# Shopping Behavioral Intentions Contributed by Store Layout and Perceived Crowding: An Exploratory Study Using Computer Walk-Through Simulation

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**ABSTRACT**

The purpose of this study is to understand the role of store layout in predicting shopping behaviors by influencing the perception of crowding. With today's growing popularity of online shopping, brick-and-mortar stores are faced with increased challenges to create positive shopping experiences and attract more customers to the store. The customer's shopping experience often starts with the environment's physical appearance and navigation. Crowding is one of the known factors contributing to how stores look and feel. Using 3D simulation technology capable of offering a realistic virtual experience, we tested the hypothesis—that the negative impact of crowding could be effectively controlled through physical space configuration—by exploring the role of store layout and human density on perceived crowding using a 2 × 2 between-subjects design with 60 college students. Two distinct store layouts and their effects on perceived crowding and approach intentions were investigated. In addition, we also considered the role of individual differences in crowding perception. The findings demonstrate the critical role of store layout in controlling retail crowding and shopping motivations, potentially contributing to store success. We found increased shopping intentions in the store environment with a linear and symmetrical configuration than with a curvilinear and asymmetrical one. Such tendency was found to be significantly greater for male customers. A significant mediating role for perceived crowding on the relationship between the effects of store layout on shopping intentions was also found. This confirms the critical effect of store layout on perceived crowding that indirectly, yet significantly, influences customers' shopping behavioral intentions. No prior work in retail literature has examined retail crowding on the basis of an empirical manipulation of the environment. By using virtual walk-through simulation, this study joins a limited body of knowledge pertaining to the store environment and aims to expand our understanding of the distinct effects of retail environments on consumers' experience and behavior.

## Introduction

The purpose of this study is to examine how perceptions of crowding may predict shopping behaviors by experimentally testing the roles of store layout and human density. We conducted an experiment using a 2 × 2 (store layout × human density conditions) between-subjects factorial design with a three-dimensional (3D) virtual environment and simulated walk-through experience of the store.

The shopping experience often starts with the environment's physical appearance and navigation. Crowding is an important factor contributing to how stores look and feel to customers. Studies consistently report negative influences and avoidance behaviors caused by crowding, including buying less (Harrell, Hutt, & Anderson, 1980), spending less time in the store and avoiding impulse shopping (Langrehr, 1991), and leaving the store without making a purchase (Whiting, 2006). Researchers have demonstrated that the feeling of being crowded can be moderated by successful design interventions (Baker, Parasuraman, Grewal, & Voss, 2002; Eroglu & Machleit, 1990; Lin, 2004; Wakefield & Baker,



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1998). One design element known to alter customers' perceptions of the environment is store layout (Grewal, Baker, Levy, & Voss, 2003). By designing the store layout for intended and efficient circulation throughout the space, the designer can facilitate the flow of customers and control the visual perception of crowding so the space looks less crowded or not as empty.

Despite the significant potential of interior design to influence retail crowding, its impact has been examined infrequently (Bitner, 1992; Lee, Kim, & Li, 2011). Furthermore, research on retail crowding that offers practical design implications is scarce. One of the most fundamental challenges is conducting field studies with customers in a controlled setting. This study aims at filling the gap through a systematic experiment using virtual environments to offer evidence-based information and practical insights into store design and management. Using 3D computer walk-through simulation, we empirically tested how and to what extent store layout and human density influence perceived crowding and eventually behavioral intentions.

## Background

This section provides a review of the literature informing the focus of this study. First, the roles and types of store layout as a design factor influencing customer behaviors are discussed. Second, previous approaches to shopping behavioral intentions as the key antecedent of behaviors are reviewed to establish the basis for practical implications of the study. Third, the dimensions and effects of perceived crowding identified in previous studies are reviewed to inform the design of the experiment. Finally, personal factors related to the subjective experience of crowding are discussed.

### Store Layout

Environmental stimuli in a retail setting can be classified into three groups: ambient, social, and design factors (Baker, Grewal, & Parasuraman, 1994). Several studies have examined ambient factors—the subtle elements of a store's environment that affect customers' mood and emotions—such as color (Babin, Hardesty, & Suter, 2003; Park & Chang, 2013), music (Baker, Levy, & Grewal, 1992; Mattila & Wirtz, 2001), and lighting (Baker et al., 1992; Park & Farr, 2007). Social factors represent the role of people in a retail store environment, including store employees and customers (Baker et al., 1994). Design factors are the physical, tangible factors of atmospherics related to the space that are more visual in nature, such as architecture, style, ceiling design, and arrangement of furniture (Baker et al., 2002; Li, 2004; Lin & Liang, 2011). Design factors are more critical at early stages of the design process because they tend to be more difficult and expensive to change than others (Bitner, 1992; Hui & Bateson, 1991; Lee et al., 2011; Yildirim & Akalin-Baskaya, 2007). In addition, they directly affect behaviors and influence crowding perceptions (Bitner, 1992; Hui & Bateson, 1991; Lee et al., 2011; Yildirim, Akalin-Baskaya, & Celebi, 2007).

Store layout, the arrangement of merchandise and fixtures within a given space, is the first area to consider when designing circulation around a space. The ultimate goal of most store layouts is to create an efficient, attractive shopping environment by providing adequate space for customers to navigate and shop while promoting good exposure to products (Baker et al., 2002). From a marketing point of view, an optimal layout balances the two parties—consumers and suppliers.

Levy and Weitz (2008) identified two common types of layouts that have been incorporated in retail space design: grid and free-form layouts. Grid layout, a linear arrangement of displays and long aisles running parallel to one another, is primarily used by grocery stores and convenience stores to facilitate planned shopping behavior. A free-form layout refers to the arrangement of displays and aisles in a free-flowing, asymmetrical fashion (Lee et al., 2011). Free-from layouts are frequently used by department stores or smaller specialty stores. For predominantly recreationally oriented customers, free-form layouts encourage customers to navigate throughout

the space rather than quickly spotting a target merchandise.

Previous studies found that a spacious, as opposed to a cluttered, store layout can heighten pleasure (Machleit, Eroglu, & Mantel, 2000) and reduce negative feelings around spatial control. Alternatively, a cluttered store layout can act as an obstacle to goal fulfillment (van Rompay, Tanja-Dijkstra, Verhoeven, & Van Es, 2012). Although much literature supports the importance of layout and the notion that layout can hinder or facilitate task execution, few studies have tested its effect on consumer shopping behaviors (Bäckström & Johansson, 2006; van Rompay et al., 2012) or behavioral intentions. Self-reported behavioral intentions are one of the most broadly used proxy measures of actual shopping behaviors. When situational influences and monetary constraints are controlled, a shopping behavioral intention is an immediate antecedent of behavior (Ajzen, 1991).

## Shopping Behavioral Intentions

Mehrabian and Russell (M-R) (1974) suggest that individuals react to retail environments with two meaningful yet contrasting behaviors—approach or avoidance. M-R is the most cited work in the environmental psychology literature (Mari & Poggesi, 2013), which is based on the stimulus–organism–response (S–O–R) paradigm: stimuli (S) from the environment influence people's internal evaluation (O), then influence behavioral responses (R).

While fundamental dimensions of behavioral responses of the S–O–R paradigm have been established long ago, until now active research based on the paradigm has been committed to various environmental and shopper attributes in hospitality management, retailing, and services marketing contexts, represented by the two intertwined research subjects of atmospherics and servicescape. Many of those studies focus on environmental cues (e.g., lighting, music, scent, color, or style) with clearer managerial implications, which can be critical factors in the marketing discipline (Mari & Poggesi, 2013). Despite the significant impact of store layout as a tangible design factor on behaviors (cf., Moore, 1979; Turley & Milliman, 2000; Wineman & Peponis, 2009), surprisingly few studies have empirically tested the effects of layout (Turley & Milliman, 2000; van Rompay et al., 2012) due to underlying challenges including systematic manipulation of different layout conditions.

Approach behaviors include a customers' positive behavioral responses, such as spending more time in the store; conversely, avoidance evokes negative behavior responses like leaving the store or spending less money (Donovan & Rossiter, 1982). When actual behavior is not observed, the concept of approach-avoidance has been defined as the attitude toward the act—that is, approach and avoidance intentions (Gilboa & Rafaeli, 2003). Approach intentions are established as significant precursors to behaviors and are indications of how much people are willing to try or plan to perform the behavior (Ajzen, 1991). Because it is challenging to measure actual behaviors in a field study in real time and place, approach intentions have been widely adopted as outcome (i.e., dependent variables in previous consumer behavior studies).

M-R (1974) identified four aspects of approach-avoidance responses within environments: desire to stay, desire to explore, desire to communicate, and degrees of satisfaction. Patronage is another behavioral dimension significantly influenced by the environment and is supported by several studies (Bäckström & Johansson, 2006). Repatronage intentions, a dimension suggested by Jones, Reynolds, and Arnold (2006), reflect the likelihood that a customer is willing to shop at the retail store again.

Many researchers have stressed the role of affect or store-induced pleasure in contributing to shoppers' behaviors. After Donovan and Rossiter (1982), several researchers have demonstrated the significant role of affect toward the store's atmosphere as a primary motivator of shopping behaviors (Erevelles, 1998). Baker et al. (2002) found that a pleasurable retail store atmosphere was associated with positive shopping behavior, particularly patronage intentions.

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Additionally, word-of-mouth recommendation (WOM), introduced by Harrison-Walker (2001), has become a widely used notion in consumer behavior. WOM is defined as the informal, person-to-person communication between a perceived noncommercial communicator and a receiver regarding a brand, a product, an organization, or a service (Harrison-Walker, 2001). In today's information age, WOM's growing importance has been recognized as a credible and powerful source of information and an indicator in marketing (Jones et al., 2006).

Positive shopping experience linked to actual shopping behaviors, as the ultimate goal for retailers and designers, can be predicted and achieved by understanding behavioral intention dimensions. When consumers infer difficulty in accomplishing their shopping goals due to crowding, the unique shopping experience is negatively affected (Eroglu & Machleit, 1990; Grewal et al., 2003; Machleit et al., 2000). Crowding and retail density in the context of physical shopping environments have been broadly studied in relation to customers' shopping behaviors, including patronage intention, service quality perception, satisfaction, and time and money spent in the store (Eroglu, Machleit, & Barr, 2005).

## Perceived Crowding

Some researchers define *crowding* as a physically based concept that refers to a physical environment with a high density of people (Bechtel, 1997), whereas others refer to crowding as the experience of being hemmed in, blocked, or frustrated by the presence of a number of people (Rapoport, 1976). Stokols (1972), however, identifies a relationship bewteen crowding and density. As an antecedent of crowding perceptions, density is an objective dimension formed by the number of people or objects in a limited space (Dion, 2004; Eroglu et al., 2005). Perceived crowding, then, is a personal and subjective estimation of density in an environment (Eroglu et al., 2005).

Much crowding research has focused on the human dimension of retail density, which refers to the variations of the number of shoppers present in a given space (Machleit, Kellaris, & Eroglu, 1994; Machleit et al., 2000). In a field study by Machleit et al. (2000), crowding and shopping satisfaction by different store types were examined. They found that high density conditions in a discount store had positive effects on shopping satisfaction, whereas in an upscale store, negative influences of density were apparent. In contrast, Lee et al. (2011) found that shopping satisfaction and behaviors are negatively influenced by crowding at discount stores. Their study was conducted in Taipei City, one of the world's densest cities in East Asia and respondents were asked to recall and imagine themselves back in the store environment. The different findings may be attributed to study locations as customers' perception of "being crowded" in a heavily crowded city is likely to mean different degrees of density.

Several studies examined human density effects by manipulating the number of shoppers in pictures taken at shopping environments in an attempt to control the number of people expected in various human density situations (Jones, Vilches-Montero, Spence, Eroglu, & Machleit, 2010; Machleit et al., 2000). In addition to human density, spatial density—referring to the number of fixtures and merchandise in a store—has also been studied (Levine & Hogg, 2010), as it could affect perceptions of crowding. Studies moved bookracks and shelves, reduced available space and restricted movement (Jones et al., 2010; Machleit et al., 2000), and varied the amount and arrangement of fixtures (Kim, Wen, & Doh, 2010). In a real-world store setting, it is challenging to control the number of customers and it is rarely feasible to change fixtures and merchandise for a study. However, both human and spatial dimensions need to be carefully conditioned to understand their effects on perceived crowding. Because the current study focuses on human density, the effect of spatial density was controlled by keeping the objects and display surfaces constant.

Although high human density might be desirable in some retail settings, generally it causes negative reactions when customers are restricted in movement. Perceived crowding negatively influences shopping

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satisfaction and shopping behaviors, such as spending less time shopping in the store, engaging less in impulsive shopping, purchasing fewer items, socializing less, deviating from their shopping plans, being more nervous, showing increased levels of tension and confusion, refraining from exploratory behaviors, and postponing purchases (Lee et al., 2011; Machleit et al., 2000). Other negative reactions to retail crowding include consumers' lack of desire to stay and affiliate (Hui & Bateson, 1990; Hwang, Yoon, & Bendle, 2012) as well as lower repatronage intentions (Eroglu & Machleit, 1990). Although not specific about retail spaces, Evans and Cohen (2004) demonstrated that undesirable crowding also could affect psychophysiology, performance, and human motivation beyond the direct consequences of crowding, such as uncontrollable noise or invaded personal space.

Perceived crowding is also a function of environmental variables within the space. Previous studies have argued that store layout is a critical factor contributing to crowded feelings (Baker et al., 1992; Levy & Weitz, 2008; van Rompay et al., 2012). Moreover, the consequences of perceived crowding should also be considered; individual perceptions of crowding are often caused by personal space violation and individual differences such as gender and culture (Jones et al., 2010).

### Individual Differences and Crowding

When a crowded situation occurs, the ways in which people perceive, interpret, experience, and respond depend on individual characteristics, including culture (Fleishman, Feitelson, & Salomon, 2004), tolerance to crowding (Machleit et al., 2000), and privacy preferences (Ozdemir, 2006; Stokols, 1972). Gender is a personal factor that has received constant attention as a strong determinant of crowding effects since the 1970s. A consistent pattern of gender differences has been established that personal space requirements vary with gender—men tend to have larger personal space needs than women, suggesting that men are expected to be more sensitive in crowding conditions and thus respond with more aggravated reactions. More recently, a field study with 465 participants by Yildirim and Akalin-Baskaya (2007), investigating the relationship between circulation axes and seating areas in restaurants and cafes with different seating densities, had results that contradicted earlier studies, suggesting that men perceived the crowded space more positively than women.

Cultural backgrounds can also shape individual perceptions of crowding. Culture has been investigated in crowding and retailing contexts by contrasting the differences between Americans and people of other cultures such as Chinese (Kim et al., 2010), Australian (Jones et al., 2010), and Middle Eastern (Pons, Laroche, & Mourali, 2006). In a cross-cultural comparison study by Kim et al. (2010), Chinese participants were found to judge a crowding situation as more crowded by spatial factors, whereas Americans were more sensitive to human density in a given space. A study by Pons et al. (2006) found that Middle Easterners tend to more positively evaluate crowding and report less crowding than North Americans. According to Jones et al. (2010), culture moderates the influence of crowding on shopper satisfaction, whereby American shoppers report stronger negative effects than Australian shoppers do. Overall, other contextual factors affecting individual responses need to be taken into account to fully understand the findings.

Although a few studies have incorporated some aspects of the current research, no prior work in retail literature has examined retail crowding on the basis of an empirical manipulation of the environment. One of the most fundamental challenges in studying contextual factors is testing in a controlled physical environment with groups of people in different geographical locations. Advanced simulation techniques allow researchers to overcome this challenge and to have a better understanding of customer experience.

## Research Method

Stemming from the previous discussion, we developed a research model testing the direct and indirect effects, via perceived crowding, of store layout on shopping behavioral intentions using a computer simulation. Our study investigated the effects of store

layout and human density on behavioral intentions. In order to further understand the effects of store layout and human density, we also examined the subjective perception of crowding as a potentially mediating factor between the independent variables and the dependent variable. Given the homogeneous characteristics of the participants, culture and gender differences were considered for individual factors to test any extraneous effects.

## Subjects and Data Collection

A total of 75 students from a midwestern university participated in the study. Sixty student cases were kept for the study after eliminating ones recognized as outliers or having technical errors. Based on a power analysis conducted using Gpower statistical analysis software, the number of participants kept for analysis satisfies the requirement of a minimum sample size of 58 given the number of variables. Participants were recruited via campus email. The email addresses were provided by the instructors supporting the study. Gift certificates for a popular local restaurant were used as incentives for participation. Participants' ages ranged from 18 to 38 years ($M = 23.37$, $SD = 4.14$), with 32 (53.3%) women and 28 (46.7%) men. The participants were from interior design (21.7%), architecture (30.0%), and other diverse majors, including journalism, engineering, and business (48.3%). Prior to data collection, a pretest and pilot study were undertaken to test the full experiment, detect flaws in the protocol and scenario, revise the questionnaire to create a more reliable instrument, and calibrate the experimental procedures.

The university's Institutional Review Board for human subject protection approved the application as an exempt study. One subject was invited to the laboratory at a time and asked to sit and watch an instructional presentation. A hypothetical scenario was introduced using a script asking the subject to imagine himself or herself arriving at the first floor of a department store from an escalator. Then, the subject was asked to wear 3D glasses and view a randomly assigned treatment condition for three minutes. The simulated environment was projected on a large display screen ($18' \times 6'$) by a 3D stereo-enabled projector. 3D stereoscopy was incorporated for accurate insight toward the physical space and crowds with enhanced depth perception, which resulted in a more realistic experience. Finally, the subject was asked to report his or her responses using a self-report questionnaire. The average duration of the session was approximately 15 minutes. Figure 1 shows the experimental setting.

## Study Design

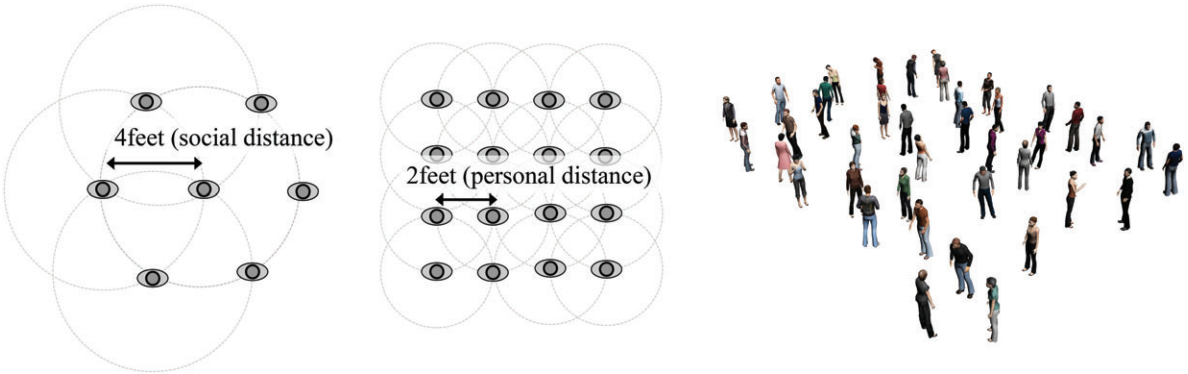
A $2 \times 2$ (Store Layout $\times$ Human Density Conditions) between-subjects design was used. A virtual store environment representing the first floor of a department store was developed in high-fidelity, 3D computer-animated walk-throughs to represent four treatment conditions: grid-based/free-flow layout and low/high density conditions. Shopping behavioral intention constructs as the dependent variables, adapted from previous studies (Donovan & Rossiter, 1982; M-R, 1974), were operationalized with six measurable dimensions: affect, patronage intention, repatronage intention, desire to stay, desire to explore, and WOM.

We adopted Hall's (1966) definition of personal distance (1.5–2.5 feet) and social distance (2.5–4 feet), which are likely to be observed in crowded shopping environments. Hall identified four distances (intimate, personal, social, and public) that U.S. residents tend to maintain; these interpersonal distances are affected by many factors such as cultural and environmental context. Personal distance is reserved for friends and family, and social distance is accepted for formal interactions. For this study, 15 people (4 feet between customers) were placed to simulate a low-crowding condition, and 150 people (2 feet between customers) were placed to simulate a high-crowding situation. Figure 2 illustrates the low and high human-density manipulation principle and the simulated shoppers in the virtual store.

As shown in Figure 3, displays were arranged in a linear manner for the grid-based layout condition, whereas the free-form condition used displays

***Figure 1.*** **Laboratory experiment setting for the virtual walk-through experience.**

***Figure 2.*** **Low versus high human density manipulation with computer-simulated customers.**



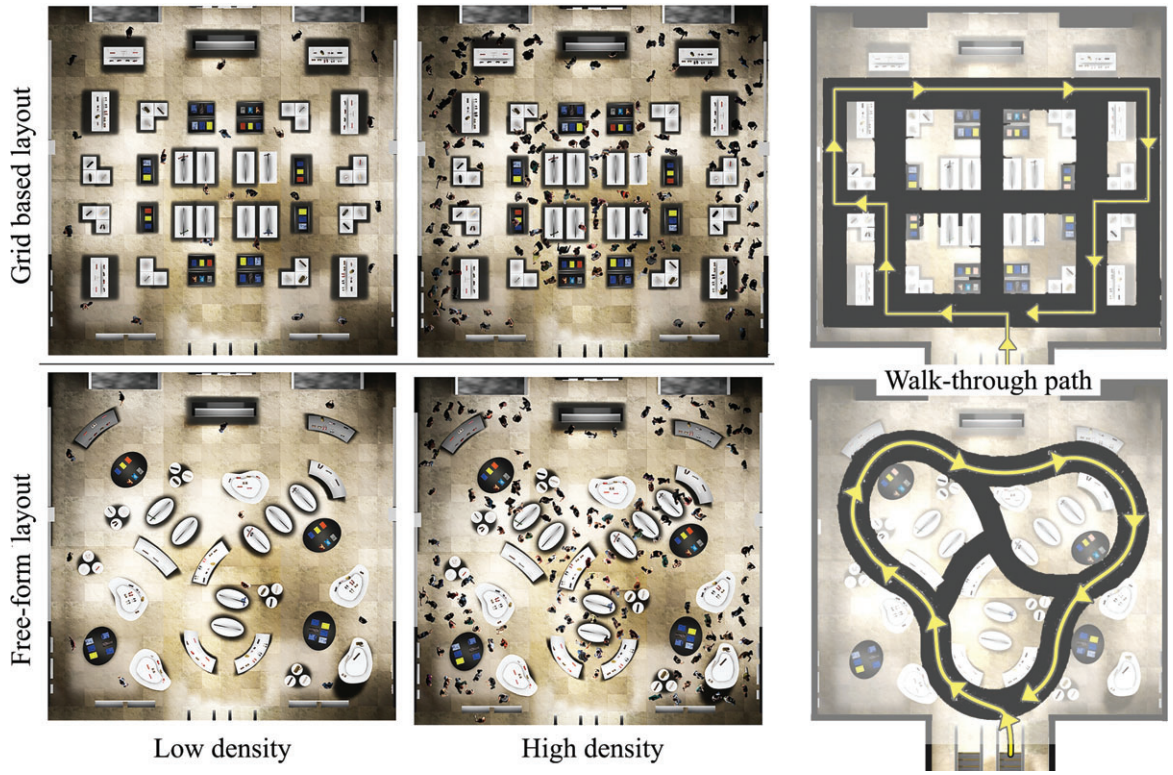

arranged in an asymmetric pattern. Density was controlled to systematically test different options by keeping the number of displays and display surface areas constant. The rest of the store's physical elements, such as walls and ceiling, were kept simple yet realistic, whereas colors and materials were controlled for all manipulations with a low-saturated, subtle color scheme. Visual openness was also controlled by maintaining consistent display heights in both layout conditions.

## Virtual Stimuli

Based on the information gathered from a number of local and international department stores, a virtual model of the space with a total area of 3600 square feet (60′ × 60′) was designed by a professional interior designer to represent a realistic shopping environment. Two store layout conditions—grid-based layout and free-form—with a variety of fashion products for both genders, were created to look photo-realistic using 3DS Max 2014 with Vray. Animated 3D human figures were added using Populate, a crowd simulator. To simulate a more realistic shopping experience, virtual walk-through animation was used. The walk-through distance, width, and speed were kept constant for both conditions. The animated viewer path is highlighted in Figure 3.

Computer simulation technology has been broadly adopted in research as a reliable technology with which to study retail design issues with grocery stores (Massara, Liu, & Melara, 2010), storefronts (Cornelius, Natter, & Faure, 2010), and restaurants

***Figure 3.*** **Store layout manipulation and walk-through paths.**




(Hwang et al., 2012). Viewers experience a greater sense of being inside the virtual environment instead of reality, particularly with simulations using a large screen and higher display fidelity (Ni, Bowman, & Chen, 2006) to provide responses similar to the real experience (Bateson & Hui, 1992). Conducting retail crowding studies in a real environment is nearly impossible without disrupting business and customers (Bateson & Hui, 1992; Eroglu & Machleit, 1990; Hui & Bateson, 1991; Kim & Kim, 2012), so high-fidelity virtual reality (VR) simulations overcome such challenges to empirically examine the impact of store design on shopping experience.

## Self-Report Questionnaires

A 10-point Likert scale questionnaire was developed to measure individual characteristics and behavioral intentions. "Affect" was assessed with three items (Cronbach's $\alpha = .90$) from a subscale of the approach-avoidance scale (Donovan & Rossiter, 1982), which included statements such as, "I like the environment." Items adapted from a scale developed by M-R (1974) and Wakefield and Baker (1998) were used to operationalize the variables "desire to stay" with three items (Cronbach's $\alpha = .92$) and "desire to explore" with two items (Cronbach's $\alpha = .72$). From M-R's (1974) approach–avoidance scales, "desire to stay" was measured with such statements as "I would like to spend a lot more time in this store," and the "desire to explore" responses were measured using statements such as "I really want to explore around this store."

"Patronage intention" was measured using three related items from Grewal et al. (2003) and three

*The stimuli were tested for realism, degree of authenticity and immersiveness.*

items from Sweeney, Soutar, and Johnson's (1999) research (Cronbach's $\alpha = .92$). The scale, representing an indication of the individual's willingness to purchase from the store, included items such as "The likelihood that I would shop in this store is very high." "Repatronage intentions," reflecting the likelihood that one would revisit the store, was measured with three items (Cronbach's $\alpha = .94$) adapted from Fishbein and Ajzen (1975) and included items such as "I look forward to visiting this store in the future" and "No matter how often I visit this store, I will always look forward to coming back."

The desire to offer positive WOM was measured with three items (Cronbach's $\alpha = .95$) adapted from an established measure by Jones et al.'s (2006) study. The WOM scale included items such as, "I'm likely to say good things about this store" and "I would recommend this store to my friends and relatives." A four-item perceived human crowding (PHC) scale (Cronbach's $\alpha = .88$) developed by Machleit et al. (1994) was added to measure the level of crowding a subject has perceived. Items in this scale include statements such as "This store seemed very crowded to me" and "This store was a little too busy." Although some of the scales are relatively old, they are still repeatedly adopted by current researchers for their stability and reliability in measuring shopping behavioral intentions and the level of crowding (Kumar, Garg, & Rahman, 2010; Li, Kim, & Lee, 2009).

### Manipulation Checks

The perceived crowding questions (PHC) were used to test the crowding manipulation of the number of people incorporated into the store. Independent *t*-test results ensured that the two groups rated perceived crowding differently, $t(58) = -14.17$, $p < .001$), with PHC scores being significantly higher for the high-crowding condition ($M = 8.25$, $SD = 1.29$) than the low-crowding condition ($M = 3.25$, $SD = 1.43$). The store layout manipulation was tested using an independent-samples *t*-test on a bipolar adjective scale. Results confirmed that the subjects clearly distinguished the two layout conditions. The grid-based condition was rated as being significantly more linear, $t(52) = -2.98$, $p < .01$, symmetrical, $t(52) = -2.85$, $p < .01$, whereas the free-form layout was rated as being more curvilinear ($M = 7.46$, $SD = 2.12$) and asymmetrical ($M = 5.00$, $SD = 2.23$).

The stimuli were tested for realism, degree of authenticity and immersiveness. Subjects were asked to rate their responses using question items developed by Hwang et al. (2012) and Vorderer et al. (2004) for virtual stimuli. The results from a one-sample *t*-test analysis comparing the means of responses to the midpoint of the scale confirmed that the subjects found the virtual stimuli with animated human models to be realistic ($t = 9.92$, $p < .001$; $M = 6.65$), felt like they were in the virtual environment ($t = 8.15$, $p < .001$; $M = 6.65$), and could act in the virtual environment as they would in an actual store ($t = 4.71$, $p < .001$; $M = 5.97$).

## Analysis and Results

Collected data were screened and analyzed using SPSS statistical software. Internal consistency and scale reliability of each measure were assessed by Cronbach's coefficient alpha and split-half (Spearman-Brown) reliability analysis. As shown in Table 1, all scales exceeded the minimal level of .65 for internal consistency and reliability (DeVellis, 2012). The strength of the relationships among the behavioral intention was tested using Pearson product–moment correlation coefficients (Table 1), demonstrating strong and positive correlations between all variables (Pearson's $r > .50$, $p < .01$). The negative correlation observed between perceived crowding and behavioral intention variables implies an inverse relationship with all behavioral intention variables; in other words, as one's level of crowding perception increases, shopping behavioral intention decreases.

### Hypothesis Testing

The relationship between the two independent variables (i.e., store layout and human density) and

**Table 1.** ***Correlation results for outcome variables***

| Variable | No. of items | Reliability | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Perceived crowding | 4 | .88 | — | | | | | | |
| 2. Affect | 3 | .90 | −.43** | — | | | | | |
| 3. Patronage intentions | 3 | .92 | −.38* | .82** | — | | | | |
| 4. Repatronage intentions | 3 | .94 | −.41** | .81** | .86** | — | | | |
| 5. Desire to stay | 3 | .92 | −.33* | .78** | .82** | .90** | — | | |
| 6. Desire to explore | 2 | .72 | −.35* | .69** | .60** | .68** | .71** | — | |
| 7. Word-of-mouth (WOM) | 3 | .95 | −.36* | .80** | .88** | .87** | .84** | .70** | — |

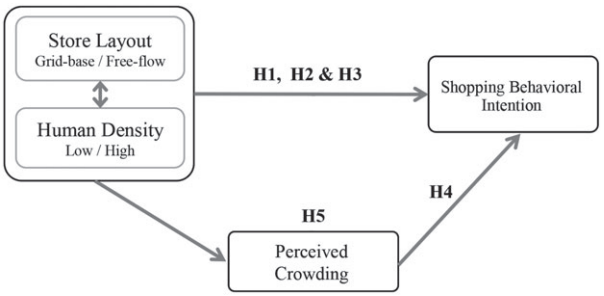
*$p < .05$, **$p < .01$.

the two dependent variables (i.e., perceived crowding and approach–avoidance behavioral intentions) were tested. The independent variables were manipulated using a 2 × 2 factorial experimental design (grid-based/free-form layout × high/low human density) in four treatment conditions with 15 participants in each cell. From the research model (Figure 4), direct and interaction effects of independent variables on dependent variables, i.e., perceived crowding and approach intention, were tested. Including the overall proposition of the study, five hypotheses were formulated:

H1: Store layout will influence behavioral intentions.
H2: Human density in a store will influence behavioral intentions.
H3: Human density and store layout together will influence behavioral intentions.
H4: Customers' perceptions of crowding will influence their behavioral intentions.
H5: Perceived crowding will mediate the effect of layout on behavioral intentions.

H1, H2, and H3 were tested with a multivariate analysis of covariance (MANCOVA) while controlling for gender and culture effects. Although there was no significant main effect for human density, significant main effects for store layout were observed on behavioral intention variables—affect ($F$ (1,54) = 5.57, $p = .02$), patronage intentions ($F$ (1,54) = 3.91, $p = .05$), repatronage intentions ($F$ (1,54) = 7.28, $p < .01$), desire to stay ($F$ (1,54) = 5.75, $p = .02$),

***Figure 4.*** **Research model.**




desire to explore ($F$ (1,54) = 7.80, $p < .01$), and WOM ($F$(1,54) = 4.21, $p = .04$). For H3, no significant interaction effect between store layout and human density was found. Between the two layout types, positive behaviroal intention scores were significantly higher in the grid-based condition than the free-form. Partial eta-squared ($\eta_p^2$) values demonstrate that such tendency was stronger for desire to explore and repatronage intentions ($M_{grid} = 6.31$, $M_{free} = 4.85$, $F$(1, 59) = 7.28), followed by desire to stay and affect (Table 2). Therefore, H1 was supported. H2 and H3 were not supported. Table 2 summarizes variable means, and standard deviation values, and MANCOVA results.

H4 (Perceived crowding will influence behavioral intentions) was tested using a series of simple regressions. As Table 3 shows, the results indicated that perceived crowding significantly predicts affect

**Table 2.** ***Means, standard deviations, and MANCOVA results on behavioral intentions by store layout and human density***

| | Behavioral intentions | *F* | *p* | $\eta_p^2$ | *M* (*SD*) *N* = 60 | |
|---|---|---|---|---|---|---|
| | | | | | Grid-based *n* = 30 | Free-form *n* = 30 |
| Store layout | **Affect** | **5.57*** | **.02** | .09 | **7.00 (2.26)** | **5.82 (2.29)** |
| | **Patronage intentions** | **3.91*** | **.05** | .07 | **6.78 (2.36)** | **5.79 (2.07)** |
| | **Repatronage intentions** | **7.28**** | **<.01** | .12 | **6.32 (2.32)** | **4.85 (2.26)** |
| | **Desire to stay** | **5.75*** | **.02** | .09 | **5.21 (2.37)** | **3.98 (2.12)** |
| | **Desire to explore** | **7.81**** | **<.01** | .13 | **6.93 (2.18)** | **5.67 (2.15)** |
| | **Word-of-mouth** | **4.21*** | **.04** | .07 | **6.87 (2.12)** | **5.88 (2.04)** |
| | | | | | Low density *n* = 30 | High density *n* = 30 |
| Human density | Affect | 1.53 | .22 | .03 | 6.79 (2.10) | 6.03 (2.51) |
| | Patronage intentions | .59 | .44 | .01 | 6.49 (2.19) | 6.08 (2.34) |
| | Repatronage intentions | .23 | .63 | .00 | 5.71 (2.43) | 5.47 (2.38) |
| | Desire to stay | .19 | .66 | .00 | 4.69 (2.41) | 4.50 (2.25) |
| | Desire to explore | .99 | .32 | .02 | 6.50 (2.29) | 6.19 (2.20) |
| | Word-of-mouth | .11 | .74 | .00 | 6.48 (1.86) | 6.27 (2.38) |
| | | | | | Store layout × human density | |
| Store layout × Human density | Affect | .25 | .62 | .01 | 6.4 (2.33) | |
| | Patronage intentions | .78 | .38 | .01 | 6.28 (2.26) | |
| | Repatronage intentions | .64 | .43 | .01 | 5.59 (2.40) | |
| | Desire to stay | 2.16 | .15 | .04 | 4.50 (2.36) | |
| | Desire to explore | .02 | .88 | .00 | 6.30 (2.24) | |
| | Word-of-mouth | .03 | .86 | .00 | 6.37 (2.12) | |

*$p < .05$, **$p < .01$.

(β = −.43, $p < .01$), patronage intentions (β = −.38, $p = .01$), repatronage intentions (β = −.41, $p < .01$), desire to stay (β = −.33, $p < .05$), desire to explore (β = −.35, $p < .05$), and WOM (β = −.36, $p = .01$). Perceived crowding explained a significant proportion of variance in affect scores, $R^2 = .43$, as well as repatronage intentions, $R^2 = .17$. All relationships were negative, as expected; the higher the perceived crowding scores, the lower the approach ratings. Therefore, H4 was supported.

For H5 (perceived crowding will mediate the effect of layout on behaviroal intentions), the mediator role of perceived crowding between store layout type and approach intentions was tested following Baron and Kenny's (1986) four-step procedure for mediation analysis. According to Baron and Kenny, mediation occurs when a variable intervenes and accounts for the relationship between a predictor and an outcome. In order to establish a mediation effect, four conditions should be satisfied:

1. *Store layout (IV) should significantly affect approach intentions (DVs).*
2. *Store layout (IV) should significantly affect perceived crowding (M).*
3. *Perceived crowding (M) should significantly affect approach intentions (DVs).*
4. *When all the aforementioned conditions are met, then the effect of store layout (IV) on approach intentions (DVs) must be nonsignificant while controlling for perceived crowding (M) for the full mediation effect to exist. If the beta coefficient becomes considerably reduced after controlling for the mediator but is still significant, then it is considered partial mediation.*

Based on results of a series of regression analyses (Table 4), the relationship between store layout and approach intention varies. Except for patronage

*Except for patronage intentions and desire to stay, significant full mediating effects of perceived crowding between store layout and all shopping behavioral intention variables were found.*

**Table 3.** ***Regression results for perceived crowding (IV) on behavioral intentions (DV)***

| IV | Behavioral intentions (DV) | *B* | β | *t* | *p* | $R^2$ |
|---|---|---|---|---|---|---|
| Perceived crowding | Affect | −.39 | −.43 | −3.16** | <.01 | .43 |
| | Patronage intentions | −.32 | −.38 | −2.67** | .01 | .14 |
| | Repatronage intentions | −.36 | −.41 | −2.94** | <.01 | .17 |
| | Desire to stay | −.29 | −.33 | −2.32* | .02 | .11 |
| | Desire to explore | −.29 | −.35 | −2.46* | .02 | .12 |
| | Word-of-mouth | −.28 | −.36 | −2.52** | .01 | .13 |

IV, independent variable; DV, dependent variable.
*$p < .05$, **$p < .01$.

intentions and desire to stay, significant full mediating effects of perceived crowding between store layout and all shopping behavioral intention variables were found. Partial mediation was observed with desire to explore, but no mediating effect was found with patronage intentions. Thus, H5 was supported.

In addition to hypothesis testing, we further examined gender and culture effects (American and international students). First, the data set was separated by gender and tested with independent-samples *t*-tests. A significant difference was found between men and women on behavioral intentions, especially, repatronage intentions ($\eta_p^2 = .12$) and desire to explore ($\eta_p^2 = .13$) show relatively stronger effects. As seen in Table 5 and Figure 5, men's ratings on behavioral intentions were significantly higher in the grid-based store, particularly on affect, $t(26) = 3.23$, $p = .001$, patronage intentions, $t(26) = 2.90$, $p = .01$, repatronage intentions, $t(26) = 2.99$, $p = .01$, desire to stay, $t(26) = 2.57$, $p < .05$, desire to explore, $t(26) = 2.15$, $p < .05$, and WOMs, $t(26) = 2.23$, $p < .05$. The differences in women's ratings, sharing similar trends, were not statistically significant. No significant gender differences were found on perceived crowding scores. The data set was separated by cultural groups and tested with independent-samples *t*-tests. A significant difference was found for international participants rating behavioral intentions significantly higher in the grid-based store, particularly on repatronage intentions, $t(28) = 2.40$, $p < .05$, desire to stay, $t(28) = 2.17$, $p < .05$, and desire to explore, $t(28) = 2.70$, $p = .01$, while reaching significance for affect, $t(28) = 1.99$, $p = .06$ and patronage intentions, $t(28) = 1.85$, $p = .07$.

# Discussion and Conclusions

## Discussion

Analysis results from multiple statistical procedures confirmed the primary proposition of the study that store layout plays a strong role, contributing to behavioral intentions in both high and low human-density conditions. This finding supports existing literature recognizing the critical role of store layout in controlling retail crowding and behavioral motivations (Baker et al., 1992; Levy & Weitz, 2008), likely contributing to store success (Griffith, 2005). We also found shopping intentions are higher in the store environment with a linear and symmetrical configuration than with a curvilinear and asymmetrical one, and such tendency is significantly greater for male customers. This study discovered that much of this effect can be attributed to customers' subjective sense of crowding. Therefore, our results provide evidence that physical design factors in a store play a key role in crowded situations, swaying the consumers' approach intentions. Additionally, perceived crowding significantly mediated the relationship between store layout and shopping intentions. This confirms the critical effect of store layout on perceived

*We also found shopping intentions are higher in the store environment with a linear and symmetrical configuration than with a curvilinear and asymmetrical one, and such tendency is significantly greater for male customers.*

**Table 4.** ***Regression results—mediation of perceived crowding***

| | Path | *B* | β | *t* | *p* | $R^2$ |
|---|---|---|---|---|---|---|
| Step 1 (IV → DV) | *Layout → shopping intentions* | | | | | |
| | **Affect** | **−1.62** | **−.33** | **−2.31*** | **.03** | **.11** |
| | Patronage intentions | −1.20 | −.26 | −1.76 | .08 | .07 |
| | **Repatronage intentions** | **−1.76** | **.68** | **−2.59**** | **.01** | **.13** |
| | Desire to stay | −1.60 | −.34 | −2.35* | .02 | .11 |
| | **Desire to explore** | **−1.73** | **−.38** | **−2.72**** | **<.01** | **.15** |
| | Word-of-mouth | −1.26 | −.29 | −2.01* | .05 | .09 |
| Step 2 (M → DV) | *Perceived crowding → shopping intentions* | | | | | |
| | **Affect** | **−.39** | **−.43** | **−3.16**** | **<.01** | **.43** |
| | **Patronage intentions** | **−.32** | **−.38** | **−2.67**** | **.01** | **.14** |
| | **Repatronage intentions** | **−.36** | **−.41** | **−2.94**** | **<.01** | **.17** |
| | **Desire to stay** | **−.29** | **−.33** | **−2.32*** | **.02** | **.11** |
| | **Desire to explore** | **−.29** | **−.35** | **−2.46*** | **.02** | **.12** |
| | **Word-of-mouth** | **−.28** | **−.36** | **−2.52**** | **.01** | **.13** |
| Step 3 (IV → M) | ***Layout → perceived crowding*** | **1.89** | **.34** | | **.02** | **.12** |
| Step 4 (IV → DV Controlling for M) | *Layout → shopping intentions* | | | | | |
| | Affect | −1.01 | −.21 | −1.43 | .16 | .47 |
| | Patronage intentions | −.67 | −.15 | −.97 | .34 | .16 |
| | Repatronage intentions | −1.23 | −.26 | −1.78 | .08 | .23 |
| | Desire to stay | −1.20 | −.25 | −1.68 | .10 | .17 |
| | **Desire to explore** | **−1.34** | **−.30** | **−2.02*** | **.05** | **.20** |
| | Word-of-mouth | −.83 | −.19 | −1.27 | .21 | .16 |

*Note.* Significant values are in boldface.
IV, independent variable; DV, dependent variable; *M*, mediator.
*$p < .05$, **$p < .01$.

crowding that indirectly, yet significantly, influences customers' shopping behavioral intentions.

In addition, the findings provide a better understanding of how individual differences, like gender, may influence the shopping process. The analysis revealed that men have significantly higher shopping intentions in a grid-based store environment. There are possible explanations, including store layout being a stronger cue for shopping behavior for men than women and men's general design preferences for regular geometric forms and simpler design (Yoon, Oh, & Cho, 2010). Another possible explanation is that a grid-based layout may work better for young men's shopping tendencies as task shoppers rather than social shoppers (Baker & Wakefield, 2012).

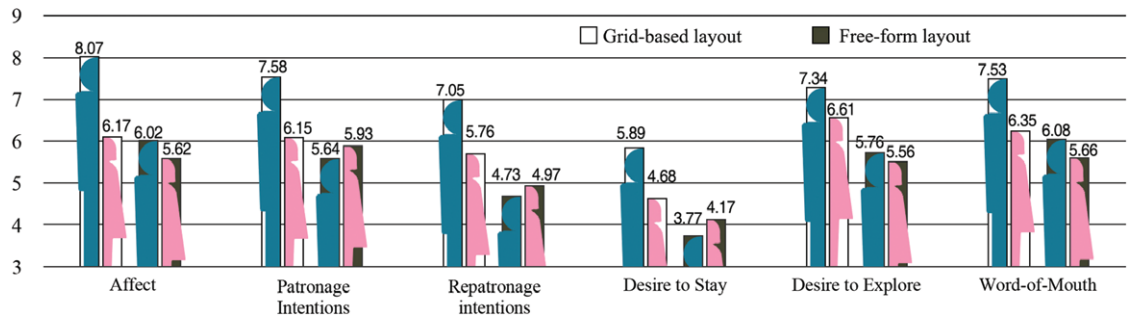
Another interesting finding is that only women had significantly lower shopping intentions in the store with high human density. This result is inconsistent with previous studies that found that men require more personal space (Baum & Koman, 1976; Stokols, 1972). However, our result presents a picture of gender difference consistent with Yildirim and Akalin-Baskaya's (2007) study showing that men perceive crowding in a hospital waiting area more positively than women. Mixed reports among researchers on which gender is more negatively affected by high-density situations are most likely due to multiple factors influencing the research setting. The young female population of this study reported significantly lower shopping intention for the crowded store, despite Baker and Wakefield's (2012) work suggesting that young females tend

**Table 5.** ***t-Test results on purchase intentions for layout type by gender groups***

| Outcome variables | Gender | Layout type *M* (*SD*) Grid-based (13 males, 17 females) | Free-form (15 males, 15females) | *t*(26) | *p* |
|---|---|---|---|---|---|
| Perceived crowding | Male | 5.46 (2.83) | 5.28 (2.18) | 0.19 | .85 |
| | Female | 5.73 (3.59) | 6.48 (2.69) | –0.66 | .51 |
| Affect | Male | 8.07 (1.52) | 6.02 (1.80) | 3.23*** | <.01 |
| | Female | 6.17 (2.42) | 5.62 (2.73) | 0.61 | .55 |
| Patronage intentions | Male | 7.58 (1.81) | 5.64 (1.72) | 2.90** | .01 |
| | Female | 6.15 (2.59) | 5.93 (2.41) | 0.25 | .80 |
| Repatronage intentions | Male | 7.05 (1.85) | 4.73 (2.20) | 2.99** | .01 |
| | Female | 5.76 (2.53) | 4.97 (2.39) | 0.90 | .38 |
| Desire to stay | Male | 5.89 (2.20) | 3.77 (2.14) | 2.57* | .02 |
| | Female | 4.68 (2.42) | 4.17 (2.15) | 0.62 | .54 |
| Desire to explore | Male | 7.34 (1.92) | 5.76 (1.94) | 2.15* | .04 |
| | Female | 6.61 (2.36) | 5.56 (2.40) | 1.24 | .22 |
| Word-of-mouth | Male | 7.53 (1.74) | 6.08 (1.68) | 2.23* | .03 |
| | Female | 6.35 (2.28) | 5.66 (2.37) | 0.83 | .41 |

*$p<.05$, **$p<.01$, ***$p<.001$.

***Figure 5.*** **Behavioral intention responses by store layout and gender.**




to be social shoppers with hedonic shopping motivations, seek social interaction, and have a more positive sense of crowding. This result indicates an area of study for further research in the future.

## Implications

This study seeks to broaden the body of knowledge on customer intentions influenced by retail store design factors and to offer managerial information for marketers, as well as designers. This study also addresses the importance of understanding the effect of perceived crowding on shopping intentions, as well as the designer's role in successful and evidence-based design intervention to facilitate optimal environmental quality.

With advanced computer-aided design and manufacturing technology offering unlimited possibilities for store space design plus the stiff competition today's brick-and-mortar stores face, interior designers have new opportunities and challenges. For example, although high-end fashion stores are expressing futuristic looks with unique and fluid store interiors,

*Integrating constructs of consumer behavior and environmental psychology theories allows design researchers to explore environmental cues and behavioral intentions using readily available technology.*

customer experience and value are yet to be tested in terms of store success. Our results contribute evidence-based insights to the retail design literature to support informed decisions. This study examined behavioral intentions rather than actual behavior. However, when the design of a store successfully encourages customers to stay longer, to be willing to revisit the store, or to recommend the store to others, it is very likely to result in more pleasant shopping experience and increased sales.

Theoretically, this work tests and extends previous approach–avoidance conflict theories and contributes to multiple literatures, including marketing, retail management, atmospherics, and environmental psychology. Moreover, our study answers calls for further research in retail crowding that fill the gap in investigating store layout in retailing research.

This study joins a limited body of research pertaining to the designed environment and aims to advance understanding of the distinct effects of retail environments on consumers' experience and behavior. In addition, we have magnified the role of gender in the context, thus offering a better understanding of consumer characteristics that may influence perception and behavioral responses.

The findings of the current work accentuate the potential of integrating high-fidelity computer simulation to achieve results comparable with those of traditional field research. Learning which environmental factors are preferred by customers and what advanced benefits are offered should be a high priority for practitioners. Realistic simulations give researchers, practitioners, and viewers alike the opportunity to examine design projects with lifelike qualities prior to implementation.

Advanced 3D computer graphics have been widely used as effective tools to simulate and substitute real-world experience in various areas, including technical training, medical treatments, design prototyping, and review (Yoon, Choi, & Oh, 2015). Advancing crowd-simulation technology adds value to simulation-based research. Integrating constructs of consumer behavior and environmental psychology theories allows design researchers to explore environmental cues and behavioral intentions using readily available technology.

## Limitations and Future Directions

Although care and rigor were exercised in this empirical investigation, there were still limitations, as with all research that is exploratory in nature. The first recognized limitation stems from the recruited sample of college students. Students attending the same college, with about half of the sample coming from the Department of Architecture, constitute a very homogeneous group. Whereas there is an advantage regarding a high degree of representativeness, the same experiment may not lead to consistent results for the general population or for different clusters.

The research method applied was also subject to some limitations due to the nature of the simulation and the study design. In a real-world situation, crowding accompanies other environmental cues such as noise, smell, and temperature, which were not accounted for this study. Another limitation is also related to the computer-simulation technique used for the study. The appearance and motion of the virtual shoppers, generic and predetermined 3D figures, may not fully represent probable shoppers in a department store, and they do not interact with one another or the attending staff. As a result, the viewer's sense of realism may be diminished.

The current study highlights several opportunities and avenues for future research. Two significant areas to be further addressed are individual customer attributes and product attributes. Beyond gender differences, extensive studies in consumer behavior and marketing have examined factors including culture, generation, and shopping orientations in association with characteristically differentiated behaviors. Depending on product or service attributes, many scenarios can be developed such as hypermarkets, electronics versus fashion products, and hedonic settings versus utilitarian settings.

An additional direction to be considered for future research is to test with other important environmental

factors (e.g., partitions, aisle width, ceilings, and size of the store), ambient factors (e.g., colors and noise), and social factors (e.g., inclusion of staff, male crowds vs. female crowds, and interactions with other customers). Finally, appropriate sound effects combined in the simulation will offer a great potential for interesting future research. On top of the obvious benefit (i.e., increased realism for the subject's experience), negative (loud human noise) or positive sound effects (music, white noise) in hypothetical contexts can be effectively explored on behavioral intensions in simulation.

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