Artificial Intelligence, Machine Learning, & Robotics in Business

# When AI Meets AR, Online Shopping Becomes Even More Irresistible

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**Abstract:** Online shopping generally presents the pain point of not being able to try on products. Therefore, various industries are gradually developing and applying augmented reality (AR) to improve the online product experience. The purpose of this study is to explore the impact of AR in assisting the online presentation of cosmetics on consumers and, based on the S-O-R model, to examine how AR features affect consumers' perceived value. In this study, AR features are categorized into interactivity, vividness, system quality, and product informativeness. Consumers' perceived value after using AR makeup tools is divided into three dimensions: perceived emotional value, perceived cognitive value, and perceived social value. The study also examines how these perceived values influence consumers' attitudes toward AR technology, which, in turn, affect their willingness to use AR makeup tools. Perceived social benefits and intention to use determine whether they will patronize brand websites. A research model was tested through an empirical survey of 81 valid participants. The PLS analysis results show that consumers' perceived cognitive value is significantly affected by the interactivity, vividness, system quality, and product informativeness provided by AR. Perceived social value is significantly influenced by AR's presence effect, while perceived emotional value is influenced by AR's interactivity and vividness. The study also suggests that consumers' perceived value affects their attitude toward AR technology, which, in turn, significantly influences their willingness to use AR makeup tools and patronize brand websites. The findings of this study provide the cosmetics industry with optimization suggestions for the application of AR makeup tools and contribute to research on AR technology.

**Keywords**: Augmented Reality, Perceived Value, Usage Intention, Patronage Intention, S-O-R Model

## 1 INTRODUCTION

The application of e-commerce has become more convenient with the advancement of information technology, evolving from one-click shopping and personalized recommendations to online VR displays, creating a competitive edge that is difficult for physical stores to rival. The prevalence of intelligent technology and the advances in immersive technology have made online shopping easier (Daassi & Debbabi, 2021). To solve the problem of online shoppers failing to experience products, many enterprises have introduced augmented reality (AR) to

increase the value of customer experience, with the furniture, accessories, footwear, and beauty industries beginning to use AR to better their online shopping experience. In recent years, with the development of AI (Artificial Intelligence) technology and the application of AR, the interaction between online and offline experiences has become more seamless and realistic.

AI and AR technologies are transforming the online shopping experience by enhancing personalization, improving decision-making, and providing immersive experiences. A key application of AI in AR-assisted online shopping is virtual try-ons and product visualization. Consumers can virtually try on clothing, accessories, or view how furniture would look in their homes using the camera on their smartphone or computer. For example, companies like L'Oreal and Sephora have adopted AR to allow users to simulate different makeup looks in real-time. Similarly, IKEA's "IKEA Place" app enables users to virtually place furniture in their living spaces, providing a realistic sense of how products would fit and look in their environment. Research shows that this use of AR in e-commerce significantly boosts consumer engagement and satisfaction, as it bridges the gap between online and in-store experiences (Scholz & Duffy, 2018).

Another significant development is the use of AI to power personalized product recommendations. Machine learning algorithms analyze consumers' shopping behavior, preferences, and historical data to provide tailored suggestions. When combined with AR, these recommendations can be visualized interactively, allowing users to see suggested outfits on themselves or view furniture suited to their space and style. For instance, AI can analyze a user's body shape and fashion preferences to suggest clothing items that would fit both physically and stylistically, which can then be virtually tried on using AR technology. This kind of personalized experience is highly effective, with studies showing that personalization in e-commerce can lead to increased sales and customer loyalty (Grewal et al., 2017).

AI and AR technologies also create an immersive shopping environment where consumers can interact with products in a 3D space rather than relying solely on static images. Virtual showrooms allow users to "walk" through a store and explore products from various angles, enhancing the realism of the shopping experience. Furthermore, AI-driven image recognition and generative technologies enable detailed examination of products, such as zooming in on fabric textures or inspecting the craftsmanship of a piece of furniture. This ability to offer a more tactile and comprehensive understanding of a product online has been shown to reduce return rates and improve customer confidence in their purchases (Poushneh & Vasquez-Parraga, 2017).

Additionally, AI and AR enable context-aware shopping experiences. By analyzing the user's environment or conditions, such as lighting or room design, AI can recommend products that fit the specific context, which can then be visualized through AR. For example, an AR app might adjust its product recommendations for furniture or decor based on the style and dimensions of a user's room. This blend of AI and AR allows consumers to make more informed decisions, leading to higher satisfaction and fewer product returns. Additionally, since it is difficult for consumers to continuously display the whole body through the camera of a cell phone or tablet, the virtual fitting room adopted by the apparel industry is also one of the solutions to enhancing customer experience. The future of these technologies will likely involve even more seamless integration, where AI's ability to process vast amounts of data and AR's immersive capabilities will converge to blur the line between virtual and physical shopping (Devagiri et al. 2022; Alimamy & Gnoth, J. 2022; Javornik, 2016).

In past studies, the effect of AI and AR applications on consumers was mainly based on the methodology for development technology or the analysis of consumer cognition from the existing store functions. However, the cognitive impact of applying a combination of AR and AI (AIR, Augmented Intelligent Reality) at different stages of consumer decision-making is seldom explored in terms of the shopping process (Zimmermann et al. 2023). Therefore, this

study uses the AIR beauty tool as an example and incorporates consumers' perceived value of AIR with consumer decision-making stages in mind, exploring consumers' attitudes toward AIR after the use of such a tool. Finally, by examining how these attitudes influence consumers' willingness to use the tool and visit the store, the study deals with the following research questions (RQs):

RQ1: How do consumers' attitudes toward AIR affect their willingness to use the smart AIR beauty tool and enhance patronage intention?
RQ2: How the characteristics of AIR enhance consumers' perceived value, including emotional, social, and cognitive value?

## 2 THEORETICAL FOUNDATION AND RESEARCH MODEL

### 2.1 The S-O-R Model

The Stimulus-Organism-Response (S-O-R) model is a theory based on behavioral psychology and is used to predict consumer responses to changes in information media modes (Lee et al., 2010). The model suggests that when consumers have a stimulus (S), the internal and external perceptions of the organism (O) will be affected, in turn triggering responses (R). The stimulus is related to the environment, which can be classified as physical or virtual (Gatautis et al., 2016), and affects changes in experiences of the organism (Animesh et al., 2011) through sensory information (visual, auditory…), perception (interactivity and fun), and topics (learning and games) (Suh & Prophet, 2018). Organisms' changes involve psychology and physiology, such as emotion, internal perception, and participation, while behavioral responses include consumer attitudes and usage intentions (Gatautis et al., 2016; Mollen & Wilson, 2010).

The S-O-R model can help retailers understand how to manipulate technological stimuli to provide consumers with engaging experiences (Vieira, 2013). Many studies relying on the S-O-R model have found that in a physical retail store, the ambient stimuli affect consumers' internal perceptions, leading to purchase intentions and behavior (Robert & John, 1982). On the other hand, virtually, ambient stimuli also affect consumers' emotions and cognition, and elicit positive or negative responses such as desire or avoidance to purchase products (Eroglu et al. 2001). Therefore, this study uses the S-O-R model to understand how the differences between consumers' perceptual cognition and perceptual emotion during AIR-supported online experiences have a bearing on consumers' patronage intentions.

### 2.2 The Research Model

This study bases the research framework on the S-O-R model, divided into stimulus (S), organism (O), and response (R). The stimulus is characterized by AIR, featuring consumers' reactions to an online color trial service provided by the smart AIR beauty tool. The organism pertains to perceptual value, which is composed of three aspects—perceptual emotional value, perceptual-cognitive value, and perceptual social value. This study proposes a research framework as shown in Figure 1, as well as 12 hypotheses. This study analyzes customer behavior based on the consumption experience process outlined in the Experiential Hierarchy Model (EHM) (Holbrook & Hirschman, 1982) and incorporates social value, classifying perceptual value into three major categories: perceptual emotional value, perceptual-cognitive value, and perceptual social value. Perceptual emotional value includes immersion and enjoyment, and adopts usefulness, ease of use, confidence in choice, and presence as the sub-factors of perceptual cognitive value (Kowalczuk et al., 2021; Heitmann et al., 2007; Dacko, 2017; Martínez -Navarro, et al. 2019). Perceptual social benefits are classified as the factor of perceptual social value (Lee and Xu, 2020).

In perceptual emotional value, it is explored whether the color trial service of the smart AIR beauty tool can make consumers feel the emotional value of enjoyment and immersion. In perceptual-cognitive value, it is explored whether such a service can make consumers feel the cognitive value of usefulness, ease of use, confidence in choice, and presence. In perceptual social value, it is explored whether such a service can make consumers feel the social value of perceptual social benefits. Finally, the response is all about the desire for patronage, exploring how consumers respond after using the color trial service and then measuring the perceived perceptual value, i.e. the impact of the smart AIR beauty tool on consumers' desire for patronage.

Stimuli can be created through virtual environments and evoke consumers' emotions (Mehrabian & Russell, 1974). In the existing literature on AR, several key features of AR are often mentioned as capable of stimulating consumers' perceptions (Sun et al. 2022; Yoo, 2020; McLean & Wilson, 2019; Yim et al., 2017; Javornik, 2016). This study identifies interactivity, vividness, system quality, and product informativeness as the four key AR features that stimulate consumers' perceived value.

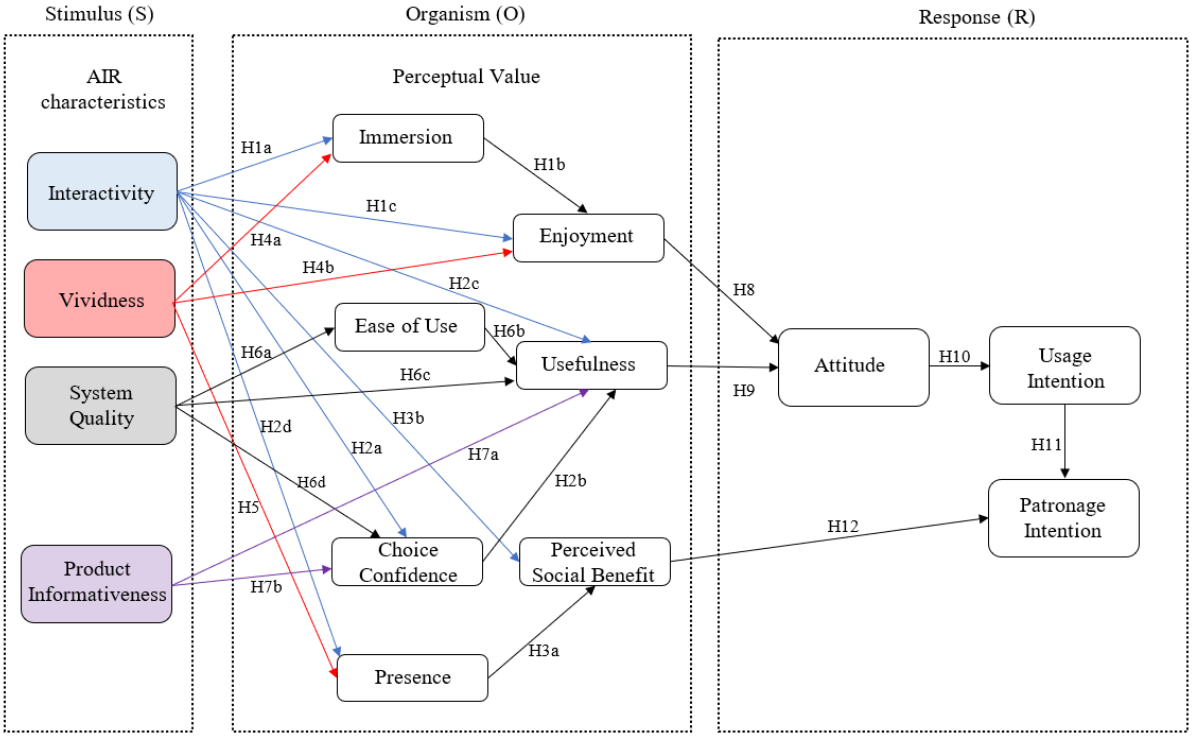

Figure 1. The research model and hypothesis

## 2.3 Research Hypotheses

This study aims to explore the perceived value generated by consumers when using AIR, and it measures consumers' perceived value of AIR in terms of perceived emotional value, perceived cognitive value, and perceived social value. In terms of perceived emotional value, this is further divided into two aspects: immersion and enjoyment. This study categorizes AIR characteristics into interactivity, vividness, system quality, and the amount of product informativeness. AR characteristics influence users' emotional responses and perceived reactions, which in turn trigger behavioral responses (Kowalczuk et al., 2021). Under vivid product demonstrations in AR, immersion and enjoyment are most strongly related to AR's interactivity in users' emotional responses (Kowalczuk et al., 2021). Yim et al. (2017) also

proposed that AR interactivity significantly enhances consumers' sense of immersion and evokes enjoyment value, including the pleasure felt by consumers when using the product (Yoo et al., 2010). Immersion is a psychological state in which a person becomes deeply engaged in an activity and experiences great joy and enjoyment (Moneta & Csikszentmihalyi, 1996). Following the results of the above studies, this study proposes Hypotheses H1a - H1c in an AIR experience:

H1a: AIR interactivity will enhance the degree of immersion.
H1b: The immersion will have positive effect on enjoyment.
H1c: AIR interactivity will enhance the degree of enjoyment.

In terms of perceived cognitive value, this study divides perceived cognitive value into four dimensions: presence, choice confidence, usefulness, and ease of use. AR interactivity can give consumers a sense of telepresence (Kim & Hyun, 2016), which is the perceived sensation from AR technology. Kowalczuk et al. (2021) also mentioned that increasing AR interactivity can influence consumers' product preferences, thereby ensuring their confidence in product selection. AR interactivity can also enhance usefulness (Perannagari & Chakrabarti, 2019). Additionally, in AR-related research, as with general decision-support systems, it has been noted that AR's interactivity and ability to present detailed, accurate information increase users' confidence in the tool's decision support. This leads to a higher perceived usefulness of the tool as it contributes to better decision-making outcomes (Perannagari & Chakrabarti, 2019). Following the results of the above studies, this study proposes Hypotheses H2a - H2c in an AIR experience:

H2a: AIR interactivity will enhance the level of choice confidence.
H2b: The level of choice confidence will have positive effect on the perception of usefulness.
H2c: AIR interactivity will enhance the perception of usefulness.
H2d: AIR interactivity will enhance the perception of presence.

In terms of perceived social value, this study uses Perceived Social Benefit as a measurement. In social environments, AR allows consumers to personalize themselves based on individual preferences, enabling them to express themselves (Carrozzi et al., 2019), and to demonstrate the roles they play in social interactions. The interactivity of AR also helps consumers gain perceived social benefits (Lee & Xu, 2020). When interacting with virtual environments, the experience of interaction similar to actual communication is called social presence (Lombard et al., 1997). Social presence enhances consumers' sense of social identity, promoting value benefits for both individuals and communities, thus influencing perceived social benefits (Ahearne et al., 2005). Based on the above findings, this study proposes hypothesis H3a - H3b in an AIR experience:

H3a: The perception of presence will have positive effect on perceived social benefit.
H3b: AIR interactivity will have positive effect on perceived social benefit.

Perannagari and Chakrabarti (2019) proposed that AR vividness affects consumers' enjoyment, and in a vivid AR environment, consumers experience emotional responses of enjoyment and immersion (Kowalczuk et al., 2021). Riar et al. (2021) argued that vividness influences consumers' immersion experience, involving a higher degree of enjoyment. In terms of perceived cognitive value, Kim and Hyun (2016) suggested that AR vividness induces a sense of presence in consumers, giving them an immersive illusion in the AR environment

(Biocca, 1997). Based on the above research findings, this study proposes Hypotheses H4a - H4b and H5 in an AIR experience:

H4a: AIR vividness will enhance the degree of immersion.
H4b: AIR vividness will enhance the degree of enjoyment.
H5: AIR vividness will enhance the perception of presence.

System quality represents the measurement of a website's information system processing capabilities and also refers to the system's ease of use (Rai et al., 2002). Therefore, in terms of perceived cognitive value, system quality positively influences users' perceived ease of use. The Information System Success Model (McLean et al., 1992) suggests that system quality will affect users, including decision accuracy and decision confidence, which in turn influence choice confidence. Previous studies found that the system quality of AR can enhance usefulness (Kim & Hyun, 2016) and AR system quality allows consumers to obtain perceived benefits from the usage process, such as usefulness (Lin & Lu, 2000). The Technology Acceptance Model (TAM) also indicates that ease of use affects usefulness (Davis, 1986), which has a positive impact on users' perceived value of technology. Based on the above research, this study proposes Hypotheses H6a - H6d in an AIR experience:

H6a: AIR system quality will enhance the ease of use perception.
H6b: The ease of use perception will have positive effect on the perception of usefulness.
H6c: AIR system quality will enhance the perception of usefulness.
H6d: AIR system quality will enhance the level of choice confidence.

The amount of product information can compensate for insufficient information by simulating a shopping experience through AR and allowing consumers to directly experience virtual products (Poushneh, 2018). It has been proven that such interactive decision-making aids in AR can lead to higher consumer choice confidence. Rese et al. (2014) proposed that AR product information can enhance usefulness, allowing consumers to gain perceived benefits during the usage process (Lin & Lu, 2000). Based on the above research, this study proposes Hypothesis H7a - H7b in an AIR experience:

H7a: AIR product informativeness will enhance the perception of usefulness.
H7b: AIR product informativeness will enhance the level of choice confidence.

From the perspective of perceived emotional value, when users experience hedonic value while using a system, their attitude towards the system improves (Chung et al., 2015). Therefore, this study hypothesizes that enjoyment will positively influence consumers' attitudes towards AIR. From the perspective of perceived cognitive value, attitude toward using a technology is an important factor in a person's behavioral intention to adopt a technology and will be affected by the perception of usefulness (Davis, 1989). Hence, this study proposes Hypotheses H8 and H9 in an AIR experience:

H8: The degree of enjoyment will have positive effect on attitude toward AIR.
H9: The perception of usefulness will have positive effect on attitude toward AIR.

External variables influence individuals' beliefs about the outcomes of behaviors, which in turn shape their attitudes toward the behavior (Ajzen and Fishbein, 1980). These attitudes then affect behavioral intentions, which ultimately influence the behavior itself. Hence, technology use is driven by behavioral intention, which is determined by attitude (Venkatesh et al., 2003;

Davis, 1989). When users have the intention to use a system, it affects their intention to patronize the website (Chung et al., 2015). From the perspective of perceived social value, perceived social benefits are influenced by online community identification and trust in the system and website. Consumer trust in a website affects their stickiness to it, which refers to their intention to patronize the brand website (Wang et al., 2016). Therefore, this study hypothesizes that perceived social benefits will also positively influence consumers' patronage intentions toward brand websites. Therefore, this study hypothesizes that attitude influences usage intention, and usage intention, in turn, influences patronage intention. Based on the above research, this study proposes Hypotheses H10, H11, and H12:

H10: Attitude towards AIR will enhance intention to use AIR.
H11: The intention to use AIR will enhance the patronage intention.
H12: Perceived social benefit will have positive effect on patronage intention.

This study refers to numerous past studies and organizes relevant theories and research findings to define the influencing factors. It also develops survey items and conducts a pretest of the questionnaire to ensure a well-designed questionnaire.

## 3 RESEARCH METHODOLOGY

### 3.1 Experiment and Questionnaire Design

The Experiment Method was used to collect data, and the smart AIR beauty tool on the official website of L'Oréal Paris Taiwan was used as the interface of the experimental system. After the experiment, a questionnaire was administered to the subjects to examine the effect of AIR features on consumers' perceptual value, and how the value affects consumers' attitudes toward AIR and their willingness to use the tool and visit the website. The experimental process was based on the five stages of the EBM model (Kotler & Dubois, 2003), one of the consumer purchase decision-making models. The five stages are needs identification, information collection, pre-purchase evaluation, purchase action, and post-purchase evaluation. From them, pre-purchase evaluation and purchase action were selected as the basis of the process for the study. As Figure 2 shows, the experiment was further divided into five sub-stages: checking one's right shade, checking the recommended matching products, matching one's makeup, checking the trial effect, and asking others' opinions.

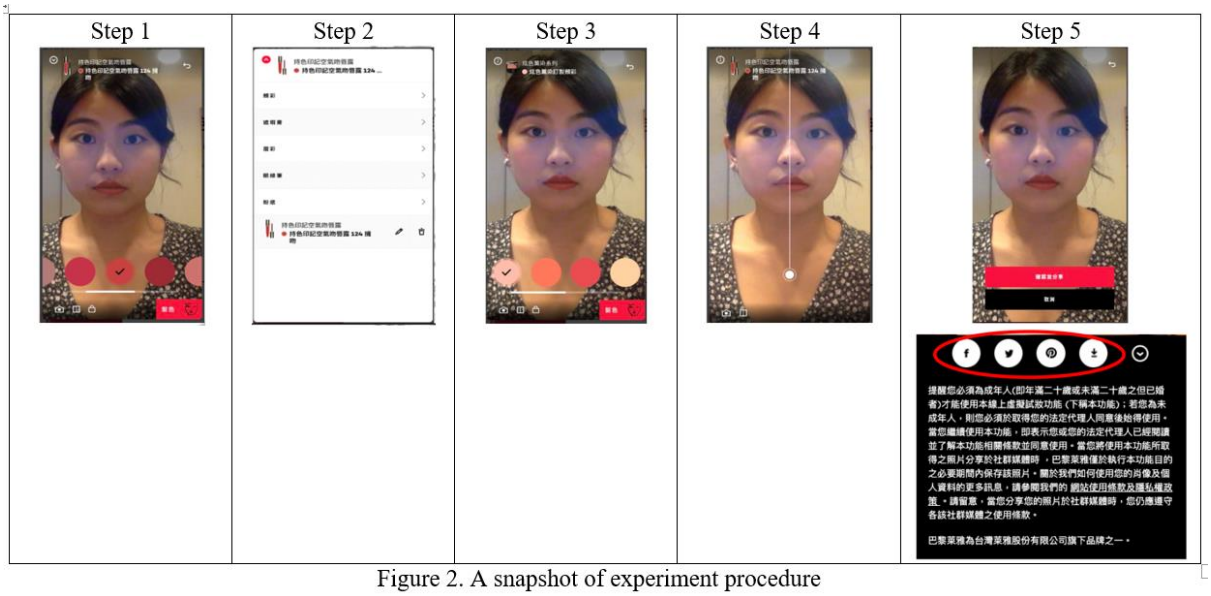


Figure 2. A snapshot of experiment procedure

After completing the experimental process design and questionnaire design, this study recruited 30 female college students for a pre-test, offering a gift card equivalent to approximately USD $3 as an incentive. The subjects were guided into the experiment with the help of experimental situation task cards. After some of the questions were revised, the reliability of the questions was greater than 0.83 in the pre-test. For example, immersion: Cronbach's α = 0.593, so two items were deleted: "The AIR smart beauty tool created a new environment, but it suddenly disappeared after the demonstration," and "The AIR smart beauty tool added virtual makeup to my face." After deletion, Cronbach's α increased to 0.867, improving reliability. The operational definitions of each construct, along with the revised measurement items and cited reference sources, are presented in Table 1.

Table 1 Operational definition and measurement items

| |
|---|
| **AIR Features:** |
| **Interactivity**: The extent to which consumers can actively engage and modify the content in the environment while using AIR smart beauty tools.<br>● IN-1: I find that the virtual product display has significant interactive features when using the AIR smart beauty tool.<br>● IN-2: By interacting with the virtual product display through the AIR smart beauty tool, I can gain a deeper understanding of the product.<br>● IN-3: By interacting with the virtual product display through the AIR smart beauty tool, I can obtain information that is tailored to my specific needs (such as makeup color requirements, etc.).<br>Adapted from Pantano et al. (2017). Cronbach's $\alpha^* = 0.838$ |
| **Vividness**: When using AIR smart beauty tools, the emotional and sensory stimuli received by consumers allow them to connect reality with imagination.<br>● VI-1: The AIR smart beauty tool presents virtual products in a visually appealing manner.<br>● VI-2: The AIR smart beauty tool realistically displays the design of virtual products (such as color and shape).<br>● VI-3: The virtual products presented by the AIR smart beauty tool appear as if they are real.<br>Adapted from Pantano et al. (2017). Cronbach's $\alpha^* = 0.893$ |
| **System quality**: The ability of AIR smart beauty tools to respond to consumer needs.<br>● SQ-1: I believe that the AIR smart beauty tool can respond to my requests in a timely manner and provide good results.<br>● SQ-2: I think the AIR smart beauty tool can execute its functions quickly and efficiently.<br>● SQ-3: I find the AIR smart beauty tool to be reliable (it is always operational, does not encounter errors while running, and does what it is supposed to do).<br>● SQ-4: I believe the AIR smart beauty tool provides comprehensive and precise services that align with the system's objectives.<br>Adapted from Kowalczuk (2018) and Park et al. (2015). Cronbach's $\alpha^* = 0.908$ |
| **Product informativeness**: The extent to which AIR smart beauty tools can provide consumers with useful product information.<br>● PI-1: The AIR smart beauty tool provides detailed information about the product.<br>● PI-2: The AIR smart beauty tool provides comprehensive information about the product.<br>● PI-3: The AIR smart beauty tool offers information for comparing products.<br>Adapted from Rese et al. (2014). Cronbach's $\alpha^* = 0.831$ |
| **Perceived Emotional Value** |

**Immersion**: The extent to which consumers feel immersed and actively engaged while using AIR smart beauty tools.

- IM-1: I feel that the AIR smart beauty tool completely captures my attention, allowing me to focus entirely on it.
- IM-2: The virtual makeup I just experienced feels like it has become a part of my face.
- IM-3: The virtual makeup I just experienced seems to exist in real-time.

Adapted from Daassi and Debbabi (2021) & Yim et al. (2017). Cronbach's $\alpha^* = 0.867$

**Enjoyment**: The extent to which consumers feel pleasure while using AIR smart beauty tools.

- EN-1: I find using the AIR smart beauty tool to be enjoyable.
- EN-2: I find that using the AIR smart beauty tool for online cosmetics shopping on the website is a pleasant experience.
- EN-3: I find that using the AIR smart beauty tool creates a great shopping experience on this website.

Adapted from Venkatesh (2008) and Davis (1989). Cronbach's $\alpha^* = 0.893$

**Perceived Cognitive Value**

**Usefulness**: The extent to which consumers believe they can gain benefits from using AIR smart beauty tools.

- PU-1: Using the AIR smart beauty tool will enhance my shopping efficiency by reducing issues related to matching my skin tone (for example: whether the shade matches my complexion).
- PU-2: Using the AIR smart beauty tool is very useful for obtaining information.
- PU-3: Using the AIR smart beauty tool can increase my efficiency in acquiring information.
- PU-4: Using the AIR smart beauty tool enables me to obtain information more quickly to complete tasks.

Adapted from Davis (1989). Cronbach's $\alpha^* = 0.901$

**Ease of use**: The extent to which consumers believe they can quickly grasp the operation of the system when using the AIR smart beauty tool.

- PEOU-1: I find the interface of the AIR smart beauty tool clear and easy to understand.
- PEOU-2: I find it easy to become proficient in using the AIR smart beauty tool.
- PEOU-3: I find it easy to master the use of the AIR smart beauty tool.

Adapted from Davis (1989). Cronbach's $\alpha^* = 0.931$

**Choice confidence**: The extent of consumer confidence in the accuracy of their decision when using the AIR smart beauty tool.

Using the AIR smart beauty tool

- CC-1: allows me to be certain about which product best suits my preferences.
- CC-2: gives me confidence in finding the product that best matches my preferences.
- CC-3: makes me confident that I have found the product that best meets my needs.

Adapted from Heitmann et al. (2007). Cronbach's $\alpha^* = 0.897$

**Presence**: The extent to which consumers feel present in the environment when using the AIR smart beauty tool.

When I use the AIR smart beauty tool,

- PR-1: at times the space created by the tool feels as real as the physical world.
- PR-2: the website makes it easy for me to imagine what the cosmetics would look like in real life.
- PR-3: the website provides me with a lot of sensory information about the product, just like being in a store.
- PR-4: the website creates a product experience similar to shopping in a store.

Adapted from Fiore et al. (2005) and Usoh et al. (2000). Cronbach's $\alpha^* = 0.94$

**Perceived Social Value**

**Perceived social benefit**: the extent of social benefits consumers gain from the experience.

- PSV-1: I believe using the AIR smart beauty tool allows me to share my virtual image with my friends.
- PSV-2: I believe using the AIR smart beauty tool enables me to receive feedback from my friends about my virtual image.
- PSV-3: I believe that feedback from my friends about my virtual image can increase my confidence in my purchasing decisions.

Adapted from Alshibly (2015). Cronbach's $\alpha^* = 0.871$

**Users' Response**

**Attitude:** The extent of a user's overall positive or negative feelings about using the AIR smart beauty tool.

- AT_1: Using this AIR smart beauty tool is a good idea when browsing a beauty website.
- AT_2: I enjoy using the AIR smart beauty tool when browsing a beauty website.
- AT_3: Using this AIR smart beauty tool makes my shopping experience more enjoyable.
- AT_4: Using this AIR smart beauty tool makes browsing beauty websites more fun.

Adapted from Chung et al. (2015). Cronbach's $\alpha^* = 0.880$

**Usage Intention**: The extent of a user's willingness to the AIR smart beauty tool in the future.

- UI_1: I intend to use this AIR smart beauty tool in the future.
- UI_2: I expect to use this AIR smart beauty tool in the future.
- UI_3: I plan to use this AIR smart beauty tool in the future.

Adapted from Chung et al. (2015). Cronbach's $\alpha^* = 0.944$

**Patronage intention**: The extent to which consumers express their willingness to visit, purchase from, or continue engaging with this brand's website in the future.

- PTI_1: I want to visit this brand's website again.
- PTI_2: I will continue visiting this brand's website.
- PTI_3: I might recommend this brand's website to my friends.

Adapted from Liew et al. (2017). Cronbach's $\alpha^* = 0.953$

Note: *The reliability analysis results after deleting the inappropriate items from the pre-test phase.

### 3.2 Samples and Reliability and Validity Analysis

In this study, the Experimental Method was used for data collection. A total of 82 volunteers were recruited to participate in the experiment. The questionnaire had attention check questions designed to see whether the subjects were serious about filling in the questionnaire. Getting the questions wrong meant the questionnaire was invalid and then eliminated. Altogether 81 valid questionnaires were obtained, with a valid response rate of 98.78%. Among the valid samples, the gender ratio was 100% for biological females due to the consideration that the products used in the experiment were more suitable for women. The reliability and validity of each construct were first examined, and the analysis results showed that the composite reliability and Cronbach's alpha of each construct were above 0.8, indicating the reliability of the measurement questions for each construct (Table 2). In terms of construct validity, the factor loading of the indicator value for each question was higher than 0.79 (Table 3). In addition, each construct had discriminant validity to a certain degree and met the criteria (Table 4).

Table 2. Descriptive Statistics and Average Variance Extracted (AVE) of Constructs

| Construct | CR | α | mean | SD | AVE |
|---|---|---|---|---|---|
| Interactivity | 0.912 | 0.855 | 4.6173 | 1.25126 | 0.775 |
| Vividness | 0.948 | 0.916 | 4.5370 | 1.42664 | 0.858 |
| System Quality | 0.905 | 0.842 | 4.4676 | 1.23151 | 0.705 |
| Product Informativeness | 0.937 | 0.901 | 4.9506 | 1.26293 | 0.832 |
| Immersion | 0.871 | 0.804 | 5.1111 | 1.12400 | 0.629 |
| Enjoyment | 0.920 | 0.869 | 4.9444 | 1.08303 | 0.792 |
| Usefulness | 0.949 | 0.926 | 5.1574 | 1.21245 | 0.823 |
| Ease of Use | 0.908 | 0.848 | 5.5988 | 1.02665 | 0.766 |
| Choice Confidence | 0.975 | 0.962 | 4.6420 | 1.51284 | 0.928 |
| Presence | 0.930 | 0.903 | 4.3796 | 1.38450 | 0.769 |
| Perceived Social Benefit | 0.884 | 0.805 | 5.3395 | 1.16643 | 0.718 |
| Attitude | 0.941 | 0.915 | 5.1296 | 1.09968 | 0.799 |
| Usage Intention | 0.981 | 0.971 | 4.3580 | 1.20072 | 0.945 |
| Patronage Intention | 0.969 | 0.952 | 4.7099 | 1.26731 | 0.913 |

Table 3 The factor loading of the indicator value for each construct

| Construct | Item | Factor loading | Construct | Item | Factor loading | Construct | Item | Factor loading |
|---|---|---|---|---|---|---|---|---|
| Interactivity | IN-1 | 0.872 | Enjoyment | EN-1 | 0.891 | Perceived social benefit | PSV-1 | 0.827 |
| | IN-2 | 0.892 | | EN-2 | 0.865 | | PSV-2 | 0.848 |
| | IN-3 | 0.877 | | EN-3 | 0.914 | | PSV-3 | 0.866 |
| System quality | SQ-1 | 0.841 | Usefulness | PU-1 | 0.791 | Attitude | AT_1 | 0.814 |
| | SQ-2 | 0.845 | | PU-2 | 0.928 | | AT_2 | 0.907 |
| | SQ-3 | 0.793 | | PU-3 | 0.948 | | AT_3 | 0.919 |
| | SQ-4 | 0.877 | | PU-4 | 0.953 | | AT_4 | 0.929 |
| Vividness | VI-1 | 0.878 | Ease of use | PEOU-1 | 0.874 | Usage Intention | UI_1 | 0.966 |
| | VI-2 | 0.963 | | PEOU-2 | 0.858 | | UI_2 | 0.984 |
| | VI-3 | 0.935 | | PEOU-3 | 0.893 | | UI_3 | 0.967 |
| Product informativeness | PI-1 | 0.936 | Choice Confidence | CC-1 | 0.951 | Patronage Intention | PTI_1 | 0.962 |
| | PI-2 | 0.895 | | CC-2 | 0.971 | | PTI_2 | 0.959 |
| | PI-3 | 0.906 | | CC-3 | 0.968 | | PTI_3 | 0.944 |
| Immersion | IM-1 | 0.815 | Presence | PR-1 | 0.889 | | | |
| | IM-2 | 0.827 | | PR-2 | 0.892 | | | |
| | IM-3 | 0.855 | | PR-3 | 0.882 | | | |
| | | | | PR-4 | 0.845 | | | |

Table 4 The correlation coefficients and discriminant analysis among the constructs

| Construct | IN | VI | SQ | PI | IM | EN | PU | PEOU | CC | PR | PSV | AT | UI | PTI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interactivity | **0.880** | | | | | | | | | | | | | |
| Vividness | 0.820 | **0.926** | | | | | | | | | | | | |
| System Quality | 0.765 | 0.741 | **0.840** | | | | | | | | | | | |
| Product Informativeness | 0.253 | 0.198 | 0.257 | **0.912** | | | | | | | | | | |
| Immersion | 0.677 | 0.675 | 0.599 | 0.265 | **0.847** | | | | | | | | | |
| Enjoyment | 0.775 | 0.789 | 0.727 | 0.183 | 0.716 | **0.890** | | | | | | | | |
| Usefulness | 0.662 | 0.519 | 0.614 | 0.312 | 0.579 | 0.681 | **0.907** | | | | | | | |
| Ease of Use | 0.390 | 0.311 | 0.482 | 0.231 | 0.489 | 0.436 | 0.527 | **0.874** | | | | | | |
| Choice Confidence | 0.768 | 0.693 | 0.706 | 0.075 | 0.669 | 0.718 | 0.730 | 0.311 | **0.963** | | | | | |
| Presence | 0.757 | 0.725 | 0.717 | 0.222 | 0.710 | 0.747 | 0.697 | 0.350 | 0.845 | **0.877** | | | | |
| Perceived Social Benefit | 0.532 | 0.420 | 0.505 | 0.168 | 0.610 | 0.567 | 0.663 | 0.503 | 0.589 | 0.632 | **0.847** | | | |
| Attitude | 0.696 | 0.625 | 0.535 | 0.256 | 0.555 | 0.711 | 0.678 | 0.428 | 0.622 | 0.651 | 0.686 | **0.894** | | |
| Usage Intention | 0.564 | 0.545 | 0.505 | 0.176 | 0.413 | 0.627 | 0.492 | 0.291 | 0.554 | 0.586 | 0.459 | 0.679 | **0.972** | |
| Patronage Intention | 0.674 | 0.581 | 0.558 | 0.183 | 0.556 | 0.741 | 0.697 | 0.463 | 0.684 | 0.679 | 0.610 | 0.752 | 0.680 | **0.955** |

**Note:** The bold values with gray background on the diagonal represent the square root of the AVE, while the lower left part of the diagonal shows the correlation coefficients.

## 4 ANALYSIS RESULTS AND DISCUSSION

This study uses path analysis in Smart PLS 3 statistical software for hypothesis validation, and the Bootstrapping sample was set at 5,000 (Figure 3). The influence of AIR features on consumers' perceptual value is focused on that of interactivity of AIR. In terms of perceptual emotional value, the impact of interactivity on immersion and enjoyment is significant, with immersion positively affecting enjoyment. Therefore, hypotheses H1a, H1b, and H1c are valid, which means that the interactivity of AIR will positively influence consumers' perceived emotional value of the AIR smart beauty tool. In perceptual-cognitive value, interactivity has a significantly positive effect on confidence in choice and presence, and choice confidence also has a significantly positive effect on usefulness. Hypotheses H2a, H2b, and H2d are valid, but H2c is not. In perceptual social value, presence has a significantly positive effect on perceptual social benefits, and hypothesis H3a is valid, but H3b is not. In perceptual emotional value, vividness has a significantly positive effect on immersion and enjoyment, so hypotheses H4a and H4b are valid, which also means that the vividness of AIR will positively influence consumers' perceived emotional value of the AIR smart beauty tool. In perceptual-cognitive value, vividness has a significantly positive effect on presence, so hypothesis H5 is valid. As for the effect of AIR system quality on consumers' perceptual value, hypotheses H6a, H6b, and H6d are valid, while hypothesis H6c is not valid. When it comes to the effect of the product informativeness on consumers' perceptual value, about perceptual-cognitive value, the effect of the product informativeness on usefulness is significant, but the path coefficient for the effect on confidence in choice is negative. Thus, hypothesis H7b is not valid, but hypothesis H7a is.

Considering the explanatory power of the model in terms of perceptual emotional value, the $R^2$ for immersion and enjoyment are 0.506 and 0.719 respectively, indicating that this consumer's emotional cognition is influenced by AIR interactivity and vividness. This goes to explain the variations of 50.6% and 71.9% respectively. In perceptual-cognitive value, $R^2$ = 0.674 for usefulness indicates that in terms of AIR characteristics, usefulness is influenced by choice confidence, ease of use, and product informativeness. $R^2$ = 0.236 for ease of use indicates that ease of use is influenced by system quality. The $R^2$ = 0.644 for confidence in choice indicates that choice confidence is influenced by interactivity, system quality, and product informativeness, which can explain the variation of 64.4%. $R^2$ = 0.607 for presence indicates that its variation of 60.7% can be explained by interactivity and vividness. In terms of perceptual social value, $R^2$ = 0.410 for perceptual social benefits indicates that perceived social benefits are affected by presence.

If we look at the influence of consumers' perceptual value on their attitudes toward AIR, for the influence of consumers' perceptual emotional value on their attitudes toward AIR, the influence of enjoyment on these attitudes is significant. Therefore, hypothesis H8 is valid. For the effect of consumers' perceptual-cognitive value on their attitudes toward AIR, the effect of usefulness on these attitudes is significant, so hypothesis H9 is valid. $R^2$ = 0.578 for attitudes toward AIR means that such attitudes are affected by enjoyment and usefulness, which can explain the variation of 57.8%. Regarding how consumers' attitudes toward AIR relate to their willingness to use smart AIR beauty tools, such attitudes have a significantly positive effect on the willingness, so hypothesis H10 is valid. $R^2$ = 0.460 is for usage intention. As for consumers' willingness to use smart AIR beauty tools in relation to their willingness to visit the website, the effect of usage intention on patronage intention is significant, so hypothesis H11 is valid. For the effect of consumers' perceptual social value on their desire for patronage, the effect of perceptual social benefit on their desire for patronage is significant, so hypothesis H12 is valid. $R^2$ = 0.575 for patronage intention means that patronage intention is influenced by perceptual social benefits and usage intention, explaining the 57.5% variation.

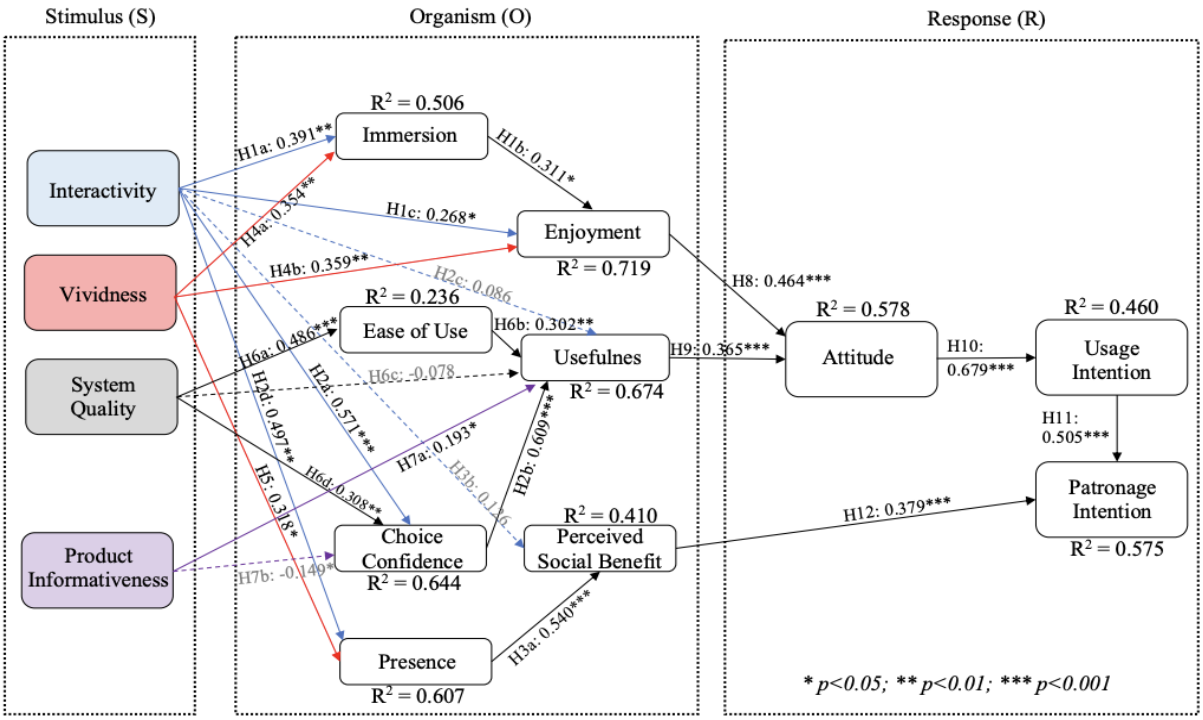


Figure 3. The results of PLS analysis

## 5 CONCLUSION

The purpose of this study is to explore the impact of AIR features on consumers' perceptual value and their attitudes toward AIR technology. Then this study goes on to explore how consumers' attitudes toward AIR affect their willingness to use smart AIR beauty tools and visit the website. Consumers' perceptual-cognitive value is significantly influenced by interactivity, vividness, system quality, and product informativeness of AIR. Perceptual social value is significantly influenced by the presence. Perceptual emotional value is significantly influenced by the vividness and the interactivity of AIR. This study also suggests that consumers' perceptual value affects their attitudes toward AIR technology, and that such attitudes in turn significantly affect their willingness to use smart AIR beauty tools and to visit the website. The results of the study verify that consumers' attitudes toward AIR technology do influence their willingness to use smart AIR beauty tools, and that consumers' willingness to use smart AIR beauty tools significantly influences their willingness to visit the website. This also confirms that consumers' willingness to use a system increases their trust in the website of the system, and positively influences their willingness to visit the website that uses the system.

### 5.1 Academic Implications

For researchers studying the S-O-R model and AIR technology, this study offers several academic suggestions. This research is based on the S-O-R model as the foundational framework, using AIR features as the stimulus (S), consumers' perceived value as the emotional response (O), and AR attitude, usage intention, and patronage intention as the response factors (R). The aim of this study is to explore consumers' positive perceived value; therefore, the emotional response factors employed in the S-O-R model consist of relatively positive perceived value variables.

It is recommended that future researchers adopting the S-O-R model to investigate AIR technology consider incorporating negative variables, such as perceived risk and privacy concerns, into the emotional response construct. This would allow for a more comprehensive exploration of consumers' attitudes, usage intentions, and patronage intentions when using AIR tools, providing a more holistic assessment of emotional response factors during AIR usage.

Additionally, this study specifically analyzes the impact of AIR on consumers' perceived value, using the EHM model as a basis to discuss perceived emotional value, perceived cognitive value, and perceived social value. However, according to past literature, there are many other dimensions of perceived value that could be analyzed. Therefore, it is suggested that future researchers examining the impact of AIR on consumers' perceived value consider including monetary value in their analysis to explore how the use of AIR systems influences consumers' perceived value beyond emotional and cognitive aspects at both individual and societal levels.

### 5.2 Practical Implications

This study also offers some practical suggestions for e-commerce businesses that adopt AIR technology to assist in sales. The results indicate that the interactivity of AIR significantly affects consumers' perceived cognitive value and perceived emotional value. Therefore, it is recommended that e-commerce operators optimize the interactive features when implementing AIR systems. For instance, in the cosmetics industry, when creating an AIR smart beauty tool system, businesses could enhance the AIR system by incorporating interactive features that provide consumers with shade recommendations based on their skin tone, simulating the experience of interacting with staff in a physical store or counter.

Furthermore, the findings of this study also reveal that the vividness and interactivity influence consumers' perceived emotional value. Consequently, e-commerce businesses should regularly monitor consumer responses to the AIR system and continuously optimize it. In the cosmetics sector, for example, operators could periodically assess consumer feedback on the AIR system and consistently improve the AIR smart beauty tool system to ensure that the colors of virtual products closely match real shades. Additionally, enhancing the system's speed can create a more authentic experience for consumers, making the usage process smoother and allowing them to enjoy more personalized services.

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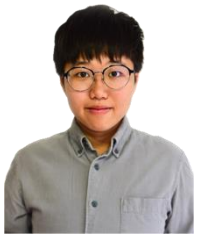

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