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Research Article

Users' Perceptions of Technological Features in Augmented Reality (AR) and Virtual Reality (VR) in Fashion Retailing: A Qualitative Content Analysis

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This study explores users' perceptions of technological features in augmented reality (AR) and virtual reality (VR) and analyzes the advantages and disadvantages of technologies (e.g., AR vs. VR) in fashion retailing. The findings are presented from a qualitative approach and content analysis of focus group interviews. Users' perception of AR technological features consisted of 5 dimensions: augmentation, user control, vividness, responsiveness, and simplicity. Users' perception of VR technological features consisted of 4 dimensions: telepresence, simulator sickness, visual discomfort, and user control. Practical implications for the application of mixed reality technology in fashion venues are discussed: for AR technology as a part of shopping tools, the advantages of control and simplicity should be taken seriously; for VR, an immersive experience as the main pros facilitated by telepresence, while sickness, followed by visual discomfort as the main simulator cons. This research offers valuable and useful insights into AR and VR as antecedents from the technological aspect and helps marketers develop and formulate new solutions for the application of AR and VR in fashion retailing.

1. Introduction

In the late 1990s, digital information and communication technologies (ICT) greatly increased marketing efficiency. Enterprises can use digital marketing to create value and communicate with customers and all stakeholders to deliver the value [1]. On the other hand, some consumer experiences brought by ICT still have some shortcomings. For example, they are not as rich as the actual shopping experience to fully meet the moral needs of customers. Mixed reality technologies, with their massive impact on consumer experience, could solve the problem of a decline in online shopping [2]. Virtual reality (VR), as an important immersive technology, constructs a three-dimensional virtual world through simulation, allowing people to enter and interact with the virtual world. Although the lack of contact with the real space is a problem in VR, augmented reality (AR) technology solves the problem and proposes a new visualization method that can add computer-generated content to the real world, and this technology creates an augmented world that users can interact with [3].

Based on the impact of these technologies on the retail industry, shopping has recently become one of the most popular activities in virtual worlds. Because the evaluation of fashion products requires multiple sensory experiences [4], leading fashion companies like Gucci, ZARA, H&M, Nike, and Myer Department Store, and cosmetic companies like Estée Lauder, Sephora, L'Oreal, and Oliveyoung are actively developing AR and VR shopping platforms to increase consumption by maximizing the shopping experience [5].

The retail industry has already proven the effectiveness and usefulness of VR [6], which can reproduce the environment, objects, and people with high fidelity, and consumers have a similar experience to shopping in physical

stores [7]. In the VR environment, consumers can tour around the store freely, and their emotional needs can be satisfied by more immersive and interactive shopping experiences [8]. However, for fashion products, it is more important for consumers to understand the fit between the product and the consumer. AR try-on technology allows consumers to experience virtual products in a physical environment that is similar to the feeling of being able to try-on them directly [9]. This feature makes it a great tool for marketing products that require a high level of body involvement (e.g., apparel and cosmetics) [10].

While the benefits are intuitive, the application of AR and VR in fashion retail still faces many difficulties, and many fashion retailers' virtual retail attempts have ended to a halt. With the support of the government's textile fashion promotion project, LF launched the 3D virtual fitting "LF My Fit" service at the LF shopping mall, but it ended after six months. Amorepacific Laneige's virtual makeup application "Beauty Mirror" and JSTINA's "AR sunglasses try-on service" are also short-term events. LF officials said, "Thus far, the accuracy of this technology is poor, it is difficult to obtain the required services [11]."

Retailers have invested enormously in these advanced technologies but are facing numerous problems. Exploring how consumers perceive these advanced technologies and whether consumers will accept and continue to use these devices for shopping assistance is crucial for the success of new technologies in retail. The majority of previous research has focused on understanding how AR and VR technology are applied, while little has been done looking at AR's technological features. Moreover, there has been some discussion of a feature-centric view of technology, which stresses that postadoption decisions are driven by reflective processing by users with prior expectations, who recognize and evaluate the features of the technology mindfully [12]. User satisfaction and perceived benefits are strongly influenced by technological features, both of which are positive for use intentions and continual use [13]. Nevertheless, there is still only a small amount of research involving some factors and effects about or related to technological features on the user's attitude toward and the continuous use intention of AR and VR.

Given the lack of theoretical and empirical insights on the issue, it is important to understand the dynamics that stimulate users' virtual experiences in technological environments. With a qualitative approach, this study explores users' technological connotations for apparel shopping in virtual stores to address this issue as defined in the research questions: (1) to identify underlying dimensions of perceived technological features and (2) to analyze the advantages and disadvantages of technologies (e.g., AR vs. VR) in fashion retailing. By identifying the technological features that the user perceives, marketing managers can optimize their promotion strategies for e-commerce to increase consumer evaluations.

2. Theoretical Background

2.1. AR and VR in Fashion Retail. VR builds a three-dimensional virtual world through simulation and reshapes the way people interact with the real and virtual worlds. By combining computer-simulated graphics with real-time interactive environments, it immerses users in a simulation and gives them the ability to interact directly with that world [14]. In this interaction, users mostly interact with the environment through agents (i.e., avatars) in their environment to form a simulated experience [15]. This simulated experience can be similar or completely different from the real world. As a consequence of using the visual experience as the main output device and the input technique that provides timely interaction, it gives this kind of simulated experience vividness, interactivity, immersion, and imagination features, and the user can generate a rich sense of telepresence in a virtual reality environment [16]. The core technologies of VR are real-time 3D computer graphics technology, virtual scene display technology, recognition and tracking technology, voice, gesture, sensory feedback, and other interactive technologies [17]. A VR system can be classified into two types, immersive and non-immersive. [18]. The difference between the output equipment and the effect achieved is the foremost criterion for classification. Non-immersive VR systems use infrared monitors for output, while immersive VR systems use head-mounted displays for output [19]. Corresponding to the use of the monitor, the user uses the mouse, keyboard, or manual control using a touch screen controller. In more immersive VR devices, input depends on gestures or eye gaze [20].

In AR, virtual elements are superimposed directly onto a real-life environment via a screen or projector. The augmentation-enrichment of the environment coexists with the physical world due to AR's technological ability to augment real objects with virtual annotations [21–23]. The most significant difference with VR technology is that the main environment is real, but the objects depicted in the environment are virtual [24]. With AR, users can experience the virtual world and remain to see the real world [25]. With see-through and monitor-based displays [26] or mobile terminal devices [27] to present real and virtual information simultaneously [28]. The webcam allows the image of real objects (users) and virtual objects (target products) to be displayed simultaneously on the output device [29]. A speech recognition system converts spoken input into computer instructions, while a gesture recognition system interprets movement using cameras or sensors embedded in peripheral devices including a wand, stylus, pointer, glove, or other bodywear. [30–34]. Table 1 shows the basic differences between VR and AR.

2.2. VR and AR in Fashion Retail. In the early stage, some researchers noted four advantages of VR technology applied to retailing and e-commerce practices： similar experience to real shopping, free in-store tours, more immersive and interactive experience, and social communication [35]. In the later period, many researchers responded to the previous research. VR technology has high simulation characteristics. In the experience, because VR can build a virtual world, that is, very similar to the real world through the computer system, customers cannot perceive the difference between

Table 1: The difference between VR and AR.

	VR	AR
Generated image	Virtual	Combination of virtual and reality
Main environment	Virtual environment	Real environment
Interacting object	Virtual object	Both virtual and real objects
Effect achieved	Users explore the environment from a subjective perspective inside the virtual environment, can integrate multiple sensory interaction effects, can move avatars in the space, and can also change the environment and objects in the virtual space	The virtual information and the real image of the user are mapped to the output device at the same time. The user can use this mapping in the real environment to freely experience the virtual product and view the virtual information related to the product

the real environment and the fictitious environment, thereby helping users realize the dual perception of physical and psychological immersion [36]. VR is also highly experiential and can integrate various sensory dynamic and autonomous interactions such as vision, hearing, smell, and touch [2] so customers can get more than other media (such as TV and computer displays) natural, richer, and closer to the real experience [37].

Many fashion retailers take efforts to apply VR technology for marketing. In May 2016, the US e-commerce giant eBay and Australian retailer Myer jointly created the world's first VR department store. The two parties jointly launched a virtual reality headset-a "shoptical" carton display. With a smartphone and customized app, shoppers can be in the virtual reality version of Myer Department Store, browsing and buying more than 125,000 items in the department store [38]. Oliveyoung, a Korean cosmetics collection store, has also launched VR virtual stores for mobile phones, computers, and head-mounted devices. Although VR is applied in various forms in fashion retail, one of them, mobile-based HMD, simple and cheap, relies entirely on a smartphone to display stereoscopic animation and uses optical structures to generate depth perception [39]. Due to the accessibility of interest, the mobile-based HMD is selected for the experiment.

Since the end of the 2000s, AR has been applied to the exploration of marketing practices [21] and the retail industry is also benefiting from this exploration. With try-on sensory effects, online consumers can obtain product information similar to directly touching products in a physical world [9]. For instance, consumers have the ability to manipulate virtual products directly through gestures and other bodily actions, a feature, that is, currently limited in a website user's experience. Additionally, AR tracks various behaviors and try-dynamics associated with online consumers in real-time, allowing consumers to review, recheck, and correct self-fitting effects at any time [27, 40].

Italian luxury brand Gucci launched AR technology in 2019 through its application (app), consumers can choose the shoes they want, and then try to put the phone camera on their feet to wear shoes virtually. ZARA has launched an AR shopping assistant application that can virtually display clothes worn by models when the camera is pointed at the store, and Nike has launched a service that can scan the size of a customer's feet and suggest shoe size through AR. L'Oreal, the world's number one cosmetics company, has launched the "Make-up Genius" app, which allows women to apply L'Oreal cosmetics virtually using facial mapping technology. To enhance its functions, the company also acquired a related technology startup "ModiFace" in March 2018 [11]; previously, Sephora also launched the Sephora Virtual Artist with the help of ModiFace, enabling customers to "try" Sephora up to more than 3,000 lipsticks. After receiving feedback from customers, Sephora and ModiFace expanded the application, developed virtual eyelashes virtual try-on, and online beauty makeup virtual tutorials; Estée Lauder (Easter Lauder) launched a trial product based on AR technology on its website and mobile website. As the light in the room changes, users can see the trial effects of different products. The technology can also make up for the lack of texture and gloss in photos and videos. Through the AR function, users can try many of the eyeshadows and lipsticks launched by brands on e-commerce websites.

It can be seen from the AR application examples of different retail brands, that the current AR embracing retailing can be classified into two types: in-store devices, i.e., virtual dressing room, virtual fitting mirrors, and consumers' mobile according to the different output devices. Both of these technologies are by overlaying virtual products on consumers' faces and bodies through different output devices [27, 41–45]. In this study, subjects need to conduct virtual try-on experiments under unified guidance. In order to eliminate other interference factors in the use of mobile devices, in-store devices in fixed situations are more suitable for experiments. Based on the abovementioned considerations, an AR-based virtual fitting mirror was selected for the experiment.

2.3. Technological Features of AR and VR in Retail. During the past few decades, VR technologies have dramatically changed consumer shopping patterns. Previous research in retail mainly focused on an understanding of consumers' response to the technology and discussed the value of VR based on this perspective. From the perspective of practical value, in a virtual reality retail store, consumers can get a shopping experience closer to the real situation, such as entering the store, observing, and selecting products

[46]. Companies leveraging VR technology can benefit by improving the quality of product knowledge and marketing communications [47]. While enhancing customer perception of the product, this technology can also improve the communication process [48]. Virtual product presentations allow consumers to better examine items [49] and can enhance customers' understanding of product availability and services [50]. As an interactive online real-time interactive technology, VR reflects the benefits of consumers' cognitive learning about product features and functions [51].

When exploring the value of VR in retail, most of the studies focused on the value of immersive experience, and one of the technological factors mentioned most frequently is telepresence. Telepresence positively influences persuasion at the merchandise and attribute levels [52] and creates shopping pleasure (experience value) by influencing consumer fantasy, which directly contributes to the willingness to buy from online retailers [53]. Vividness and interactivity are the key technological variables of the stimulus features communicated to the user, which can determine the virtual experience quality [54, 55]. More vivid images lead to more positive attitudes of consumers [6]. Some buying features such as an addition to the cart, and removal from the cart, and some visual features such as item selection, rotation, and zoom, are related to user control, both of which influence purchase intention through interactive shopping experiences in VR [46].

VR can help consumers in the shopping process, and whether consumers will accept and continue to use these devices for shopping assistance is crucial for the success of new technologies in retail. In research on VR hardware acceptance, perceived ease of use positively affects the attitude toward VR hardware. Functional simplicity and inefficiency are closely related to switching intention to AR/VR content services [56]. Factors such as telepresence and control can enhance consumer flow, which is positively associated with antecedent factors of technology acceptance (i.e., playfulness and usefulness), which are, in turn, associated with greater intentions to adopt and utilize VR technology in a consumer setting [57]. In a study on how to evoke consumers' intention to enter a VR store, the results showed that participants, who perceived higher vividness and interactivity tended to exhibit stronger approach intentions, and this positive effect was mediated by perceived telepresence [54]. A study that examined the effects of online stimuli on users' motivational states and their behavioral intentions toward virtual shopping on a social networking site provided a controllable, responsive, connected mode of interactivity, that is, important to increasing users' motivations [58]. From a negative perspective, the operation of VR remains a major challenge affecting customer satisfaction and VR acceptance [50]. Additionally, simulator sickness is one of the main reasons users abandon using VR [59].

Previous AR research has examined these various aspects of the advantages or disadvantages of various applications to retail settings. AR enhances consumers' understanding of the product and enables them to anticipate, how they are wearing the product without really try-on [2, 60], and this enriches the consumer shopping experience by visualizing the product on an image that features the consumer's body [61]. The enhancement of user experience due to AR devices can affect consumers' engagement [45], evaluation of products [62], patronage, and purchase intentions [63]. The AR devices in a physical store also positively affect the average customer stay time and the frequency of shop entry [64]. When AR is applied to e-commerce, it affects the novelty, immersion, enjoyment, and usefulness of the media, as well as users' attitudes toward the media and consumers' willingness to buy [43].

The technological factor of AR forms technology-mediated experiences that result in integral technology-enhanced experiences [2]. Some researchers detail how interactivity and vividness in the AR context lead consumers to evaluate products in similar ways to traditional shopping. When virtually trying on clothes using AR, the size selection, the fitness evaluation of the neck, shoulders, width, cuffs, and volume/fullness of the skirt can be consistent with the actual try-on effect to some extent. In a study that took virtual try-on sunglasses as an example, it was found that imprecise product mapping (augmentation) makes it difficult to convince consumers to buy [42]). Furthermore, individuals, who perceive higher telepresence have better attitudes and higher purchase intent toward apparel products [65]. A synchronized sense of control positively impacts the rapport experience [66]. Simulated physical control and environmental embedding as two attributes can lower cognitive load but improve cognitive fluency and then affect users' product attitude and purchase intention. Controllability positively affects elaboration and quality, which in turn affects consumer attitudes and behavioral intentions [67]. In regard to paying intention, sensory control (i.e., touch control and voice control) and feedback modalities affect consumer value judgments by reducing mental intangibility, positively affecting decision comfort, and resulting in a willingness to pay [68].

As mentioned above, a study on how technological features affect use intention and continual use intention examines three features: representational fidelity, the immediacy of control, and interactivity [13]. The key interactive qualities of AR service automation are visually appealing and task-appropriate information. Both of these enable a feeling that the digital environment is "real" and the transition between interaction and engagement. In this process, the use-value is generated and reflected in the key behavior of repeated use of services and word of mouth [22, 69]. In research on the acceptance of AR in retail, augmentation quality and media characteristics are two themes studied in the literature. In these studies, some technological features, such as augmentation, vividness, interactivity, responsiveness, response time, and control are mentioned when exploring their effect on users' attitudes and behavioral intentions through flow and value [42, 70]. Some scholars researched AR for clothing virtual try-on and found that ease of use positively affects perceived usefulness and perceived entertainment value and attitudes toward this tech [9]. Simple operation mediates the relationship between presence and technology acceptance [71]. The result of an Italian

qualitative investigation also shows that ease of use, searching and managing information, and speed in surfing the web all contribute to consumer eagerness [72]. A mechanism through which AR inspires users echoes previous studies showing augmentation quality, and ease of use can inspire users through the link, nostalgia, between psychological and behavioral inspiration [73].

Jasperson et al. called for a feature-centric view of technology [12]. Various technological features have served as catalysts for investigating effects on consumer responses and as tools for understanding certain interactive technologies [13, 74]. Although some technological features such as telepresence, vividness, augmentation, interactivity and control, responsiveness, simplicity, simulator sickness, and visual discomfort have been mentioned and discussed in previous studies. Nevertheless, there is still only a small amount of research involving some factors and effects about or related to technological features on the user's attitude toward AR and VR. Whether there are any other factors that are ignored is also an inevitable problem in the current academic research stage. Even if the individual's experience is produced by artificial technology, due to the different psychological states or subjective perceptions of each person, the individual's perception of different attributes is not the same. Understanding consumer responses to new technologies such as AR and VR, as well as sharing barriers and technical implementation requirements, is critical to the design of an effective virtual shopping environment and enrichment of the shopping experience for consumers [75].In the research, we asked users to experience shopping in fashion retail stores with AR and VR devices and select qualitative research methods to explore users' perceptions of technological features and identify the underlying dimensions of perceived technological features and from users' perceptions of technological features to analyze the advantages and disadvantages of AR and VR in fashion retailing.

3. Research Method

3.1. Focus Group Interview (FGI). As a qualitative approach, this study used focus group interviews (FGI) to explore how the technological features the user perceives and how users' perception of technological features affects users' attitudes toward AR and VR.

Qualitative research methods provide us with unique insights into perspectives and opinions. This approach is appropriate to explore perspectives, attitudes, and experiences. Focus group interview (FGI) as a representative method in qualitative research has been used for a variety of consumer-driven marketing purposes. In actual operation, we provide a permissive, and threatening environment, participants are free to speak and interactively discuss with each other under the auspices and prompts of the moderator. By creating a process of sharing and comparison, FGI provides a deep and broad understanding of participants' experiences and beliefs [76]. Compared to other methods, the main advantage is that it allows participants more freedom of expression. In this way, participants can choose the way they prefer to answer questions, and can also discuss and interact with other participants and exchange opinions, thereby increasing the complexity of qualitative information [77]. It is considered to be one of the most important methods commonly employed in consumer marketing and research [78].

3.2. Field Experience Setting. Since AR and VR are in the early stages of introduction in the fashion field, there are very few cases of application and prior research in the domestic fashion market, and few experienced people have shopped fashion goods with AR and VR. Therefore, the research subjects should visit the store in person. After having AR and VR shopping experience, FGI will execute based on the participant's experience. The procedures followed during the focus group sessions carried out for this research.

Fashion retail covers a wide range of goods. In the cases of fashion retail using AR and VR, the types of goods are mainly concentrated in apparel, accessories, cosmetics, etc. Mobile-based HMD is easy to use by consumers due to its simple structure and affordable price, and an AR-based virtual fitting mirror is most widely used in fashion retail stores. In this study, based on the three most representative product categories, we selected two fashion physical stores with AR-based virtual fitting mirrors, rounds for eyewear, within 24 for apparel, and mobile-based HMD's VR virtual cosmetic store, Olive Young.

The participants are selected because they have certain characteristics related to the research question. This study follows the sample selection criteria of previous studies [43], recruiting young consumers (i.e., college students), who are most familiar with innovative technologies and are the target market segment [66]. For these reasons, in this study, there were 14 participants (females = 10, males = 4), who enrolled at a university in Korea. All the participants should never have experienced AR and VR technologies in the fashion retail store. For this purpose, the method used is a non-probabilistic convenience sampling method to obtain an approximation of a specific subject [79]. Participation in this study is voluntary and can be withdrawn at any time if they do not wish to participate, even if they have agreed to participate in this study.

Participants can apply to participate in the experiment after seeing the enlightenment of recruitment, and after they are familiar with the content of the experiment, if they have a certain willingness to participate, they can submit a research agreement (written signature). We used a research meeting to explain the research content and experimental process to all participants in detail. After everything is ready, the panel was randomly divided into two groups for field experience of AR within two retail stores located in Seoul, Korea. Group 1 was asked to use an AR-based virtual fitting mirror at Rounds to experience the shopping for eyewear, while group 2 was asked to experience the shopping process of clothing with the AR device at Within 24. It is worth emphasizing that during the entire experience, the subjects use the augmented reality device to experience shopping freely. For the VR experience, two groups of the panel were asked to visit the

laboratory at a designated time and then experience mobile shopping in the Olive Young VR store by using the mobile-based HMD device for 10–15 minutes. For better illustration, Table 2 shows the field experience setting before the FGI. After the experiment and the intermission, FGI was separately conducted with two groups of panels, and one of the authors served as the moderator.

For FGI processing, the moderator began the discussion with self-introduction and participant self-introduction and informed participants that these questions were just personal opinions and beliefs and that there were no right or wrong answers. The panel groups were asked to open-discuss based on their experience with AR and VR technologies for one and a half hours.

For content analysis, the entire session was audio-recorded and transcribed into a script for content analysis. A total of 242 responses of verbal data were obtained from focus group interviews. Qualitative content analysis was used to analyze the verbal data using the NVivo10 program.

4. Results and Discussion

4.1. User Perceived Key Themes and Sub-Themes of Technological Features. Of the total 242 paragraphs, 154 phrases regarding technological features were excerpted. The excerpts were encoded and categorized based on consistency and frequency. A total of 128 excerpts related to the technological features were encoded into eight nodes according to previous research. This section presents our findings with the eight technological features of the discussions: augmentation, telepresence, vividness, simulator sickness visual discomfort, user control, responsiveness, and simplicity, which are further explained through a set of sub-items (Table 3) that emerged from the qualitative analysis. The technological features are not mutually exclusive and independent, but somewhat overlapping.

4.1.1. Augmentation. In recent years, some researchers have proposed the concepts of augmentation and augmentation quality. Augmentation refers to the enrichment of the environment where the virtual elements are no longer separated from the physical and the computer-generated elements coexist with the physical environment due to the AR technological ability to augment real objects with virtual annotations [80]. The computer-generated makeup or accessories map on the mirror image of a real person as if they are wearing them and looking in the mirror [81]. Another broader-scope concept, augmentation quality, is similar to augmentation, which refers to the output quality that results from interaction with virtual content and the integration of virtual and real content onto reality in terms of information quality, correspondence quality, or mapping quality [42]. Among the three, mapping can best reflect the technical characteristics of augmentation. Mapping as part of the output quality produced by interacting with virtual content and integrating virtual and real content into reality is a reflection of the appropriateness of the position of the virtual information. For example, when using AR equipment to try-on clothes, whether the clothes can be accurately placed on the user's body, whether the neckline, shoulder point, waistline, and other parts can correspond to the human body one by one, and whether the size of the clothes can be accurately presented, etc., are closely related to the mapping attribute. In our experiment, augmentation can be linked to the user himself, the surrounding space of the store, and a product image and some product information (e.g., sunglasses and apparel). According to previous studies by Javornik et al. using AR to try cosmetics, in this experiment, augmentation can be described as follows: (a) The application adds virtual products to users' bodies; (b) The way the product is placed on users' bodies seems real; (c) The products seem to be part of users' bodies; (d) The products move together with users' bodies when the user moves; and (e) The products seem to exist in real-time [81].

4.1.2. Telepresence. Telepresence is one of the dominant characteristics in VR technology [20, 82], which is defined as a sense of presence in a virtually created environment [16]. Telepresence is composed of the feeling of being in a mediated environment and leaving the physical environment [83], which is an important component in our understanding of how people experience VR [84], and the user's sense of being in a virtual environment determines the success of the VR experience [54]. Based on the previous claims, we describe telepresence as (a) Users feel that they are actually at the store; (b) Users feel that the visible scene is part of the actual store; (c) Users can easily recognize the atmosphere of the store; (d) Users feel that they can touch the products and things in the store; and (e) Users feel that things in the virtual environment are real [85].

4.1.3. Vividness. Steuer (1992) suggested that vividness and interactivity are two determinants of VR experience contributed by telepresence. Many studies have covered variables that can create telepresence and have identified it as the top priority for telepresence.

Vividness describes a technology's ability to produce a sensory-rich mediated environment, and sensory breadth contributes to vividness [16]. Vividness combines "the sensory experience of actual objects" with "hallucination." Hallucination is the nonsensory experience of imaginary objects. [86]. Other scholars also respond to this concept, which is expressed as realness, realism, or richness [20, 87]. In e-commerce, vividness is usually interpreted as the quality of the product display [88]. In the promotion of products, from a technical point of view, the quality and breadth of representation information perceived by users can also express vividness; that is, higher image quality can produce a higher level of vividness. High-resolution product image display technology can enhance consumer response to product promotions [89]. A recent study in immersive VR advertising found that participants in high vividness immersive VR conditions were more likely to have positive attitudes and to purchase advertised products via telepresence than those in non-immersive conditions with relatively low vividness. [6]. According to the study of

Table 2: Field experience setting (before interview).

Focus group	Number of panel	Types of technology		Tasks
		AR store (FX mirror)	VR store (VR headset)	
Group 1	$N = 7$	Roundz (eyewear)	Olive young (cosmetic)	AR: Visit to retail store and use FX mirror for shopping
Group 2	$N = 7$	With-in 24 (apparel)	Olive young (cosmetic)	VR: Wear VR headset and visit to VR shopping for 10–15 minutes

Table 3: Key themes and sub-themes.

Key themes	Sub-themes
Augmentation	(a) The application adds virtual products to users' bodies; (b) the way the product is placed on users' bodies seems real; (c) the products seem to be part of users' bodies; (d) the products move together with users' bodies when the user moves; (e) the products seem to exist in real-time.
Telepresence	(a) Users feel that they are actually at the store; (b) users feel that the visible scene is part of the actual store; (c) users can easily recognize the atmosphere of the store; (d) users feel that they can touch the products and things in the store; (e) users feel that things in the virtual environment are real.
Vividness	The quality of the image is: (a) Clear; (b) detailed; (c) vague; (d) vivid; (e) sharp; (f) well-defined
Simulator sickness	(a) Headache; (b) sweating; (c) dry mouth; (d) nausea; (e) dizziness; (f) drowsiness; (g) disorientation; (h) vomiting
Visual discomfort	(a) The sore your eyes feel; (b) the clear degree of your vision; (c) how fatigued you feel
User control	(a) Modify the position; (b) orientation; (c) features (e.g., shape, scale) of previously selected objects.
Responsiveness	(a) The speed of responses from or communications with the devices; (b) the speed at which users can navigate to access information.
Simplicity	(a) The operation is simple; (b) the content is easy to understand.

Javornik et al., in this experiment, vividness can be described as follows: (a) Clear; (b) Detailed; (c) Vague; (d) Vivid; (e) Sharp; and (f) Well-defined [81].

4.1.4. Interactivity (Control, Responsiveness). Because interaction is reflected in multiple aspects of human behavior, it is not a simple one-sided concept. From a technical point of view, the definition of interactivity is the degree to which users can participate in the real-time modification of the form and content of the intermediary environment, including the speed at which the content in the intermediary environment can be manipulated and how similar the controls used in the intermediary environment are to those in the real world, contributes to interactivity [16]. Some other scholars echo the definition of interactivity. Considering the machine and the individual, interactivity consists of control, responsiveness, and two-way communication [90]. Website service users perceive four dimensions of interactivity: controllability, playfulness, connectedness, and responsiveness [91]. Despite the fact that researchers have referred to these dimensions differently, the two factors most commonly identified were control and responsiveness. Allowing user control to be at the best level, not only to achieve virtual experience but also to reduce user distraction and potential information overload [52]. As a critical determinant of telepresence, the level of responsiveness of the environment to the user's movement has been identified [92]. Using two dimensions, perceived interactivity refers to the degree to which users perceive control over where they are, where they are going, and whether the system responds to their actions.

An individual's ability to manipulate the content, timing, and communications of an event or situation is controlled [92]. Clicking and pressing keys on external devices, such as computers or smartphones, produces an indirect interactive component as the actions are transformed into activities displayed on the screen [2]. In this study, control refers to the sense of being able to (a) modify the position; (b) orientation; and (c) features (e.g., shape and scale) of previously selected objects.

Corresponding to the control is the device's feedback on human control behavior. The responsiveness of the media is a reflection of the speed of responses. [93]. Likewise, it refers to how quickly information can be accessed by users [94]. In this research, responsiveness is mainly described as (a) the speed of responses from or communications with the devices and (b) the speed at which users can navigate to access information.

4.1.5. Simplicity. Simplicity can be interpreted the same way as functional simplicity, which is defined by how content users perceive the variety and functionality and the degree of dynamic functionality of AR and VR devices [56]. In the research using TAM as the theoretical framework, variables related to simplicity simplification are usually presented as ease of use. A person's perception of ease of use is the degree to which they believe that using technology is effortless [74]. The structure and interface of the system make it easy to use, but the content is difficult to understand due to its functional simplicity. Therefore, here, we describe simplicity as follows: (a) The operation is simple; (b) The content is easy to understand.

4.1.6. Visual Discomfort. An immersive viewing environment of VR applications is provided by head-mounted displays (HMDs). While HMD provides unprecedented immersion and engagement in interaction, it can substantially add mental workload and visual strain on users [95]. As suggested by scholars who study visual discomfort, visual discomfort comes from unnatural blur, deep and fast motion, and inconsistencies in space and time due to insufficient depth information in the input data signal [96]. Because the brain "remembers" the expected visual behavior, if the actual stimulus does not meet this expectation, it will cause discomfort. Delay is the main problem of HMD. This is because, we expect that our eyes will update at the same speed when the head moves, and even in the update of the visual field, even a small-time difference due to the inconsistency between simulated viewing pairing and reality will be uncomfortable [97]. According to Chamilothori et al., in this experiment, visual discomfort can be described as the quality of the image: (a) The sore your eyes feel; (b) The clear degree of your vision; and (c) How fatigued you feel [85].

4.1.7. Simulator Sickness. Differences in the visual and vestibular systems, as well as the acceleration of movement perception, can cause simulator sickness [98], which has been linked to mismatched movements [99], motion parallax [100], limited reproduction of the real environment [101], and the imperfect simulation of human-world interactions [59] (Draper et al.). When exposed to a VR environment, simulator sickness causes (a) headache; (b) sweating; (c) dry mouth; (d) nausea; (e) dizziness; (f) drowsiness; (g) disorientation; and (h) vomiting [102, 103].

Table 4 shows the frequency of excerpts in AR and VR technological factors. Augmentation was mentioned the most frequently (28 excerpts, 21.8%), and followed by user control (25 excerpts, 19.5%), telepresence (17 excerpts, 13.2%), vividness (15 excerpts, 11.7%), simulator sickness (14 excerpts, 10.9%), responsiveness (11 excerpts, 8.5%), visual discomfort (9 excerpts, 7.0%), and simplicity (9 excerpts, 7.0%). Although the concepts seem to be correlated, excerpted contents about technological features were divided into two types of technologies (i.e., AR and VR). In descriptive frequency, the technological features of AR were mentioned slightly higher (69 excerpts, 54%) than were those of VR (59 excerpts, 46%).

4.2. Users' Perceptions of Technological Features in AR. For AR experience with a virtual fitting mirror, users' perception of technological features consisted of 5 dimensions such as augmentation, user control, vividness, responsiveness, and simplicity. For AR technology as a part of shopping tools, simplicity, user control, and responsiveness were positively perceived.

In terms of simplicity, the operation is easy to understand, the operation process and organizational structure are reduced, and most users can use the device easily and without obstacles. This also enables consumers to quickly adapt to the use of new technological devices, which enhances users' willingness to use them.

Table 4: Frequency of excerpts in AR and VR technological factors

Key themes	Total	AR	VR
Augmentation	28	28	
Telepresence	17		17
Vividness	16	11	5
Simulator sickness	14		14
Visual discomfort	9		9
User control	25	13	12
Responsiveness	11	8	3
Simplicity	9	9	
Total (%)	129 (100%)	69 (54%)	60 (46%)

"I could see the classification of products at a glance and easily find the desired category."

"I can try-on many products easily, and the uncomplicated use makes me more willing to use it."

Most participants had a positive attitude toward the control of AR devices. The user is satisfied with the operation of selecting items, switching items, searching for information, comparing information, and other information acquisition methods.

"I could switch different glasses with a flip."

"I could compare the product name, model, and price with this device."

This is very helpful for consumers to use AR for shopping assistance and makes consumers more willing to use AR for shopping.

"I could try different matching clothes, which was helpful for shopping."

"As soon as I touch the screen, the sunglasses are put on my face, which is very interesting; I will use it to compare products."

In addition, the quick response speed reduces the user's waiting time and makes users feel that it is convenient to use AR in shopping.

"We were able to see many products in a short time."

"I could switch products very quickly"

Of course, in the above aspects, very few users also perceive some inconveniences such as two-handed operation and the inability to try on an item of interest alone. However, these problems can be improved through human-computer interaction design.

"Many left-handed operations and two-handed operations were inconvenient."

"The most inconvenient was that after choosing a product category, I had to try all the products in this category one by one. I could not directly select the desired products and try again."

AR's advantages in simplicity, user control, and responsiveness have narrowed the gap between consumers and new technologies; however, augmentation was negatively perceived, and vividness was negatively perceived, especially in terms of the fabric, color, pattern, and other representational digital images.

"When turning around and looking in the mirror, the effect was very unnatural."

"The white product was slightly different from the actual one."

"It could not show the true look of denim and knitted fabrics."

"The picture quality and details display were not good."

The user's negative perception of these characteristics affects consumers' intention to use AR in fashion shopping, which warns of a challenge of AR applications in fashion retailers.

4.3. Users' Perceptions of Technological Features in VR. In the content analysis of VR store experience, perceptions of VR technological features mainly consisted of 4 dimensions: telepresence, simulator sickness, visual discomfort, and user control.

For VR stores, telepresence is an immersive experience that users can perceive positively, which strongly supports the advantages of virtual reality stores in fashion retail establishments.

"I saw the entrance hall and the shelves where the products were displayed; it felt like I truly came to the real store."

"Without going to the offline store, I can also feel the overall atmosphere of the store and know which brands are on sale, so I felt very good."

"Store decoration and display were exactly the same as offline stores."

"Before that, I only played VR games, but after experiencing shopping in VR shops this time, I was deeply impressed by the application of this device in shopping."

"I truly like the real feeling brought by this virtual information."

Users have mixed feelings about control. Some users think that in a virtual shopping environment, they can move the location of the item at will, rotate the direction of the item, and zoom in or out of the selected object. However, other consumers feel that the method of sight control is not accurate enough and inconvenient during use.

"I could zoom in and out of products and get product information."

"I could move by staring at the circle on the ground, which made me feel very engaged."

"Even if zoomed in to the maximum, I could not see some product information clearly."

"When I wanted to move to another place with staring, sometimes it would be difficult to focus on the circle."

Last and most importantly, users' biggest barrier with VR store was simulator sickness as it has already known, followed by visual discomfort. In the virtual environment, the blur and delay of the picture quality mentioned above will result in user headache, sweating, dry mouth, nausea, dizziness, drowsiness, disorientation, vomiting, and other feelings. Here, users mainly perceive dizziness. Moreover, because in the use of HMD devices, users always need to use their eyes for focusing, difficulty focusing and prolonged use will also cause eye discomfort and fatigue.

"I felt dizzy when I looked around."

"I felt very dizzy when I used VR glasses for more than 10 minutes."

"My mind got confused, and it was difficult to concentrate."

"After I took off my VR glasses, I was nearly unsteady."

"Excessive use of eyes might cause eye fatigue and pain."

"Eyes were too tired to focus, it was hard to keep moving and shopping in a VR store."

Users who try VR devices due to immersion and curiosity will suspend or give up further use and experience of VR because of these discomforts.

5. Conclusion

A focus group study was conducted to determine users' perceptions of technological features in AR and VR in fashion retailing. The results of this study show that technological features were multi-dimensional and perceived by consumers using AR and VR. For AR experience with a virtual fitting mirror, users' perception of technological features consisted of 5 dimensions: augmentation, user control, vividness, responsiveness, and simplicity; for VR experience with a head-mounted display, users' perceptions of technological features mainly consisted of 4 dimensions: telepresence, simulator sickness, visual discomfort, and user control.

As an exploratory approach, this study discussed theoretical and practical implications for the application of mixed reality technology in fashion venues. For AR technology as a part of shopping tools, simplicity (e.g., reduction

and organization), user control (e.g., operability and information acquisition), and responsiveness (e.g., speed) were positively perceived. However, warning a challenge of AR applications in fashion retailers is the followings: augmentation including a precise 3D image of products, appropriate places, and a balance between virtual and real information (size, visual image, placement, etc.) was negatively perceived; vividness was negatively perceived especially in terms of the fabric, color, pattern and other representational digital images.

For VR stores, telepresence is an immersive experience, users can perceive positively which strongly supports the advantages of virtual reality stores in fashion retail establishments. Users' biggest barrier with VR store was simulator sickness(e.g.,focusing, dizziness, etc.) as it has already known, followed by visual discomfort (e.g., uncomfortable to watch and poor image quality).

These results can be potentially useful for practitioners, especially given the fact that the uses of AR and VR in marketing are an exploring area. Studying users' perceptions of technological features of AR and VR in fashion retailing can facilitate the investigation of consumer behavior. Such qualitative content analysis can assist practitioners when assessing the value of tools for retailing and marketing communication, thus developing a strategic success in digital fashion marketing. Also, designers and developers of AR and VR fashion retail technology can also get inspiration and direction for future technological improvements from this research.

In conclusion, the objective of this study was to explore users' perceptions of technological features in VR and AR and analyze the advantages and disadvantages of technologies in fashion retailing. Although additional work is needed, particularly in the methodological domain, the results reported are promising. The findings provide a basic framework and, combined with the above recommendations, provide a direction for future research [103].

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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