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Mi-ah Lee

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Eunju Ko



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# Digital Signage User Satisfaction Model: The Dual Effect of Technological Complexity*

Mi-ah Lee**
Sooyeon Lee***
Eunju Ko****

This paper seeks to suggest user satisfaction model of digital signage to see how new in-store technology can effectively lead to customers' shopping satisfaction in fashion retails. Authors in particular focus on technological complexity, which is expected to serve a subtle role in using digital signage. This study employed a scenario-based online survey. Interactive digital signage with virtual try-on and video-captures functions was used as stimuli. Data were collected from 320 respondents and 307 useable responses were analyzed to examine a proposed model. Research model compares dual paths of motivators: the extrinsic motivation route that leads from usefulness to shopping outcome satisfaction and intrinsic motivation route that leads from enjoyment to shopping process satisfaction. Technological complexity of digital signage indirectly and negatively influences shopping outcome and process satisfaction, mediated by usefulness and enjoyment, but directly and positively affects shopping process satisfaction. In omni-channel environments, the findings have implications for fashion retail managers in using digital signage to maximize customer satisfaction and to counterbalance the advantages and disadvantages of technological complexity.

Keywords: Digital signage, Technological complexity, Motivation route, Shopping satisfaction, Fashion retailer

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** Researcher, Research Institute of Human Ecology, Seoul National University (ennuie3@naver.com)
*** Master's Graduates, Clothing and Textiles, Yonsei University (sooyeonlee.ys@gmail.com)
**** Professor, Clothing and Textiles, Yonsei University (ejko@yonsei.ac.kr), Corresponding Author

# Ⅰ. Introduction

One of the most important trends in the retail sector is the digital transformation (Hagberg, Sundstrom, and Egels-Zandén 2016; Pantano and Vannucci 2019). Retailers are introducing new and attractive technologies to enhance the shopping experience while making consumers' in-store navigation efficient and convenient. This is not only one way for physical stores to maintain differences in the competition with online stores, which is rapidly growing, but is also an essential tool to build omnichannel retailing (Harberg et al. 2016). In-store technologies such as interactive storefront windows, virtual catalogue, digital signage, virtual fitting room, QR code, and self-checkout payment system have appeared, transforming retail stores into smarter spaces than ever before (Willems, Brengman, and Van De Sanden 2017).

Fashion retailers are the fastest adopters of innovative technologies in the face of this challenge of digitalization (Pantano and Vannucci 2019). In particular, one of the technologies they are interested in is digital signage(DS hereafter). DS refers to a multimedia-type interactive kiosk that provides customized information by creating content that fits the purpose of a particular OOH (out of home) space (Dennis et al. 2012). For example, Adidas and Reebok help customers find desired products easily and quickly by using DS to provide detailed product information including in-store product locations and 3-D simulated products. Target, Uniqlo, and Macy's have installed large in-store DS devices with augmented reality technology, allowing consumers to avoid the trouble of changing clothes physically by trying on clothes virtually. Consequently, fashion retailers are enhancing the attractiveness of retail stores by using DS that provides intriguing experiences and communicates previously unavailable product information.

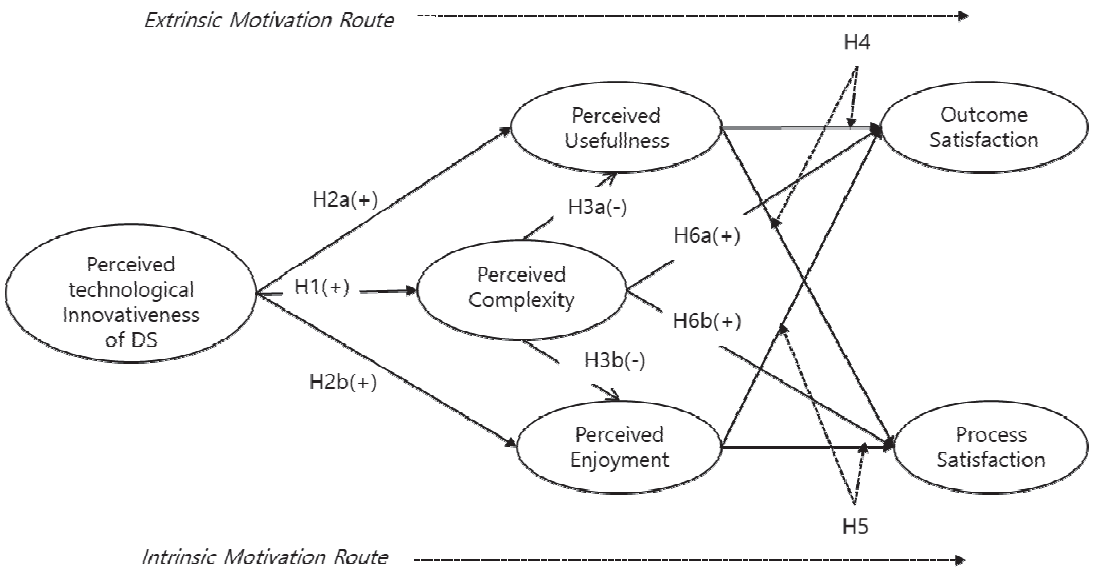
Early studies on DS in the retail field consisted mainly of exploratory studies (Bauer, Dohmen, and Strauss 2011; Müller et al. 2009; Newman, Dennis, and Zaman 2006). Since then, empirical studies have been conducted in three main directions: First, studies that regard DS as an advertising medium and examine its communication effects (e.g., noticing, recall, purchase intention, sales, etc.) (Burke 2009; Jäger and Weber 2020; Lee and Cho 2019; Willems et al. 2017); Secondly, researches that consider DS or in-store technology as an atmospheric stimulus or environmental cue and apply the stimulus-organism-response (SOR) model (Garaus and Wagner 2019; Kim and Sung 2017; Kim and Yang 2018; Roux, Mahlangu, and Manetje 2020); Thirdly, studies that see DS or in-store technology as an innovation and identify consumers' intention to adopt or use new technologies, based on the extended technology acceptance model (TAM) (Adapa et al. 2020;

Kim and Forsythe 2007, 2008; Kim et al. 2017; Roy et al. 2018).

This study follows the third research trend in terms of considering DS as an innovation. However, most previous studies based on TAM address only positive aspects of technology. While on the one hand new technologies provide pleasure and access to useful information, on the other hand they can confuse consumers or discourage them from spending the time to use those technologies (Venkatesh 2000). Consumers have not always responded positively to progressive technologies intended to improve service in retail stores. In fact, such attempts have often ended in failure because of consumer indifference or non-use (Burke 2002). However, studies that take into account the negative aspects of the introduction of in-store technology in retail settings are only very limited (Adapa et al. 2020). We focus on the perceived complexity of innovative DS as an important characteristic. Complexity conceptually aligns with ease of use in that it indicates difficulty in using a technological product or service. Multiple studies have reported that innovation complexity negatively affects attitude, acceptance, and use (Tornatzky and Klein 1982). However, another study of the meta-analytic examination of diffusion of innovations (Weigel Hazen et al. 2014) suggested that the effect of complexity on adoption is not consistent. In some cases, the influence of complexity may be positive or negative depending on the stage of the decision process, and this could possibly be explained based on construal level theory (CLT) (Arts, Frambach, and Bijmolt 2011). CLT is a theory that explains the relation between psychological distance and the extent to which one's interpretation of objects is abstract or concrete (Trope and Liberman 2003). As the psychological distance from an object increases, construals would become more abstract. On the contrary, the closer the object is, the more concretely it will be construed. Likewise, the perceived complexity can have a negative effect on the direct evaluation of the properties of signage (ie, usefulness and enjoyment), whereas when judging satisfaction that appear as the ultimate goal of signage use, higher-level cues are used. Therefore, the perceived complexity is expected to serve a subtle role in using digital innovation, which extends beyond the simple counter concept of "ease of use" (Weigel Hazen et al. 2014).

For our study, we focus on retailers' marketing objectives for introducing DS, namely, to enhance consumer satisfaction by providing intensive and rich shopping experiences (Pantano and Naccarato 2012). We apply self-determination theory (Deci and Ryan 1985), focusing on perceived usefulness (i.e., extrinsic motivation) and enjoyment (i.e., intrinsic motivation) as mediating variables, and extend the concept of motivation to satisfaction as a dependent variable to increase specificity and utility. In other words, our research model incorporates

〈Figure 1〉 Proposed Model: Digital Signage User Satisfaction Model




satisfaction with shopping outcomes (i.e., satisfaction related to the output or performance of shopping behavior) following the extrinsic motivation path, and satisfaction with shopping processes (i.e., satisfaction gained from the act of shopping itself) following the intrinsic motivation path (see Figure 1).

By investigating how retailers can use DS featuring advanced technologies as an in-store technological service that maximizes shopping satisfaction, we provide useful data for retailers who must strategically cope with changes in consumer behavior in omni-channel environments.

# Ⅱ. Literature Review and Hypotheses

## 2.1 Innovations Diffusion Theory and Construal Level Theory

Innovations diffusion theory (IDT) defines innovation as "an idea, practice, or object that is perceived as new by an individual or another unit of adoption" (Rogers 1995, p. 11). Technological innovation studies have widely applied the IDT model of five stages in innovation decision processes, particularly focusing on five innovation characteristics that facilitate or inhibit innovation adoption: relative advantage, complexity, compatibility, observability, and trialability (Rogers 1995). However, only the

first three characteristics have been shown to consistently and significantly be relate to innovation adoption (Tornatzky and Klein 1982).

The reason this paper focuses on the IDT is that complexity plays a dual role in consumer behavior. Complexity captures consumers' perceptions that they will encounter difficulties in understanding or using innovations (Gopalakrishnan and Damanpour 1994; Rogers 1995). However, research has provided mixed explanations regarding how complexity affects attitudes toward or intentions to adopt innovations.

In general, multiple studies support negative effects of complexity, including that it drives consumers to postpone purchase or use and adhere to previous purchasing behavior patterns (Adapa et al. 2020; Wood and Moreau 2006) by causing feature fatigue (Thompson, Hamilton, and Rust 2005). Six out of seven studies in a meta-analysis of 75 studies related to innovation characteristics and adoption indicated that complexity negatively affects innovation acceptance (Tornatzky and Klein 1982). On the other hand, complexity did not have a significant impact on adoption in studies by Damanpour and Schneider (2008) regarding innovation adoption within public organizations and Ko, Sung, and Yun (2009) regarding smart clothing adoption. Taylor and Todd (1995), who studied technology product adoption models, found that complexity has a positive effect on attitudes. In a study of meta-analytic examination of Diffusion of Innovations, Weigel et al. (2014) found that the relationship between complexity, unlike other innovations characteristics (e.g., compatibility, relative advantage), and adoption propensity is inconsistent.

In particular, Arts et al. (2011) suggest a reason for the mixed results about the complexity effect. They revised and extended Tornatzky and Klein (1982) and generalized the findings of 77 studies on consumer innovation adoption published from 1970 to 2007 (Arts et al. 2011). Multivariate analysis showed that complexity positively affected adoption intentions and negatively affected adoption behavior. Although intentions and behaviors are similar acceptance concepts, both occur at different stages of the decision process. Complexity may have varying influences depending on the decision stage (Arts et al. 2011). They explained the results beyond the prediction based on temporal CLT (Trope and Liberman 2003). CLT indicates that interpretations of objects systematically change depending on psychological distance from the object. When individuals perceive objects as temporally distant, they interpret the object at higher levels. In contrast, when they perceive objects as temporally closer, they interpret the object at lower levels. Therefore, when consumers perceive that the adoption will occur soon, complexity will play a negative role as they focus on concrete and specific considerations. In contrast, when consumers perceive that adoption will occur later, complexity will play a positive role because their focus is

on the ultimate value of an object (Arts et al. 2011).

Customers should perceive that DS is technologically complex because it features highly innovative, new, and unique technical functions (Gopalakrishnan and Damanpour 1994; Watchravesringkan, Hodges, and Kim 2010). We predict, however, that complexity can generate negative direct evaluations regarding the usefulness and enjoyment of DS but not when DS is used in pursuit of ultimate satisfaction at a later time, evoking higher levels of interpretation. That observation could explain why previous studies have found mixed results regarding the relationship between complexity and attitudes or behaviors.

#### 2.1.1 Technological innovativeness and complexity

Innovativeness is most frequently defined as "the newness (Watchravesringkan et al. 2010)" or "the creativity and uniqueness (Loiacono, Watson, and Goodhue 2002)" of technical function of a product. Generally, the newer a technology is implemented to a product, the higher its innovativeness is (Loiacono et al. 2002). However, technological products or services with high innovativeness cause consumers to change their previous behavioral patterns (Adapta et al., 2020; Calantone, Chan, and Cui 2006; Garcia and Calantone 2002). Recently emerging products and services centered on digital technology (e.g., mobile payment, digital signage) can give consumers a psychological burden regarding complex usage due to their characteristics as innovative products (Thompson et al. 2005). They perceive that learning the new technology will be costly, with uncertain benefits (Rogers 1995). DS is a technological or functional innovation rather than an experiential or aesthetic service (Wood and Moreau 2006). It is still a relatively new technological innovation (Dennis et al. 2012), so if the technology used to implement the content is highly innovative, consumers will perceive higher complexity of use (Adapta et al., 2020; Gopalakrishnan and Damanpour 1994; Pantano and Vannucci 2019), which leads to our first hypothesis:

*H1: Higher the perceived technological innovativeness of DS, higher the perceived complexity.*

### 2.2 Intrinsic Versus Extrinsic Motivation

#### 2.2.1 Usefulness versus enjoyment

The well-known self-determination theory explains that individuals may choose behavior for extrinsic motivations regarding external rewards or intrinsic motivations regarding interest and enjoyment (Ryan and Deci 2000). Early technology adoption studies focused on extrinsic motivation and treated perceived usefulness and perceived ease of use as major

constructs. Perceived ease of use captures individuals' perceptions that they can use the system effortlessly; perceived usefulness captures their beliefs regarding whether the system will enhance certain tasks (Davis 1989). Based on the motivation model, Davis, Bagozzi, and Warshaw (1992) increased the predictive and explanatory power of the TAM by including enjoyment as an intrinsic motivator among key constructs in the original model. They defined enjoyment as users' perceptions that using the system is enjoyable.

Most studies using the usefulness/enjoyment motivation constructs focus on their relative effects on technology acceptance attitudes or behaviors (Ahn et al. 2004; Kim and Forsythe 2008; Moon and Kim 2001). Other studies suggest that the two motivators have different influences on various dependent variables (Fiore, Kim, and Lee 2005; Moon and Kim 2001; Zhang, Lee, and Kim 2017).

### 2.2.2 Technological innovativeness, usefulness, and enjoyment

In general, product innovativeness can not only reduce consumer familiarity but also increase complexity, while it can represent superiority to competitors in terms of product quality features and benefits (Calantone et al. 2006). Consumers' cognitive curiosity may be piqued when they consider using highly technologically advanced DS (Malone 1981), so that they can easily evaluate the product they are considering. Indeed, 3-D product experiences are more powerful than 2-D product experiences for enhancing product decision quality and perceived knowledge (Li et al. 2002). Also, users will show higher positive responses when they have visual and functional virtual control in using advanced multimedia technology rather than responding to plain text and static images, because advanced multimedia technology portrays information more vividly and accurately while facilitating learning and understanding (Jeon, Han, and Woo 2020; Jiang and Benbasat 2004-2005).

Perceived technological innovativeness tends to arouse intrinsic excitement and interest in consumers and motivates them to embrace highly innovative products (Venkatraman 1991). A study based on the SOR model examined consumer responses to advanced technology products and demonstrated that perceived technological innovativeness affects attitude, enjoyment, and arousal, and leads to greater enjoyment of the products (Lee, Ha, and Widdows 2011). Advanced technology, such as virtual try-on programs, tends to increase hedonic value, reduce risks in purchasing clothing (Kim an Forsythe 2008), and encourage sensory curiosity (Malone 1981), leading to enjoyment. Thus, we hypothesize:

*H2: Higher the perceived technological innovativeness of DS, (a) higher the*

*perceived usefulness and (b) higher the perceived enjoyment.*

#### 2.2.3 Complexity, usefulness, and enjoyment

The cost-benefit framework explains that decision makers have two objectives: to maximize decision quality and minimize effort. Excessively complex evaluations require extra effort. DS uses advanced technology and high-dimensional images, so users might judge it as being too complicated.

Furthermore, when individuals first encounter new, complex digital devices, they often feel so frightened and stressed that they cannot enjoy the experience (Adapa et al. 2020; Hackbarth, Grover, and Mun 2003). DS is so technologically complex that it is likely to cause "feature fatigue" (Thompson et al. 2005), reducing the level of enjoyment regarding its contents. TAM-related literature supports that ease of use, the opposite concept of complexity, positively affects usefulness and enjoyment (Davis et al. 1992). Therefore, we expect perceived complexity of DS use to predict negative attitudes regarding perceived usefulness and enjoyment:

*H3: Higher the perceived complexity in using DS, (a) lower the perceived usefulness and (b) lower the perceived enjoyment.*

### 2.3 Shopping Satisfaction

#### 2.3.1 Outcome versus process satisfaction

Consumer satisfaction indicates consumers' overall cognitive and affective evaluations of shopping experiences (Kunz, Schmitt, and Meyer 2011). Shopping experiences can satisfy needs to pursue goals and acquire products or satisfy hedonic desires for enjoyment and fun (Babin, Darden, and Griffin 1994; Kunz et al. 2011). Acquiring goods or services can provide cognitive satisfaction (Kunz et al. 2011), while the very act of shopping can provide fun and emotional satisfaction (Ahn, Ryu, and Han 2007; Kim and Ahn 2020; Zang and Fitzsimons 1999). Thus, shoppers can derive satisfaction from both shopping processes and outcomes (Reutskaja and Horgarth 2009).

Consumer behavior research views satisfaction as an important attitudinal variable linked forward and backward in the causal chain of cognitive attitude behavior theory(Santini, Ladeira, and Sampaio 2018; Wang, Tang, and Tang 2001). Customer satisfaction in the retail environment strongly influences purchase intentions, repurchases, store loyalty, and word-of-mouth advertising (Kunz et al. 2011; Wang et al. 2001). In this study, we focus on the upstream factors forming consumer satisfaction. By dividing satisfaction into process and outcome satisfaction, we follow the dual paths of intrinsic and extrinsic motivation.

### 2.3.2 Usefulness, enjoyment, and satisfaction

Most studies on the TAM or extended TAM agree that usefulness and enjoyment have positive effects on attitude (Ha and Stoel 2007; Kim and Forsythe 2007; Moon and Kim 2001) and behavioral intention (Kim et al. 2017; Moon and Kim 2001). When consumers are motivated by usefulness, they focus on outcomes obtained from their actions, not on enjoying the act itself (Deci and Ryan 1985), and thus usefulness motivations will have a greater effect on outcome satisfaction than on process satisfaction. Meanwhile, when consumers are motivated by enjoyment, they focus on the actions itself that generate playfulness rather than outcomes, so enjoyable motivations should have a greater effect on process satisfaction than on outcome satisfaction. To compare the relative influence of usefulness and playfulness on purchase intentions, Moon and Kim (2001) separated an intrinsically entertainment-motivated group from an extrinsically work-motivated group and found that usefulness had a greater influence for the work-purpose group, whereas playfulness had a greater effect for the entertainment-purpose group. We hypothesize:

*H4: Consumers' perceived usefulness of DS is more strongly related to their shopping outcome satisfaction than to their shopping process satisfaction.*

*H5: Consumers' perceived enjoyment of DS is more strongly related to their shopping process satisfaction than to their shopping outcome satisfaction.*

### 2.3.3 Complexity and satisfaction.

According to CLT, individuals use concrete context-dependent considerations when they judge behavior that will occur soon, but they use abstract and general considerations when they consider behavior in the distant future. Therefore, in judging their likelihood of adopting technology with complexity soon, they will be more aware of negative costs rather than benefits of technological complexity (Hoeffler 2003). Conversely, in judging their intentions to adopt innovative and complex technology in the distant future, they will focus on the beneficial aspects of technological complexity (Arts et al. 2011).

Consumers focus on feasibility constraints at lower level when judging usefulness and enjoyment, which are the instrumental goals of DS use (Lynch and Zauberman 2006). So the perceived complexity can have negative effects. However, since desirability, a high level benefit, plays an important role in evaluating satisfaction, which is the ultimate value of using DS (Lynch and Zauberman 2006), the perceived complexity will have a positive effect. In a study by Taylor and Todd (1995) on innovation adoption, the perceived complexity was found to have a positive influence on attitudes.

Therefore, we predict that the perceived complexity will act as an interesting factor rather than a resistance factor to satisfaction.

*H6: Consumer perceived complexity of DS will positively predict (a) shopping outcome and (b) shopping process satisfactions.*

# Ⅳ. Method

## 4.1 Design and Stimuli

This study employed a scenario-based online survey. Many consumers have not yet experienced the new DS technology because it is still in the pilot stage in Korea's fashion retail environment. Thus, rather than conduct a field study, we adopted a scenario approach in which we explained the new DS technology and simulated DS shopping experiences using illustrations to make our virtual scenarios seem more realistic.

Stimuli for this study came from interactive DS being used by Prada, Target, and Rebecca Minkoff. Interactive DS goes beyond simple communication of information to provide diverse advanced and complicated technologies such as webcams, 3-D, radio-frequency identification (RFID), and augmented reality(AR) to bring vivid, rich, and entertaining shopping experiences (Ahn et al. 2007; Planto and Naccarato 2020). Interactive DS used as a stimulus in our study has two characteristic functions, video-captures and virtual try-on. Video-captures technology allows customers fitting clothing to see themselves from multiple angles, with a delay, when they press the camera button. Virtual try-on technology is based on augmented reality in which consumers can try on various garments and change garment color virtually. We used Microsoft PowerPoint 2010 and Adobe Photoshop 14.0 to create the picture.

Participants viewed the scenarios, images, and descriptions and imagined that they were using the DS in a fashion retail store. Participants were college students, the potential user base of DS. The pretest indicated that they could easily imagine the scenarios and were already familiar with using touch screen kiosks. To ensure validity of the stimuli, we interviewed and surveyed 21 graduate students majoring in fashion marketing. After participants carefully read the scenarios, they assessed whether the scenarios were similar to actual situations and whether they were suitably understandable and immersive. The student reviews led us to revise and improve the scenarios and stimuli several times before three PhD students specialized in the field triangulated and confirmed the final questionnaire and stimuli.

## 4.2 Measurements

All items were measured on a 7-point Likert Scale (1 = strongly disagree; 7 = strongly

agree) (see Table 1). Perceived technological innovativeness of the DS was measured by how new and innovative the technology implementing the content actually was and how diverse its functions were. It was measured by three items based on Lee et al. (2011) and Watchravesringkan et al. (2010). Perceived usefulness was defined as the degree to which DS helped consumers evaluate the products in the stores and was measured by three items adapted from Kim and Forsythe (2008). Perceived enjoyment was measured by the amount of

〈Table 1〉 CFA Results for Measurement Items

| Factors/Items | Standardized Estimates | AVE | CR | Alpha |
|---|---|---|---|---|
| **Perceived Technology Innovativeness of DS** | | | | |
| I believe that digital signage is an innovative technology. | .913 | .561 | .863 | .834 |
| Using digital signage would allow me to experience new and innovative technology. | .832 | | | |
| Digital signage has a variety of functions. | .644 | | | |
| **Perceived Complexity** | | | | |
| Learning how to use digital signage would be complex. | .906 | .521 | .764 | .868 |
| Learning how to use digital signage would require a lot of time. | .799 | | | |
| I would have difficulty learning how to use digital signage. | .790 | | | |
| **Perceived Usefulness** | | | | |
| Digital signage would help me become familiar with products I am seeking. | .878 | .588 | .810 | .858 |
| Digital signage would help me assess products I am seeking. | .843 | | | |
| Digital signage would give you a good understanding of the design and characteristics of the product. | .743 | | | |
| **Perceived Enjoyment** | | | | |
| **I would probably find digital signage to be fun.** | .879 | .697 | .873 | .910 |
| I would probably find digital signage to be entertaining. | .878 | | | |
| I would probably find digital signage to be interesting. | .878 | | | |
| **Shopping Outcome Satisfaction** | | | | |
| I would be pleased with purchase decisions made after using digital signage. | .933 | .752 | .901 | .932 |
| I would be satisfied with shopping results after using digital signage. | .902 | | | |
| Digital signage would help me purchase exactly what I want. | .885 | | | |
| **Shopping Process Satisfaction** | | | | |
| I would be satisfied with the shopping process after using digital signage. | .895 | .590 | .812 | .889 |
| I would find that my shopping fulfills my expectations after interacting with digital signage. | .875 | | | |
| I would find special meaning in my shopping experience after using digital signage. | .803 | | | |

fun consumers had using the DS, using three items adapted from Moon and Kim (2001). Perceived complexity referred to the level of difficulty in using or understanding DS and was measured by three items adapted from Dallaert and Stremersch (2005). Shopping satisfaction was divided into process satisfaction and outcome satisfaction. Shopping process satisfaction was defined as a positive emotion felt while shopping using DS, whereas shopping outcome satisfaction was defined as satisfaction in the product purchased using DS. Process satisfaction and outcome satisfaction were measured by three items adapted from Reutskaja and Horgarth (2009) and Zhang and Fitzsimons (1999), respectively.

### 4.3 Data Collection and Sample Characteristics

We used a convenience sample for conducting the survey. We sent an invitation e-mail to 1,000 undergraduate and graduate students enrolled in fashion or business-related courses from five universities in large cities such as Seoul, Incheon, Daegu, and Daejeon in Korea. After they gave their consent to participate, students could open the survey website through a link attached in the e-mail. After they saw the scenarios and picture stimuli, they imagined that they were using DS. To verify whether they read the scenario sufficiently, we gave them a two-question quiz. Those who answered both questions correctly were allowed to continue.

We excluded incomplete or insincere responses, leaving us with 307 responses of the original 320 responses for the final analysis. Demographic characteristics of the samples used in the empirical analysis showed 45.3% of the participants were men, 54.7% were women, 19.9% were in their teens, 67.1% were in their 20s, and 13% were in their 30s; the average participant age was 23.4; In terms of average monthly household income, 60.6% earned US$2,000 to US$8,000; 55.7% reported spending a monthly average of US$100 to US$300 on fashion items.

## V. Results

### 5.1 Measurement Model

Confirmatory factor analysis (CFA) was used to assess the fit, construct reliability, and validity among the model's construct measures (see Table 1). The overall fit of the measurement model was assessed via fit indices provided by AMOS 18.0. The values of the overall fit indices were: $\chi^2$ = 202.836 (df = 120, $p$ < .001), goodness of fit (GFI) = .934, adjusted goodness of fit (AGFI) = .905, incremental fit index (IFI) = .979, comparative fit index (CFI) = .979, and the root mean square error of approximation (RMSEA) = .047, all of which

suggest a good data fit and support for the measurement model.

Construct reliability was assessed using Cronbach's alpha from .834 to .932, higher than the recommended value (i.e., 〉 .70). Table 1 shows that factor loadings of the indicators for each construct were significant at the .001 level. The average variance extracted (AVE) estimates of all constructs were over .50, and all composite reliabilities were higher than the desired level (i.e., 〉 .70), confirming convergent validity (Hair et al. 2005). The squared correlation between two constructs was lower than the AVE for each construct, suggesting discriminant validity(See Table 2).

## 5.2 Hypotheses Testing

Structural equation modeling was used to test the hypothesized relationships using maximum likelihood estimation. All fit indices ( $\chi^2$ = 294.927, df = 124, $p$ 〈 .001, GFI = .906, IFI = .958, CFI = .957, RMSEA = .067) were within acceptable ranges (Hair et al. 2005), indicating that the hypothesized structural model fit the data well. Table 3 summarizes the results.

Consistent with the hypothesized path, perceived technological innovativeness of DS was positively related to perceived complexity ( $\gamma$ = .218, $p$ 〈 .001), perceived usefulness ( $\gamma$ = .417, $p$ 〈 .001), and perceived enjoyment ( $\gamma$ = .622, $p$ 〈 .001), supporting H1, H2(a), and H2(b). Perceived complexity of DS was negatively related to both perceived usefulness ( $\beta$ = -.190, $p$ 〈 .01) and perceived enjoyment ( $\beta$ = -.262, $p$ 〈 .001), supporting H3(a) and H3(b). H4 predicted that the path coefficient between perceived usefulness and shopping outcome satisfaction was greater than the path between perceived usefulness and shopping process satisfaction. H5 predicted that the path coefficient between perceived enjoyment and shopping process satisfaction was greater than the path

〈Table 2〉 Measurement Model Correlation Matrix

| Constructs | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Perceived Technological Innovativeness of DS | .561 | | | | | |
| 2. Perceived Complexity | .045** | .521 | | | | |
| 3. Perceived Usefulness | .121*** | .007 | .588 | | | |
| 4. Perceived Enjoyment | .295*** | .014 | .385*** | .697 | | |
| 5. Outcome Satisfaction | .065*** | .007 | .520*** | .378*** | .752 | |
| 6. Process Satisfaction | .340*** | .004 | .426*** | .584*** | .466*** | .590 |

Note: Diagonal (average variance extracted: AVE), Under (squared pair-wise correlation coefficient).
* p〈.05, ** p〈.01, *** p〈.001

〈Table 3〉 Results from Testing Hypotheses

| Hypotheses | Causal path | Coefficient | $t$-value | $\chi^2$difference | Results |
|---|---|---|---|---|---|
| H1 | PTI → PC | .218 | 3.429*** | | Support |
| H2a | PTI → PU | .417 | 6.146*** | | Support |
| H2b | PTI → PE | .622 | 10.005*** | | Support |
| H3a | PC → PU | -.190 | -2.981** | | Support |
| H3b | PC → PE | -.262 | -4.636*** | | Support |
| H4 | PU → OS | .588 | 8.803*** | $\Delta\chi^2$= 7.029** (Δdf=1) | Support |
| | PU → PS | .373 | 6.441*** | | Support |
| H5 | PE → OS | .307 | 5.246*** | $\Delta\chi^2$=21.496*** (Δdf=1) | Support |
| | PE → PS | .641 | 10.720*** | | Support |
| H6a | PC → OS | .001 | .025 | | Reject |
| H6b | PC → PS | .182 | 4.042*** | | Support |
| $\chi^2$=294.927, df=124, $p$=.000, GFI=.906, CFI=.957, IFI=.958, RMSEA=.067 | | | | | |

Note: PTI, perceived technological innovativeness of DS : PC, perceived complexity; PU, perceived usefulness; PE, perceived enjoyment; OS, outcome satisfaction; PS, process satisfaction
* p〈.05, ** $p$〈.01, *** $p$〈.001

between perceived enjoyment and shopping outcome satisfaction. Results revealed that both perceived usefulness and enjoyment of DS had significant positive relationships with shopping outcome and process satisfaction. To compare the different strengths between relationships, we conducted $\chi^2$ difference test between the free and constrained model. As we proposed, perceived usefulness had a stronger relationship with shopping outcome satisfaction ($\beta$ = .588, $p$ 〈 .001) than with shopping process satisfaction ($\beta$ = .373, $p$ 〈 .001), supporting H4 ($\Delta\chi^2$ = 7.029, Δdf = 1, $p$ 〈 .01). On the other hand, perceived enjoyment had a stronger relationship with shopping process satisfaction ($\beta$ = .641, $p$ 〈 .001) than with shopping outcome satisfaction ($\beta$ = .307, $p$ 〈 .001), supporting H5 ($\Delta\chi^2$ = 21.496, Δdf = 1, $p$ 〈 .001). Perceived complexity positively predicted shopping process satisfaction ($\beta$ = .182, $p$ 〈 .001), but perceived complexity was not related to shopping outcome satisfaction ($\beta$ = .001, $p$ 〉 .05). Thus, H6(b) was supported, but H6(a) was not.

## Ⅵ. Discussion & Conclusion

In the current situation where traditional retailers are more actively introducing innovative in-store technologies to meet the challenges of digital transformation, the present study suggests a DS user satisfaction model to see how new

technological services can effectively lead to customers' shopping satisfaction. Based on our research findings, the academic and managerial implications can be suggested as follows.

## 6.1 Theoretical implications

First, the results of this study present a new model of consumer shopping satisfaction in smart retail environments by identifying paths from perceived technological innovativeness of DS to evaluation of DS (perceived usefulness, perceived enjoyment, and perceived complexity) and shopping satisfaction (process and outcome satisfaction). In particular, considering the DS as a technological innovation, the authors attempted empirical research applying an extended motivation model and IDT theory. Our findings show that higher perceived technological innovativeness of DS leads to higher perceived usefulness and enjoyment. This is consistent with the results of previous studies reporting that information presentation using advanced technology increases interactivity and vividness, thus providing a diagnostic evaluation of actual clothing as well as entertainment and enjoyment for technology use (Jiang and Benbasat 2004-5; Lee et al. 2011; Li et al. 2002). On the other hand, as demonstrated by previous studies (Garcia and Calantone 2002), results also show that perceived technological innovativeness can cause difficulties for consumers and thus increase consumer perception of complexity in using it. Perceived complexity seems to induce information overload or technology anxiety in consumers, causing them to perceive low usefulness of the technological services (Adapa et al. 2020). Moreover, fear and stress from using new technology decreased enjoyment when using the services (Hackbarth et al. 2003). Three evaluation variables have been shown to have a positive effect on shopping satisfaction directly.

Second, we extend the motivation model by incorporating satisfaction with shopping outcomes following the extrinsic motivation path and satisfaction with shopping processes following the intrinsic motivation path. Usefulness, an extrinsic motivator, positively predicted stronger satisfaction with shopping outcomes than with the shopping process itself. In contrast, enjoyment, an intrinsic motivator, positively predicted satisfaction with both shopping processes and outcomes, but the stronger effect was on satisfaction with the shopping process. Just as shopping motivations are categorized into two paths, goal-directed versus experiential or utilitarian versus hedonic (Babin et al. 1994; Fiore et al. 2005), shopping satisfaction is also found to follow two paths. Our findings support the previous researches that concluded that shopping satisfaction can come not only from the result of an act to purchase an item, but also from the various stimuli and experiences gained during shopping (Babin et al. 1994; Kunz et al. 2011; Reutskaja and Horgarth 2009).

Third, we enhanced our model with technological complexity, a key variable of IDT, and explained that based on CLT theory, perceived complexity has a dual effect in evaluation and satisfaction of DS use. Perceived complexity proved to be a barrier to technological innovation by negatively affecting perceived usefulness and enjoyment. But conversely, it has been playing a positive role in satisfaction with the shopping process, triggering attention as a stimulator (Arts et al. 2001; Berlyne 1974). However, perceived complexity was nonsignificantly related with shopping outcome satisfaction. Though it is associated with superordinate goals at a far distance, shopping outcome satisfaction comes from achieving specific shopping tasks. Some customers may be able to interpret objects at a more concrete level when considering outcome satisfaction than when considering process satisfaction. Perceived complexity may have different effects on shopping outcome satisfaction depending, for example, on whether consumers are innovative or highly engaged in technology (Han and Park 2016; Kim and Kim 2917). Technological complexity can make it difficult for low technologically innovative customers to achieve specific shopping tasks through DS(Adapa et al. 2020) and ultimately dissatisfy them with the results of their use. But for customers with high innovativeness technologically, the opposite will happen.

## 6.2 Managerial implications

Our findings show that how high levels of in-store technology should be used can vary depend on what the retailer is trying to use it for. Even if ICT (information and communication technology) is absorbed into our lives as a whole, services using too innovative technologies can increase perceived complexity and ultimately play a negative role in consumers' satisfaction of shopping results. When retailers want to induce in-store customers to increase the efficiency of their intended work, it will be necessary to utilize smart in-store technology that is not too new to them and is easily accessible.

For retailers who want to enhance the experience of the shopping process in physical store, introduction of high innovative technology is inevitable (Pantano and Vannucci 2019). Indeed, many fashion flagship stores strive to represent brand identity and brand image by providing consumers with a memorable experience rather than simply a place to sell their products (Hagberg et al. 2016; Willems et al. 2017). They actively introduce innovative technological services, such as virtual shopping assistance, smart fitting room and biometric authentification system, etc., into their stores (Willems et al. 2017). Therefore, retailers will be required to consider a way to offset the disadvantages of technological complexity by accurately providing demonstrations on how to use technology to consumers even if they use high level of

technology-enabled DS.

## 6.3 Limitations and directions for future research

Although our findings have academic and practical implications, this study has some limitations. First, the domestic fashion retail environment is currently using DS on a trial basis, so we asked our respondents to imagine their perceptions or attitudes toward DS stimuli rather than actually use it. Accordingly, responses to imaginary use might not align with actual use. To improve accuracy and preciseness, future experiments could study reactions to actual DS in retail stores or could use virtual signage implemented online through virtual control technology.

Second, this study does not distinguish the types of contents provided by DS. However, types of contents provided by DS would influence perceived usefulness, enjoyment, and complexity. For example, the content provided by digital signage may have high experiential elements such as virtual trying on clothes (like the stimulus presented in this study), or high informative elements such as product functions or detailed production descriptions. Therefore, it will be necessary to find out which types can increase consumer shopping satisfaction through research design that diversifies such contents.

Third, we presumed that the study's main participants who were 20 to 30 years old would be familiar with using highly innovative digital devices. For a broader scope, future research should compare different target groups including senior consumers who are gradually increasing their use of digital devices and have higher purchasing powers. In addition, important consumer characteristics will need to be included in future research. Consumer innovativeness, engagement, pre-experience with DS could definitely be the key factor that has an impact of perceived complexity.

Fourth, since this study was conducted with a focus on DS services that can be used in fashion retail stores, additional studies should be conducted for generalization of the research results. Currently, DS is being used not only in the fashion retail store, but also in various retail types such as convenience stores and hypermarkets. Therefore, research on digital signage services needs to be extended to various retail sectors.

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