to meet high standards.	1	2	3	4	5
The watch shown in this video appears to be made of high-quality materials.	1	2	3	4	5
If you are currently reading this, please select Agree.	1	2	3	4	5
The watch shown in this video is likely to be good quality.	1	2	3	4	5
The overall appearance of the watch shown in this video is attractive.	1	2	3	4	5
The watch shown in this video would last a long time.	1	2	3	4	5
Hedonic Value of a Product					
The watch shown in this video is the one that I would enjoy.	1	2	3	4	5
The watch shown in this video would make me want to use.	1	2	3	4	5
The watch shown in this video would make me feel good when I use it.	1	2	3	4	5

The watch shown in this video would give me pleasure when I use it.	1	2	3	4	5

Section III: Product Attitude

DIRECTION: For each line showing a pair of words below, please indicate your response to complete the following sentence about **the *watch*** you saw on the video on the previous page.

The watch that appeared in the video is ______________________.

Unappealing (1) ___ ___ ___ ___ ___ Appealing (5)

Bad (1) ___ ___ ___ ___ ___ Good (5)

Unpleasant (1) ___ ___ ___ ___ ___ Pleasant (5)

Unfavorable (1) ___ ___ ___ ___ ___ Favorable (5)

Unlikable (1) ___ ___ ___ ___ ___ Likable (5)

Section IV: Cognitive Attention

DIRECTION: We'd like to know what you thought while you were seeing or listening to the product information in the video. Please indicate your level of agreement with each of the following statements.

Questions	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
While I was watching the video…					
I attempted to analyze the product information.	1	2	3	4	5
I was not very attentive to the product information. *	1	2	3	4	5
I deeply thought about the product information.	1	2	3	4	5
I extended my effort to evaluate the product information.	1	2	3	4	5
I was distracted by other thoughts not related to the product information. *	1	2	3	4	5
I did not exert my mind to evaluate the product information. *	1	2	3	4	5
I did my best to think about the product information.	1	2	3	4	5
I reflected on the product information.	1	2	3	4	5
I rested my mind without paying attention to the product information. *	1	2	3	4	5

I searched my mind to evaluate the product information.	1	2	3	4	5
I took it easy without trying to evaluate the product information. *	1	2	3	4	5
I was not very concerned about the product information. *	1	2	3	4	5

Section V: Sense of Presence

DIRECTION: We'd like to know **your experience with the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

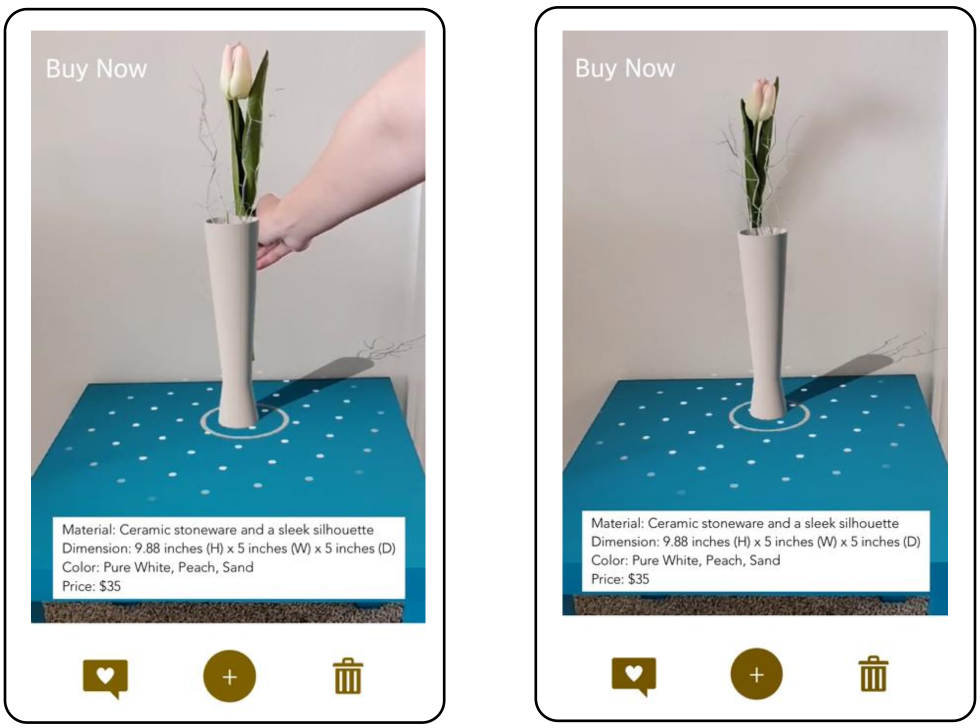
Questions	**Not Strong At All**	**Not Very Strong**	**Moderately Strong**	**Quite Strong**	**Extremely Strong**
How strongly did you sense as if the product were physically in front of you while you were watching the video?	1	2	3	4	5
	Not Realistic At All	**Not Very Realistic**	**Moderately Realistic**	**Quite Realistic**	**Extremely Realistic**
How realistic did you feel as if you were with the product when you were watching the video?	1	2	3	4	5

PRODUCT: FLOWER VASE

Section I: Manipulation Check

DIRECTION: Below is a short video of a customer shopping for a flower vase using a mobile app. Please watch the video and **imagine yourself using the app in the video at home to virtually experience a flower vase that you are considering buying**. Then, answer the questions on next pages regarding your experience with the video.

Example stimulus:



DIRCETION: We'd like to ask questions regarding **the video that you watched on the previous page.**

1. What was the product that you saw in the video?

- ☐ A watch
- ☐ A flower vase
- ☐ A mug cup
- ☐ A ring
- ☐ A table lamp
- ☐ A pair of shoes
- ☐ I didn't see any product.

2. Did you hear any voice while you were watching the video?

- ☐ Yes
- ☐ No

3. If you have heard any voice, was it a female voice or a male voice?

- ☐ Female voice
- ☐ Male voice
- ☐ I did not hear anything.

4. Did you see any body parts of the user in the mobile app screen while you were watching the video?

- ☐ Yes
- ☐ No

Section II: Utilitarian/Hedonic Value of a Product

DIRECTION: We'd like to know your **thoughts about the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Utilitarian Value of a Product					
The flower vase shown in this video seems to be well-constructed.	1	2	3	4	5
The workmanship of the flower vase shown in this video seems to meet high standards.	1	2	3	4	5
The flower vase shown in this video appears to be made of high-quality materials.	1	2	3	4	5
The flower vase shown in this video is likely to be good quality.	1	2	3	4	5
The overall appearance of the flower vase shown in this video is attractive.	1	2	3	4	5
The flower vase shown in this video would last a long time.	1	2	3	4	5
Hedonic Value of a Product					
The flower vase shown in this video is the one that I would enjoy.	1	2	3	4	5
The flower vase shown in this video would make me want to use.	1	2	3	4	5

The watch flower vase shown in this video would make me feel good when I use it.	1	2	3	4	5
The flower vase shown in this video would give me pleasure when I use it.	1	2	3	4	5

<u>Section III: Product Attitude</u>

DIRECTION: For each line showing a pair of words below, please indicate your response to complete the following sentence about **the *<u>flower vase</u>*** you saw on the video on the previous page.

The flower vase that appeared in the video is _____________________.

Unappealing (1) ___ ___ ___ ___ ___ Appealing (5)

Bad (1) ___ ___ ___ ___ ___ Good (5)

Unpleasant (1) ___ ___ ___ ___ ___ Pleasant (5)

Unfavorable (1) ___ ___ ___ ___ ___ Favorable (5)

Unlikable (1) ___ ___ ___ ___ ___ Likable (5)

<u>Section IV: Cognitive Attention</u>

DIRECTION: We'd like to know **what you thought while you were seeing or listening to the product information** in the video. Please indicate your level of agreement with each of the following statements.

Questions	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
While you were watching the video…					
I attempted to analyze the product information.	1	2	3	4	5
I was not very attentive to the product information. *	1	2	3	4	5
I deeply thought about the product information.	1	2	3	4	5
I extended my effort to evaluate the product information.	1	2	3	4	5
I was distracted by other thoughts not related to the product information. *	1	2	3	4	5
I did not exert my mind to evaluate the product information. *	1	2	3	4	5
I did my best to think about the	1	2	3	4	5

product information.					
I reflected on the product information.	1	2	3	4	5
I rested my mind without paying attention to the product information. *	1	2	3	4	5
I searched my mind to evaluate the product information.	1	2	3	4	5
I took it easy without trying to evaluate the product information. *	1	2	3	4	5
I was not very concerned about the product information. *	1	2	3	4	5

Section V: Sense of Presence

DIRECTION: We'd like to know your experience with **the product** that you saw in the video on the previous page. Please indicate your level of agreement with each of the following statements.

Questions	**Not Strong At All**	**Not Very Strong**	**Moderately Strong**	**Quite Strong**	**Extremely Strong**
How strongly did you sense as if the product were physically in front of you while you were watching the video?	1	2	3	4	5
	Not Realistic At All	**Not Very Realistic**	**Moderately Realistic**	**Quite Realistic**	**Extremely Realistic**
How realistic did you feel as if you were with the product when you were watching the video?	1	2	3	4	5

<u>THE FOLLOWING QUESTIONNAIRE ITEMS WILL BE INCLUDED ONLY ONCE AFTER PARTICIPANTS COMPLETE OTHER ITEMS BASED ON TWO PRODUCTS.</u>

<u>Section I: Need for Cognition</u>

DIRECTION: We'd like to know your **general thinking**. Please indicate your level of agreement with each of the following statements.

Questions	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Need for Cognition					
I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. *	1	2	3	4	5
I don't think to have the responsibility of handling a situation that requires a lot of thinking. *	1	2	3	4	5
I would prefer complex to simple problems.	1	2	3	4	5
I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something. *	1	2	3	4	5
I find little satisfaction in deliberating hard and for long hours. *	1	2	3	4	5
Thinking is not my idea of fun. *	1	2	3	4	5
The notion of thinking abstractly is not appealing to me. *	1	2	3	4	5
I prefer my life to be filled with puzzles that I must solve.	1	2	3	4	5
Simply knowing the answer rather than understanding the reasons for the answer to a problem is fine with me. *	1	2	3	4	5
I don't reason well under pressure. *	1	2	3	4	5
The idea of relying on thought to make my way to the top does not appeal to me. *	1	2	3	4	5
I prefer to talk about international problems rather than to gossip or talk about celebrities.	1	2	3	4	5
Learning new ways to think doesn't excite me very much. *	1	2	3	4	5
I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require	1	2	3	4	5

much thought.					
I generally prefer to accept things as they are rather than to question them. *	1	2	3	4	5
It is enough for me that something gets the job done, I don't care how or why it works. *	1	2	3	4	5
I tend to set goals that can be accomplished only by expending considerable mental effort.	1	2	3	4	5
I have difficulty thinking in new and unfamiliar situations. *	1	2	3	4	5
I feel relief rather than satisfaction after completing a task that required a lot of mental effort. *	1	2	3	4	5

<u>Section II: Faith in Intuition</u>

DIRECTION: Now, we have a few questions about how much you **trust your intuition**. Please indicate your level of agreement with each of the following statements.

Questions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My initial impressions of people are almost always right.	1	2	3	4	5
I trust my initial feelings about people.	1	2	3	4	5
When it comes to trusting people, I can usually rely on my "gut feelings."	1	2	3	4	5
I believe in trusting my hunches.	1	2	3	4	5
I can usually feel when a person is right or wrong even if I can't explain how I know.	1	2	3	4	5
I am a very intuitive person.	1	2	3	4	5
I can typically sense right away when a person is lying.	1	2	3	4	5
I am quick to form impressions about people.	1	2	3	4	5
I believe I can judge character pretty well from a person's appearance.	1	2	3	4	5
I often have clear visual images of things.	1	2	3	4	5
I have a very good sense of rhythm.	1	2	3	4	5
I am good at visualizing things.	1	2	3	4	5

<u>Section III: Previous Experiences</u>

Are you a regular mobile shopping app user?

- ☐ Yes
- ☐ No

Questions	**Not Comfortable At All**	**Not Very Comfortable**	**Moderately Comfortable**	**Quite Comfortable**	**Extremely Comfortable**
What is your overall comfort level with a mobile shopping app?	1	2	3	4	5
	Not Enjoyable At All	**Not Very Enjoyable**	**Moderately Enjoyable**	**Quite Enjoyable**	**Extremely Enjoyable**
What is your overall enjoyment level using a mobile app for product shopping?	1	2	3	4	5
	Not Easy At All	**Not Very Easy**	**Moderately Easy**	**Quite Easy**	**Extremely Easy**
How easily can you navigate on a mobile shopping app?	1	2	3	4	5

Augmented reality (AR) is a technology that allows consumers to view virtual products in the real environment (e.g., your home) through a digital display such as a computer screen or a mobile app. **Have you used AR technology for shopping?**

☐ Yes [Answer the following AR-related questions]
☐ No [Directly go to the demographic factors page]

Are you a regular augmented reality technology user?

☐ Yes
☐ No

Questions	**Not Comfortable At All**	**Not Very Comfortable**	**Moderately Comfortable**	**Quite Comfortable**	**Extremely Comfortable**
What is your overall comfort level with AR technology?	1	2	3	4	5
	Not Enjoyable At All	**Not Very Enjoyable**	**Moderately Enjoyable**	**Quite Enjoyable**	**Extremely Enjoyable**
What is your overall enjoyment level using AR technology for product shopping?	1	2	3	4	5
	Not Easy At All	**Not Very Easy**	**Moderately Easy**	**Quite Easy**	**Extremely Easy**
How easily can you navigate within the virtual environment using AR technology?	1	2	3	4	5

Section IV: Demographic Factors

What is your gender?

____ MALE
____ FEMALE

What is your age (in number of years)? ___________years old

Which of the following ethnicity groups do you consider yourself to belong to?

____ AMERICAN INDIAN/ALASKAN NATIVE
____ ASIAN/PACIFIC ISLANDER
____ HISPANIC
____ NON-HISPANIC BLACK (African American)
____ NON-HISPANIC WHITE (European or Caucasian American)
____ OTHER (Please specify:_______________________)

What is the highest degree of school you have completed?

____ 8TH GRADE OR LESS
____ SOME HIGH SCHOOL
____ HIGH SCHOOL DEGREE
____ SOME COLLEGE OR TECHNICAL SCHOOL
____ COLLEGE DEGREE (4 YEARS)
____ SOME GRADUATE SCHOOL
____ GRADUATE DEGREE (MASTER'S, DOCTORATE, ETC.)

Which of the following best describes your current occupation?

____ Full-Time Employment
____ Part-Time Employment
____ Unemployed
____ Self-Employed
____ Home-Maker
____ Student
____ Retired
____ Other (Specify:________)

Which of the following describes your current marital status?

____ SINGLE
____ MARRIED
____ SINGLE BUT LIVING WITH SIGNIFICANT OTHER

Which of the following ranges include your total annual household income from all sources before taxes in 2020?

____ Under $25,000
____ $25,000 to $35,000
____ $35,001 to $50,000
____ $50,001 to $75,000
____ $75,001 to $100,000
____ $100,001 to $125,000
____ $125,001 to $150,000
____ $150,001 to $175,000
____ $175,001 to $200,000
____ Over $200,000

Which area do you currently live in?

____ RURAL AREA
____ URBAN AREA
____ SUBURBAN AREA