Effects of virtual stores' opaque exterior on store perceptions and purchase intentions

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Abstract

Purpose – A series of research has focused on how virtual reality (VR) technology itself influences consumers' perceptions and attitudes. However, little is known about consumers' unique perceptions and behaviours that can be generated by the specific factors of the virtual stores that they visit. Therefore, the authors examine how the specific aspects of the virtual stores that consumers see on screens – namely, the opacity of virtual stores' exterior design can impact consumer perceptions and behaviours.

Design/methodology/approach – Across three studies, the authors employed 3D modelling software (Rhino 6 and Unity) and 3D architectural visualisation software (Twinmotion) to create 360° VR videos for the manipulation of the virtual store exterior design. The authors performed ANOVA and regression analyses with three studies, a total of 858 responses.

Findings – Results showed that virtual stores' opaque exterior design can promote product preferences, and this link is serially mediated by store prestige perceptions and product quality perceptions. In addition, this effect is particularly prominent among those with higher involvement in design elements.

Originality/value – By suggesting important design variables to virtual stores, it advances the emerging literature on VR. Furthermore, to our knowledge, this research is the first to highlight the importance of exterior opacity of a virtual store, and it deepens our understanding of how the opaque exterior of virtual stores influences store perceptions and consumer behaviours.

Keywords Virtual reality, Virtual store, Store environment, Product quality, Opaque store exterior design, Store prestige

Paper type Research paper

1. Introduction

Presently, consumers increasingly "go" shopping online. Since the rise of online shopping, fewer consumers visit physical stores to make purchases. Numerous retailers and brands including Macy's, CVS, BCBG and Michael Kors have closed many of their physical stores in the past several years (Fox Business, 2019). This trend could become an issue to many retailers considering the benefits that physical stores offer. For example, experiencing physical stores leads consumers to more favourably evaluate those brands' online stores (Fornari *et al.*, 2016), in turn enhancing brand equity (Frasquet *et al.*, 2017).

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In response to these trends, many retailers reshaped their business models, embraced various technologies and fused them into diverse online retail settings (Grewal *et al.*, 2017). The most frequent examples of the embraced technologies are augmented reality (AR) and virtual reality (VR) (Dwivedi *et al.*, 2021; Grewal *et al.*, 2017). First, AR is defined as a technology combining the real and virtual worlds by overlaying virtual content onto the consumer or their surroundings (Smink *et al.*, 2020). Unlike AR, VR does not incorporate real-world data, but separates users from the real world, and creates a fictional reality (Dwivedi *et al.*, 2021). This real-time interaction can be used as a criterion to differentiate AR from VR (Kumar, 2021; Lee *et al.*, 2021). Thus, VR is defined as a "form of immersive digital media that generates a three-dimensional, virtual imaginary and interactive media environment that users perceive much as they perceive the real world (Herz and Rauschnabel, 2019)". Even though VR technology lacks real-time interaction, it can overcome the physical barriers. Thus, it receives much attention from the retail industry (Wu *et al.*, 2015), and many retailers are utilising VR technology to shape their virtual stores (VSs; Retail VR, 2021). For example, Christian Dior has developed a virtual version of the flagship perfume store in Paris, while Ralph Lauren has created a VS of the shop located in Beverly Hills.

Reflecting this trend, several studies have examined how VSs influence the perceptions and attitudes of consumers (e.g. Park *et al.*, 2018). For example, VSs enrich perceived informativeness and playfulness (Kang *et al.*, 2020), and virtual tours of a store can heighten enjoyment as well as store visit intentions (Baek *et al.*, 2020; Nah *et al.*, 2011). These findings show that a virtual experience *itself* has positive effects on consumer perceptions and behaviours.

Recent research delves into how *specific factors* of VSs affect consumers' attitudes and purchase intentions. Although some studies examined the *interior* characteristics of a VS, such as density, layout and colour (Wu *et al.*, 2015), little is known about consumers' perceptions and behaviours about their specific *exterior* factors. Therefore, we aim to examine how specific exterior aspects of the VSs that consumers see on their screens can affect consumer perceptions and behaviours based on the theory of interactive media effects, which argues that technological attributes of the media can influence cognitive, affective and conative outcomes through the immersive experiences of the consumers (Sundar *et al.*, 2015). Specifically, we focus on the opacity of VSs' exterior design and demonstrate that the opaque exterior of VSs can influence consumers' perception of the stores as more prestigious and perception of the products as more high-quality; in turn, consumers may show a more favourable attitude towards the products in the stores, as well as higher product purchase intentions. Additionally, we examine whether the positive effect of an opaque store exterior on product preferences will be enhanced when consumers' involvement in design elements is high.

This research makes several distinct contributions. To our knowledge, this research is the first to highlight the importance of exterior opacity of a VS and examine its downstream consequences to understand how the opaque exterior of VSs influences store perceptions and consumer behaviours. In addition, our findings provide meaningful insights into methods to increase the exclusivity and prestige of VS. Using 3D modelling software (Rhino 6 and Unity) and 3D architectural visualisation software (Twinmotion), our study provides a novel method to create 360° VR videos without head-mounted displays and contributes to retail experience research.

2. Conceptual framework

2.1 Store exterior design of virtual stores

The term "VS" has been used in the literature to refer to 2D online websites (Burke, 2002). However, the same term is currently used to indicate a 3D VS. Many retailers increase perceived realism and immerse consumers in shopping environments by using panoramic 3D photos (Baek *et al.*, 2020) or 3D models (Kang *et al.*, 2020). The current study focuses on 3D

VSs, especially those based on 3D models, and determines the effect of specific aspects of these stores on consumers' attitudes and behaviour.

As VSs simulate an authentic shopping experience, they possess various characteristics of offline stores. For instance, VSs are likely to have interfaces that present an entire set of physical offline retail stores. Consumers can view and access the VS's entire building, façade and interior design as they do in physical stores. In addition, VSs enable consumers to enjoy a full browsing experience equivalent to an offline store (Van Kerrebroeck *et al.*, 2017).

These features suggest that consumers perceive the characteristics of offline and VSs similarly, and store design should be no exception (Schnack *et al.*, 2020). Store design often shapes the competitiveness of a store (Haug and Münster, 2015; Vos, 2018); among the most salient factors in consumers' perceptions, a store's design factors are immediately and consistently sensed by consumers and used as cues for inferences about the store and its products throughout their consumption process (Baker *et al.*, 1994; Spence *et al.*, 2014). As cue utilisation theory suggests (for a review, see Richardson *et al.*, 1994), consumers process information gained from a store's design and attribute it to the store and its products.

One stream of store design research investigates the effects of interior factors; it focuses mainly on the in-store atmosphere, such as lighting, colour, flooring, visual complexity and space-to-product ratio (Imschloss and Kuehnl, 2017; Jang *et al.*, 2018; Sevilla and Townsend, 2016). For example, consumers perceive products as more likable when the ambient colour of the store is red or blue than when it is white or green (Oberfeld *et al.*, 2009). Recent findings suggest that the effect of multisensory design factors, such as multisensory congruence (e.g. soft music combined with soft flooring), can create more favourable consumer responses (Imschloss and Kuehnl, 2017).

Another research stream on store atmospherics focuses on exterior design. A store's exterior refers to external architectural factors, including storefront, entrance, marquee, window display, window sign and the overall building facade to the surrounding factors (Berman and Evans, 1995; Turley and Milliman, 2000). In this study, we defined the stores' exterior design as an umbrella term for the visual factors that can be observed from the outside of a store.

While in-store design factors are important, store exterior designs are the first set of cues seen by consumers, and thus can be more crucial (Turley and Milliman, 2000; Ward *et al.*, 1992). That is, the exterior design of a store is likely to determine whether a consumer approaches the store in the first place; a worse-managed exterior design may not induce store entry at all (Sen *et al.*, 2002; Turley and Milliman, 2000). Store exterior design can influence consumer decisions about stores and products in various ways. For example, innovative storefront designs shape stronger store images (Cornelius *et al.*, 2010), artistic window displays may decrease store entry, depending on consumers' motives (Oh and Petrie, 2012), and the aggregation of the social, hedonic, informational and image factors of show windows increase consumers' purchase intentions (Jain *et al.*, 2014).

As with offline stores, online retail stores, including virtual ones, cannot be free from atmospheric influences. That is, as with physical stores, consumers perceive online atmospheric cues and make inferences about the retailer as well as formulate certain responses towards the shop (Eroglu *et al.*, 2001). Additionally, unlike offline stores, which usually implement other sensory cues besides visual factors such as olfactory and tactical cues (Fiore *et al.*, 2000; Imschloss and Kuehnl, 2017), online stores rely mainly on visual cues (Papagiannidis *et al.*, 2013). Therefore, visual cues, including the exterior design of a store, are a critical factor in consumer behaviours, particularly for VSs. Specifically, based on the media richness theory (Robert and Dennis, 2005), which argues that the information richness of media leads to a better understanding of the messages provided, we suggest that the exterior design of a VS, whether transparent or opaque, can provide additional information that may affect the consumer perception of the product and store.

2.2 How an opaque store exterior creates store prestige perceptions

Studies on store exterior design have distinguished the consequences along the degree of exterior transparency. Visibility of a store's inside from the outside via transparent exterior design features may lower consumers' psychological burden or costs to enter the store. For example, clearer evidence observed from product displays through transparent windows can facilitate consumers' inferences about store image and place identity, which results in consumers visiting the store without hesitation (Sen *et al.*, 2002). Put differently, an opaque exterior design, including blurred glass and windowless buildings, may increase the psychological burden of entering the store and create the impression that some are prohibited from entering (i.e. a perception of exclusivity). Exclusivity refers to the right to have something that is limited to certain people (dictionary.cambridge.org) and leads to some limitations. For example, consumers with higher needs for exclusivity tend to prefer limited editions, including limited numbers or durations (Amaldoss and Jain, 2005; Cheema and Kaikati, 2010; Radon, 2012), and exclusive access increases consumers' purchase intentions for luxury brands (e.g. rejection by a salesperson; Ward and Dahl, 2014). In other words, just as consumers have built other cognitive associations (e.g. the link between guilt and pleasure; Goldsmith *et al.*, 2012), consumers may have created a cognitive association between limitedness and exclusivity from this repeated co-activation. Given that opaque store exterior design hides the inside view from the outside and provides relatively limited information to consumers (Brzezicki, 2016), consumers may infer that the store only lets in people from a certain class.

In addition, based on the notion that an impression of exclusivity often implies superior and prestigious perceptions (Drèze and Nunes, 2009), we expect that a heightened impression of exclusivity from an opaque store exterior can create perceptions of prestige about a store.

2.3 Downstream consequences of store prestige perceptions

Why, then, is it important to promote consumers' store prestige perceptions? Since consumers' perceptions of a store are a major determinant of product valuation and choice (Dodds *et al.*, 1991), store prestige perceptions can also spill over into subsequent consumer perceptions and behaviours. Previous findings suggest that store prestige perceptions can generate beneficial downstream consequences for both perceptions and purchase behaviours towards the stores' products. For example, store prestige perceptions can be transmitted to a higher valuation of product quality and preference (Baker *et al.*, 1994; Sevilla and Townsend, 2016).

Drawing from prior research, we expect that a heightened store prestige perception from the opaque exterior of VSs can lead consumers to perceive the products in the stores to have higher levels of product qualities; in turn, the perception of higher product quality is expected to lead to more favourable attitudes and greater purchase intentions for the products. Formally summarised in Figure 1.

H1. Compared to a transparent exterior design, an opaque exterior design of a VS will lead to greater product preferences.

H2. The positive relationship between VSs' opaque exterior design and product preferences will be serially mediated by store prestige perceptions and product quality perceptions.

2.4 Moderating role of consumers' involvement in design elements

Additionally, we suggest that the proposed mechanism can be moderated by consumers' involvement in design elements. Involvement refers to the personal relevance of subjects based on inherent needs, values and interests (Zaichkowsky, 1985). We refer to

consumers' involvement in design elements (*IDE*) as their personal interests in styling- and design-related aspects, such as store exterior, aesthetics of merchandise or store colours.

Previous studies show that consumers' involvement in certain domains encourages consumers to pay more attention to the cues related to the domains and to process the information that is inferred from the cues more thoroughly, and to act on the information (Eroglu *et al.*, 2001). This view is also consistent with the elaboration likelihood model (ELM; Petty and Cacioppo, 1986). According to the ELM, involvement is one of the major determinants of whether a consumer acts on and is persuaded by marketing messages and information; when consumers have high involvement in a certain domain, they are likely to catch and think about the stimuli related to the domains, which enables them to form purchase decisions because they can relate closely to the stimuli (Petty *et al.*, 1983).

Based on this view, we posit that the positive effect of an opaque exterior on perceptions of stores and products, as well as on purchase behaviours, is particularly prominent among consumers with high IDE. That is, consumers with high IDE are more likely to catch and process the design cues from the opaque exterior of VSs and are more likely to prefer the products offered by such stores, since they are more likely to be persuaded by the inference drawn from the cues. Specifically,

H3. Consumer's IDE will moderate the link between an opaque exterior design of a VS and product purchase intentions: the positive effect of an opaque VS exterior on product preferences will be particularly prominent when the IDE is high.

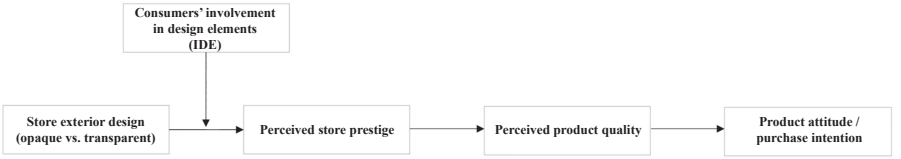

Figure 1.
Conceptual framework

3. Study 1: the influence of an opaque virtual store exterior on consumers' responses

In Study 1, we aimed to provide initial evidence that consumers were more likely to show positive responses towards products in opaque (vs transparent) exterior VSs. We employed 3D modelling software (Rhino 6 and Unity) and 3D architectural visualisation software (Twinmotion) to create 360° VR videos for the manipulation of the VS exterior design and measured product purchase intentions. We designed the VS in human scale for realistic shopping experience (Figure 2).

3.1 Method

3.1.1 Participants and design. Seventy-nine university students in South Korea participated in Study 1 (53.2% female; M_{age} = 26.43). Study 1 employed a single-factor between-subjects design (VS exterior design: opaque vs transparent).

3.1.2 Procedure. As a cover story, the participants were told that they would be asked to state their opinions about a consumption setting for a VS. Following the cover story, the participants were randomly assigned to either an opaque or a transparent VS condition. For this manipulation, we created 30-s VR video clips depicting a VS for a hypothetical clothing brand (Figure 3). While holding constant the surroundings, structures and product layouts of the store, we varied only the chroma of the VS to be either opaque or transparent. From a

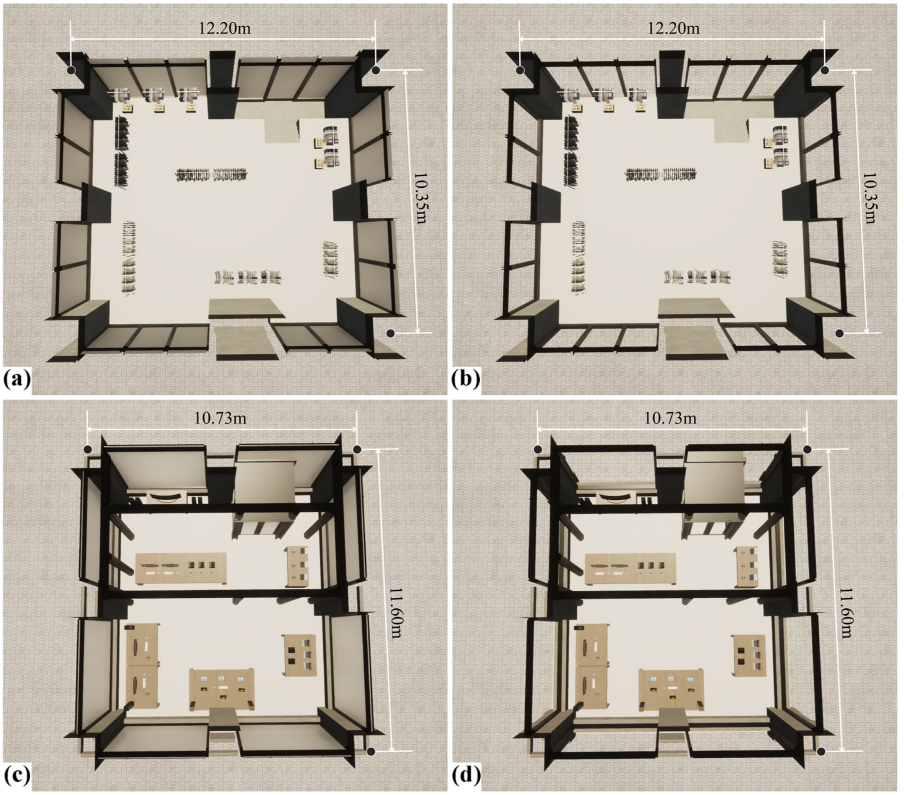

Figure.2.
Custom-developed virtual store plan view (Fashion Products): (a) Opaque Store; (b) Transparent Store. Custom-Developed Virtual Store Plan View (Electronic Products): (c) Opaque Store; (d) Transparent Store

first-person perspective, the participants in the opaque condition browsed around a VS with an opaque exterior from the outside to the inside. In the transparent condition, they browsed around the same VS but with a transparent exterior. The participants then answered a question about their product purchase intentions ("I am willing to buy some products in the store", 1 = not at all, 7 = very much; adopted and modified from Park *et al.* (2018)). Finally, the participants answered demographic questions and were then debriefed.

3.2 Results

We conducted a one-way ANOVA using product purchase intention as the dependent variable. The results revealed the predicted effect of VSs' opaque exterior design on product purchase intention. The participants were more likely to purchase products in the opaque VS than in the transparent VS ($M_{opaque} = 4.27$ vs. $M_{transparent} = 3.69$, $F(1, 77) = 3.79$, $p = 0.05$, Figure 4). We examined the moderating effect of age and sex to identify whether our hypothesised effect differs by them (Herz and Rauschnabel, 2019). The results show that the effect of the stores' opaque exterior design on purchase intention does not significantly differ by age and sex (bs < -0.01, $t(75) < -0.09$, $p > 0.31$); thus, we do not discuss the effect of age and sex in further studies.

3.3 Discussion

The findings of Study 1 provide initial support for our hypothesis that an opaque exterior design for a VS leads consumers to form greater purchase intentions for the store's products.

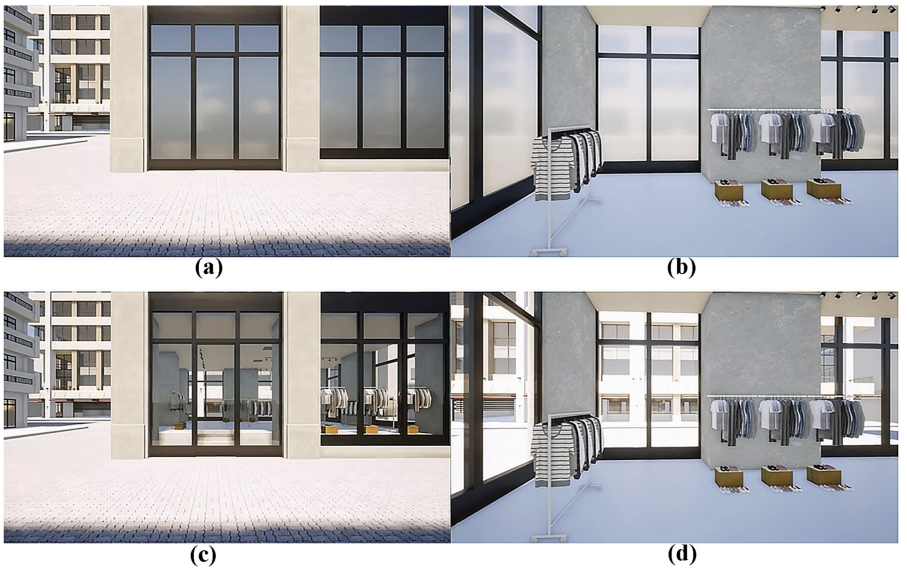

Figure 3.
Custom-developed virtual store stimuli for Study 1 (Fashion Products): (a) Opaque Store Façade; (b) Opaque Store Interior; (c) Transparent Store Façade; (d) Transparent Store Interior

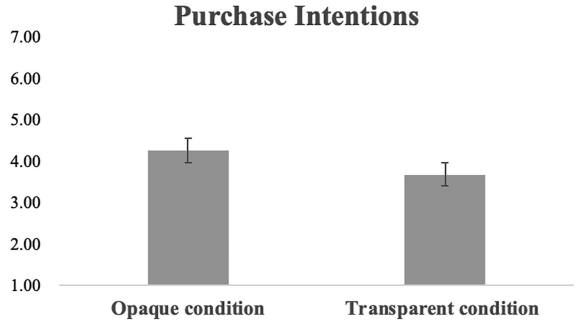

Figure 4.
Study 1: Influence of opaque virtual store exterior design on product purchase intention

4. Study 2: the underlying mechanism for the effect of an opaque virtual store exterior on consumer responses

Study 2 had several objectives. First, we aimed to replicate the observed effect using a different measure: attitudes towards products. Second, we aimed to investigate whether our expected effect of an opaque VS exterior design on consumer responses could emerge across discrete product domains: hedonic and utilitarian products. Researchers suggest various criteria to distinguish product categories and features; whether a product mainly serves a pleasurable and self-expressive function (i.e. hedonic) or a practical and useful function (i.e. utilitarian) is one of the most used criteria (Dhar and Wertenbroch, 2000). Based on the literature, we chose clothes (hedonic) and electronics (utilitarian) to investigate whether the positive effect of an opaque VS exterior on consumer responses varied across product categories. Third, we added manipulation checks for the 3D VR video stimuli. Forth, to increase generalisability, we conducted Study 2 in a different country to the one for Study 1 and tested if our hypotheses emerged consistently across cultures.

4.1 Method

4.1.1 Participants and design. Three hundred and seventy-nine US participants were recruited through Prolific (49.9% female; $M_{age} = 36.05$). The study employed a 2 (VS exterior design: opaque vs transparent) by 2 (product type: clothes vs electronics) mixed design. Specifically, the VS exterior design was a between-subjects factor, while the product type was a within-subjects factor.

4.1.2 Procedure. As a cover story, the participants were told that they would be asked to state their opinions about a virtual consumption setting for two different product types: clothes and electronics. For the clothing stores, we used the same VR stimuli used in Study 1, whereas we created another 30-s VR stimulus clip for the electronic store (Figure 5). Since the product type was a within-subjects factor, every participant saw both clothes and electronics, but in a random order.

Following the cover story, participants were randomly assigned to either an opaque or a transparent VS exterior condition. The participants then answered questions regarding their attitudes towards the products in the VS ("I feel favourable towards the products the store carries", 1 = not at all, 7 = very much; modified from Spears and Singh (2004)) as a mediator.

To ensure our manipulation significantly affected consumers' perceived opaqueness, they next answered a series of manipulation check questions. Specifically, the participants indicated their perceived opacity ("The exterior of the store seems to be opaque"), transparentness ("The exterior of the store seems to be transparent"), simplicity ("The exterior of the store seems to be simple"), sophistication ("The exterior of the store seems to be sophisticated") and complexity ("The exterior of the store seems to be complex") of the VS exterior design. All the questions were rated on a 7-point Likert scale (1 = not at all, 7 = very much).

Thereafter, the participants watched another video of a VS selling the other product type (i.e. either clothes or electronics) in the same store exterior condition they were assigned to, and answered an identical series of questions regarding their attitudes towards products and perception about the store for the manipulation check. Finally, the participants answered demographic questions.

4.2 Results

4.2.1 Manipulation check. To check whether the VS clips successfully affected consumers' perceived opacity and transparentness, we performed one-way ANOVA analyses with VS exterior design as the independent factor. The perceptions regarding the stores were averaged between electronic and fashion store conditions (rs > 0.56, ps < 0.01).

The analyses revealed that the participants in the opaque condition perceived the VSs to be more opaque than those in the transparent condition ($M_{opaque} = 5.29$ vs $M_{transparent} = 3.07$, F (1, 376) = 179.74, $p < 0.001$). In contrast, the participants in the transparent condition perceived the VSs to be significantly more transparent than those in the opaque condition ($M_{opaque} = 5.75$ vs $M_{transparent} = 3.15$, F (1, 376) = 264.79, $p < 0.001$).

In addition, we tested whether the manipulation affected the other perceptions regarding a VS exterior (i.e. simplicity, sophistication and complexity) and found no other significant results (F (1, 376) < 0.16, $p > 0.69$). Thus, the manipulation successfully affected the opacity and transparentness perceptions only, which were the target constructs, and did not affect the other perceptions regarding store exterior designs.

4.2.2 Attitudes towards products. We first analysed the results using a mixed-model ANOVA with condition (opaque vs transparent) as the between-subjects factor, and product type (electronic vs fashion) as the repeated measure. The results showed that the participants did not show significantly different attitudes towards the products ($F(1, 377) = 0.56, p > 0.46$), and confirmed that product types did not moderate the link between a VS's exterior design

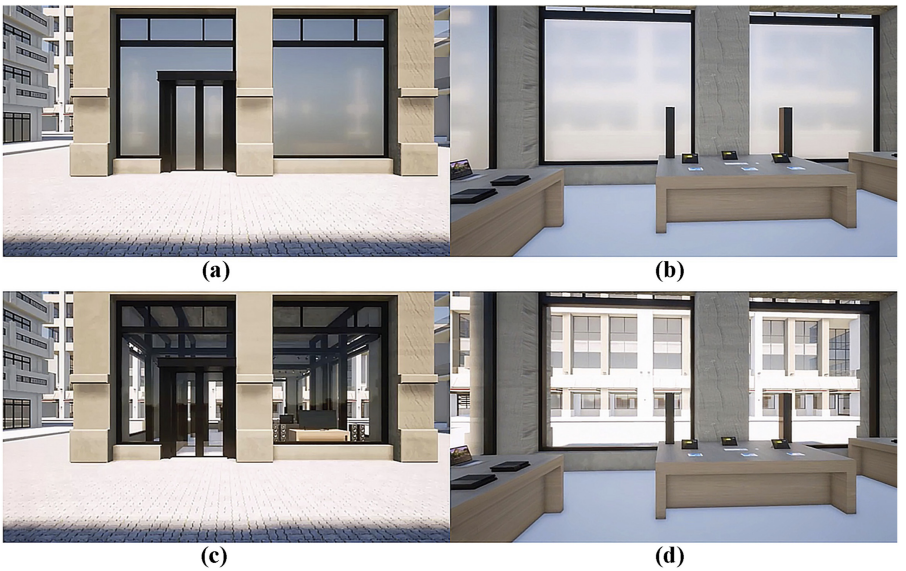

Figure 5.
Custom-developed virtual store stimuli for Study 2 (Electronic Products): (a) Opaque Store Façade; (b) Opaque Store Interior; (c) Transparent Store Façade; (d) Transparent Store Interior

and consumers' attitudes towards the products in the store. In addition, since there was no significant interaction between VS exterior designs and product types, we merged attitudes towards products as an attitude index in both product types in the following analyses ($\alpha > 0.83$).

A one-way ANOVA revealed the predicted effect of VSs' opaque exterior design on attitudes (Figure 6). The participants in the opaque VS exterior condition showed more favourable attitudes towards the products in the stores than those in the transparent VS exterior condition ($M_{\text{opaque}} = 4.91$ vs. $M_{\text{transparent}} = 4.65$, $F(1, 377) = 5.21$, $p < 0.05$).

4.3 Discussion

The results of Study 2 provide additional support for our prediction that an opaque VS exterior design increases consumers' favourable response. Furthermore, the findings suggest that this effect of an opaque VS exterior design consistently emerges across cultures and product types.

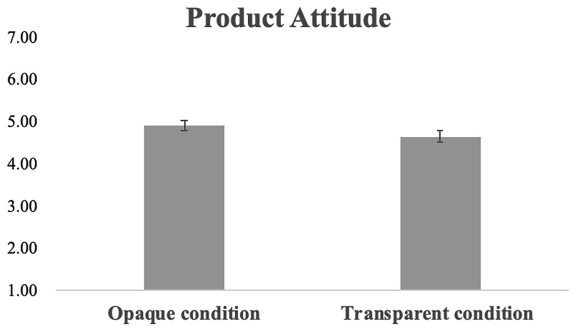

Figure 6.
Study 2: Influence of opaque virtual store exterior design on product attitude

5. Study 3: the mediational effect of store prestige perception and product quality perception, and the moderating effect of IDE

The objective of Study 3 was to examine our hypothesised serial mechanism that consumers tended to show greater purchase intentions in opaque than transparent VSs, since opaque exterior design made them perceive the stores as being more prestigious and, in turn, having higher product qualities. In addition, we aimed to test the predicted moderator of IDE. Finally, we sought to rule out alternative accounts; this is because the notion of transparency, by definition, can be associated with candidness or ethical behaviours (merriam-webster.com), and these concepts can also affect consumers' perceptions and behaviours. For example, one might perceive brands with opaque store exterior design to be less clean or ethical, and associate the brands with prestige perception and greater purchase intentions, based on the rich-but-dishonest stereotype (Kay and Jost, 2003). To rule out these alternative accounts, we measured the items related to individuals' perceptions about how clean and ethical the stores appeared in Study 3.

5.1 Method

5.1.1 Participants and design. Four hundred US participants were recruited through Prolific (46.8% female; $M_{age} = 34.49$). In Study 3, we employed a 2 (VS exterior design: opaque vs transparent) by continuous (chronic IDE) design.

5.1.2 Procedure. Similar to Studies 1 and 2, the participants were told that they would be asked to state their opinions about a consumption setting for a VS. Since, in Study 2, we confirmed that product types did not affect the link between opaque store exterior and consumer responses, we only adopted a clothing store in Study 3.

The participants were randomly assigned to either an opaque or a transparent VS condition and watched the same 30-s VR video clip used in Studies 1 and 2.

They then answered the same questions on their product purchase intentions used in Study 1, and a series of questions on product quality and store perceptions. Specifically, they answered the question on product quality perceptions ("I have trust in the quality of the products the store sells", 1 = not at all, 7 = very much), two questions on store prestige perceptions ("The store seems to be", 1 = low-end/inexpensive, 7 = high-end/expensive; Sevilla and Townsend, 2016), as well as questions on tidiness ("The store looks like a tidy store", 1 = not at all, 7 = very much), cleanliness ("The store seems clean", 1 = not at all, 7 = very much) and ethical perceptions ("The store seems to be ethical", 1 = not at all, 7 = very much). The order of these questions for store perceptions was counterbalanced. Last, the participants answered IDE ("To what extent are you interested in design?", 1 = not at all, 7 = very much) and demographic questions.

5.2 Results

5.2.1 Product purchase intentions. A one-way ANOVA revealed the predicted effect of VSs' opaque exterior design on product purchase intentions. The participants in the opaque VS exterior condition showed greater product purchase intentions than those in the transparent VS exterior condition ($M_{opaque} = 4.22$ vs $M_{transparent} = 3.83$ $F(1, 398) = 5.99$, $p = 0.05$).

5.2.2 Perceived store prestige. For the first-step mediator, we conducted another one-way ANOVA analysis using perceived store prestige as the dependent variable ($r = 0.86, p < 0.01$). As predicted, a significant main effect of VS exterior design on perceived store prestige emerged: consumers were more likely to perceive opaque VSs to be more prestigious than transparent stores ($M_{opaque} = 4.87$ vs $M_{transparent} = 4.62$, $F(1, 398) = 4.95$, $p < 0.05$).

5.2.3 Perceived product quality. For the second-step mediator, we conducted a one-way ANOVA analysis using perceived product quality as the dependent variable. As predicted, a significant main effect of VS exterior design on perceived product quality emerged:

consumers were more likely to perceive opaque VSs to have better quality products than transparent stores ($M_{opaque} = 4.48$ vs $M_{transparent} = 4.17$, $F(1, 398) = 4.45$, $p < 0.05$).

5.2.4 Alternative explanations. We tested alternative opaque store exterior effects. For this, we performed three separate ANOVA analyses with tidiness, cleanliness and ethical perceptions as the dependent variables. The results showed that none of the variables was significantly affected by opaque exterior design (Fs < 1.44, ps > 0.23). Thus, we concluded that tidiness, cleanliness and ethical perceptions about stores do not explain the effects of an opaque exterior, and these were excluded from the subsequent analyses.

5.2.5 Moderation. We next examined the moderating effect of IDE. We conducted a 2 × continuous regression analysis using product purchase intentions as the dependent variable.

The results showed a significant main effect of store exterior design ($b = 0.45$, $t(396) = 3.39$, $p < 0.01$; Figure 7). This implies that the participants showed greater purchase intentions in the opaque VS. More importantly, the predicted interaction effect emerged ($b = 0.67$, $t(396) = 8.76$, $p < 0.01$). We explored the interaction using spotlight analysis. The participants with greater IDE (+1 SD) showed greater product purchase intentions in opaque stores than in transparent stores ($M_{opaque} = 5.57$ vs $M_{transparent} = 3.97$, $b = 1.60$, $t(396) = 8.59$, $p < 0.01$). However, those with lower IDE (–1 SD) did not share this preference for the stores' opaque exterior design ($M_{opaque} = 2.98$ vs. $M_{transparent} = 3.68$, $b = -0.705$, $t(396) = -3.80$, $p < 0.01$). Furthermore, participants in the opaque VS exterior condition showed higher purchase intentions, when they had higher IDE than those with lower IDE ($M_{high} = 5.57$ vs $M_{low} = 2.98$, $b = 0.75$, $t(396) = 13.69$, $p < 0.01$). However, participants in the transparent VS exterior condition did not show varied purchase intentions, regardless of their degrees of IDE ($M_{high} = 3.97$ vs $M_{low} = 3.68$, $b = 0.08$, $t(396) = 1.60$, $p = 0.11$). Thus, as predicted, the positive effect of opaque store exterior on product preferences was particularly prominent when IDE was high.

5.2.6 Serial and moderated mediation. We next examined whether opaque exterior designs of VSs led consumers to higher purchase intentions via (1) consumers' perceived store prestige and (2) higher perceived product quality. To test this serial mediation, we employed bootstrap analysis using PROCESS (Model 6, 5000 bootstrap resamples; Hayes, 2013). Expectedly, the participants found opaque VSs to be more prestigious and, therefore, to have higher-quality products; thus, the participants showed greater purchase intentions (0.1597; 95% CI from 0.0196 to 0.3054, Figure 8). Noteworthily, we additionally conducted the same analysis, with the mediators in reverse order (i.e. product quality first and store prestige second). However, the indirect effect was not significant when the mediators were reversed (−0.0009; 95% CI from −0.0371 to 0.0345). Therefore, consumers perceived VSs with an

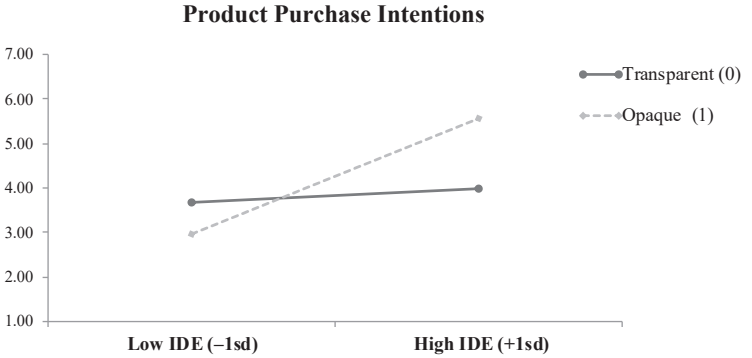

Figure 7.
Study 3: Product purchase intentions as a function of opaque virtual store exterior and consumers' involvement in design elements

opaque exterior (vs transparent) as more prestigious, and thus to have higher-quality products, which resulted in greater purchase intentions for the products in the stores.

More importantly, we examined whether the same underlying mechanism existed among consumers with high involvement in design elements. Using PROCESS (Model 85, 5000 bootstrap resamples; Hayes, 2018), we confirmed that the participants with high IDE found opaque stores to be more prestigious and, in turn, to have higher product qualities and, consequently, showed greater purchase intentions (0.2144; 95% CI from 0.1347 to 0.3067, Figure 9). Therefore, the participants with higher IDE were more willing to purchase products in opaque stores, following the same underlying process we previously found: opaque store exterior designs first increased perceived store prestige, which resulted in greater product quality perceptions.

5.3 Discussion

The results of Study 3 demonstrate that consumers tend to show greater purchase intentions in opaque than in transparent VSs, since an opaque exterior design makes them perceive the

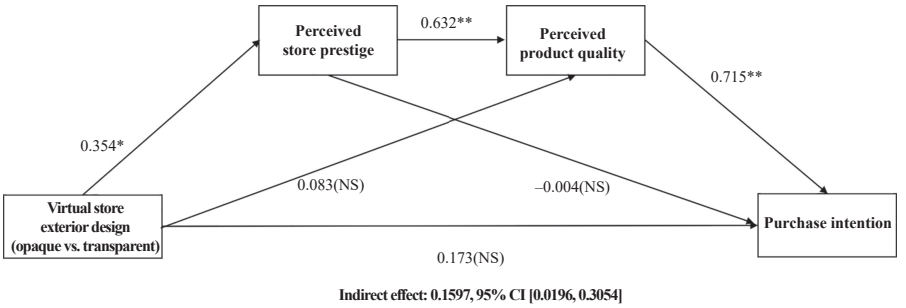

Figure 8.
Study 3: Serial mediation model of store prestige perceptions and product quality perceptions

Note(s): + indicates $p < 0.1$, *indicates $p < 0.05$, **indicates $p < 0.01$, ***indicates $p < 0.001$, NS indicates nonsignificant

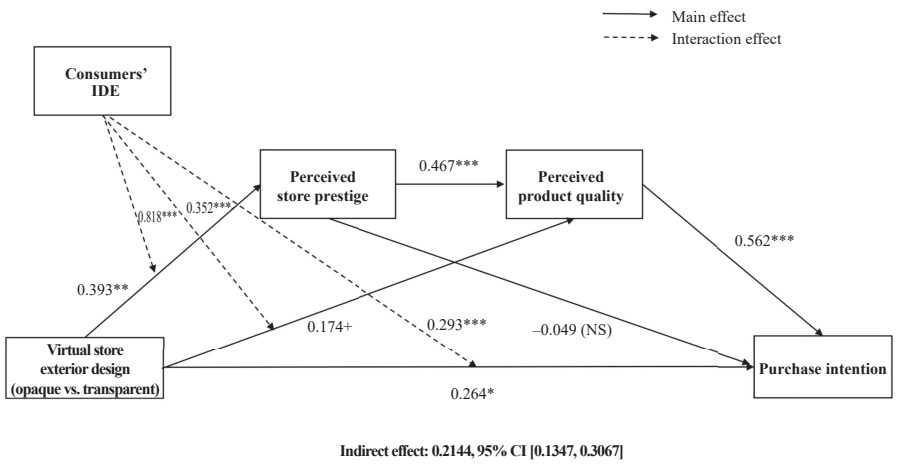

Figure 9.
Study 3: Moderated mediation model

Note(s): + indicates $p < 0.1$, *indicates $p < 0.05$, **indicates $p < 0.01$, ***indicates $p < 0.001$, NS indicates nonsignificant

stores as more prestigious, and in turn, to have higher-quality products. Furthermore, these results show that the positive effect of opaque store exterior on purchase intentions is particularly prominent when IDE is high. Finally, the findings confirm that the positive effect of opaque store exterior on purchase intentions is not influenced by individuals' cleanliness, tidiness or ethical perceptions about stores.

6. General discussion

Across three studies, we confirmed the role of the opaque exterior of VSs in increasing consumers' favourable attitudes and purchase intentions. Moreover, our findings indicated that this increase was caused because opaque store exteriors boost store prestige perceptions, thereby, boosting perceptions of product quality. Additionally, we found that the effects of opaque VSs are particularly prominent among those with higher IDE.

6.1 Theoretical implication

This study makes several significant theoretical contributions. First, our findings add to the extensive literature on retailing using VR technology. Previous research on retailing using VR focused on how the virtual experience itself creates downstream consequences (e.g. Baek *et al.*, 2020) or unique antecedents of the VR-related devices' adoption (Herz and Rauschnabel, 2019). In addition, research on the specific factors of VSs is extremely limited. To the best of our knowledge, our research is the first to investigate how the specific factors consisting of VSs shape consumers' perception and behaviours. With the advent and growth of metaverse platforms, shopping centres can be reproduced. Shopping may start from watching the exterior of the store and deciding where to go inside. Exterior designs may have a more critical influence on consumer perceptions. As such, it enriches the body of research on virtual retailing in this era of online-dominant retailing.

Second, this study expands the research on store ambience and environment. Currently, most studies on store environment explore in-store atmosphere, such as lighting, colour, flooring and space-to-product ratio (Bellizzi and Hite, 1992; Imschloss and Kuehnl, 2017; Sevilla and Townsend, 2016), and the research on store exterior is very limited. Moreover, this limited literature on the out-of-store atmosphere focuses on window displays and signage and only examines consumers' responses to store exteriors by having them view a store from the outside (e.g. Cornelius *et al.*, 2010; Oh and Petrie, 2012). By discovering the impact of store exterior opacity on consumers' perceptions and behaviours, especially from both inside and outside a store, the current research extends research on store ambience.

Third, this research contributes to retail experience research by suggesting another method of creating 360-degree VR videos. Studies on retailing have adopted 360-degree stereoscopic media (e.g. Baek *et al.*, 2020), whereas we employ 3D modelling and 3D architectural visualisation software to create 360-degree VR videos demonstrating a virtual experience without VR gears. While 360-degree stereoscopic media creates VR videos based on real photos of physical stores, videos created using 3D modelling and visualisation software make it more convenient to adjust the store environment such as lighting conditions and background images. Therefore, our methods provide more unrestricted means for future researchers to create VR videos.

6.2 Practical implications

Our findings offer useful insights for practitioners across several disciplines. First, our findings can be used for developing guidelines to design VS environments. Through the advent of the Fourth Industrial Revolution and the recent pandemic, consumers are more likely to shop online. However, it is still important to learn and experience physical

stores (e.g. Fornari *et al.*, 2016). In this respect, the significance of VSs is getting more attention, but guidelines for designing them have not been explored thoroughly. Designing the exterior of VSs can prove challenging, because it requires designers to optimise various functional and multimodal criteria (Ebster, 2011); our findings help to tackle this issue by identifying significant design factors. In addition, these results provide useful insights to designers and marketing practitioners, in accordance with the higher cost-effectiveness and advantages of online store designs over brick-and-mortar stores (Park *et al.*, 2018; Zhang and Krishnamurthi, 2004).

Second, our findings provide guidance to multichannel brands aiming to present a prestigious image. Due to the nature of online business, perceptions of prestige for stores can be a significant challenge for VSs. Since the online retailing market is open to a broad range of consumers and companies, online stores often face fierce price competition (Chen *et al.*, 2002), and many consumers visit online stores searching for the best prices (Kim *et al.*, 2012). This tendency may lead consumers to expect VSs to be less prestigious than offline stores, even when the virtual and actual stores are identical. Thus, multichannel brands having both virtual and physical stores (e.g. Ralph Lauren) can utilise our findings to promote the perceptions of the prestige of their VSs because consumers may have a lower level of prestige expectation for the stores.

6.3 Limitation and future research

This research also has a few limitations, which require further investigation. First, the current study did not examine this phenomenon using real brands or products. Although fictitious brands can show more rigorous causal relationships among variables since they tease out the confounding effects, consumers' pre-existing preference for brands can impact the causal link. In addition, this study only manipulated the opacity of glass instead of testing with other opaque materials, such as bricks and metals, to minimise the confounding effects (e.g. coldness of metal and roughness of bricks; Fleming *et al.*, 2013). Therefore, future research could investigate whether the effect of an opaque VS exterior persists using existing brands, consumers' pre-existing attitudes towards those brands and other materials to manipulate opaqueness in more realistic contexts.

Moreover, a single-item scale was used for purchase intention or attitude toward the product in this study. As the use of a single item is often observed in other experimental studies (Wang *et al.*, 2021), the index may boost the rigor of the current findings. Thus, future research should examine the effects of different scales.

Furthermore, future research can explore the interplay between social variables and the exterior opacity of VSs. Due to the highly social nature of shopping environments, consumers are prone to be influenced by the appearance of a salesperson, the presence of other consumers and the interaction dynamics between a salesperson and other consumers (e.g. Chan and Sengupta, 2013; Wan and Wyer, 2015). Therefore, it will be interesting to explore the effect of the presence of virtual people, including salespeople and other consumers, and the various contexts, in which they can moderate the influence of opaque store exterior on consumer perceptions and behaviours.

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