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**DOI**
10.1080/17452007.2022.2104206

**Publication date**
2022

**Document Version**
Final published version

**Published in**
Architectural Engineering and Design Management

**Citation (APA)**
Hasanzade, M. P., & van Oel, C. J. (2022). Passengers' preferences for architectural design characteristics in the design of airport terminals. *Architectural Engineering and Design Management*, *19*(6), 586-601. https://doi.org/10.1080/17452007.2022.2104206

Architectural Engineering and Design Management

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/taem20

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**To cite this article:** M. Parsa Hasanzade, Clarine J. van Oel & Mahdieh Pazhouhanfar (2023) Passengers' preferences for architectural design characteristics in the design of airport terminals, Architectural Engineering and Design Management, 19:6, 586-601, DOI: 10.1080/17452007.2022.2104206

**To link to this article:** https://doi.org/10.1080/17452007.2022.2104206

Published online: 03 Aug 2022.

ARCHITECTURAL ENGINEERING AND DESIGN MANAGEMENT
2023, VOL. 19, NO. 6, 586–601
https://doi.org/10.1080/17452007.2022.2104206



# Passengers' preferences for architectural design characteristics in the design of airport terminals

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**ABSTRACT**

With the need to increase total revenues, airports have begun to use commercial retail. A well-designed airport may provide great service to clients and consumers and increase their satisfaction and in turn their spending behaviours. Since there is suggestive evidence that there might be cultural associations of white, purple or black with different emotional loadings to these colours across cultures, the present study investigated passengers' preferences for architectural design characteristics of an airport in a new cultural setting. Discrete choice modelling was used to measure the passengers' preferences for 10 interior design characteristics of the passenger terminal using 3D renderings. Data on 435 passengers were collected at Mehrabad International Airport, which also included passengers' emotions. Passengers in the terminal hall preferred a curved and transparent ceiling, material in warm colours, cool lighting, with low width and low height, greenery and without any decorations. When compared to other studies, it may well be that passenger preferences for lighting and certain colour schemes reflect geographical or cultural differences. For other interior design characteristics, preferences relating to the shape of the ceiling and the amount of daylight, as well as the presence of greenery, may well be reflections of passengers' restorative needs.

**ARTICLE HISTORY**
Received 19 October 2021
Accepted 16 July 2022

**KEYWORDS**
Architecture; airport design; emotions; passengers' preferences; discrete choice experiments

## Introduction

Until the recent COVID-19 pandemic-related travel restrictions, air travel was a rapidly growing means of transportation with many customers (Chen et al., 2020). With COVID-19 becoming endemic, one might expect a further growth in customers in the near future. In the competition for airline customers, airport operators are challenged to reduce aeronautical costs such as landing fees and therefore need to change their business model, for instance by increasing the total revenues by enhancing the revenues from commercial real estate (Chen et al., 2020). In their review, Chen et al. (2020) concluded that most research considers the passenger areas '*as is*' and highlighted the importance of the design of the passenger areas at the airports in raising revenues from retail. Furthermore, to the international customers visiting a country for the first time, the terminal spaces shape their initial impressions of the country. In this way, the design of the terminal spaces, with its glamour, scale, and technological prowess of the architectural design, showcases

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This article was originally published with errors, which have now been corrected in the online version. Please see Correction (http://dx.doi.org/10.1080/17452007.2023.2230086)

a country's stature. In the past, early design instructions were directed at organising the passenger flows, resulting in most terminal buildings channelling passengers into a mandatory route from the entrance to the flight gate in an efficient and secure way (Graham, 2009). However, with the need to increase the total revenues, airports have begun to use commercial retail and services such as restaurants, cafes, and hotels to attract more customers and satisfy their needs (Han, Kim, & Hyun, 2014). A well-designed airport with unique eye-catching architecture, appealing interior spaces, peaceful areas with greenery, and efficient transportation systems may provide great service to clients and consumers and increase their satisfaction (Brian Edwards, 2004). In addition, once passengers have cleared Customs and other formalities, an attractive environment may help to reduce feelings of anxiety during their stay at the airport (Bogicevic, Yang, Cobanoglu, Bilgihan, & Bujisic, 2016). Reducing a customer's feelings of anxiety is important in raising the total revenues. Several studies in various commercial settings such as restaurants, stores, casinos, and festivals have found that the physical environment is a very influential factor regarding customer satisfaction (Bogicevic et al., 2016; Lam, Chan, Fong, & Lo, 2011; Lee, Lee, Lee, & Babin, 2008). Furthermore, evidence shows that the environment affects customer appraisal and judgment as customer satisfaction was found to depend not only on the product or service itself but also on the design of the environment or servicescape (Lam et al., 2011; Thang & Tan, 2003). Studies also suggest that one way to improve the satisfaction of airport passengers is to design a physical environment according to their preferences (de Barros, Somasundaraswaran, & Wirasinghe, 2007; Correia, Wirasinghe, and de Barros, 2008; Lam et al., 2011; Wakefield & Baker, 1998).

To summarise, given the importance of airport terminal design in relation to an airport's financial sustainability, and keeping in mind the outcomes of the extensive review by Chen et al. (2020), there is a lack of studies on the passenger preferences with respect to the design characteristics of airport terminals. Van Oel and Van den Berkhof (2013) found suggestive evidence that passenger preferences for certain design characteristics, i.e. applied colour schemes to a visualisation of the passenger areas, differed between passengers arriving at the airport on inbound flights (international passengers) and departing passengers (mostly Dutch) on outbound flights, respectively. Bogicevic et al. (2016) investigated the relationship between the passengers' preferences and the design characteristics of an airport terminal amongst passengers with a layover within the USA. They found strong evidence that the design of the transit service areas was the strongest predictor of passenger enjoyment. However, they could not address cultural differences as their passengers were travelling within the USA. Since there is suggestive evidence that there might be cultural associations of white, purple or black with funerals, causing different emotional loadings to these colours across cultures (Jonauskaite et al., 2020), it would be interesting to investigate passengers' preferences in a Persian setting. Therefore, two main objectives of this study are (1) to investigate the role of selected design characteristics on passengers' preferences and (2) to evaluate the effect of emotional states, travellers' anxiety, enjoyment and satisfaction, on the passengers' preferences for the design characteristics.

## Literature review

Given the importance of commercial revenues in realising an increase in total revenues (Chen et al., 2020), the design of passenger terminals might benefit from research insights regarding customer preferences in retail design. Following the classification by Berman, Evans, and Chatterjee (1995), this section is structured into three categories according to their categorisation of the environmental design characteristics: the general interior design characteristics, layout and design characteristics, and distinct points and decorations. In discussing the research within each category, a distinction is made as to how a customer may respond to an environment. That is, a customer might feel attracted to the design of the environment or may disapprove of the surroundings and therefore move away or avoid it. In the literature, the former is generally referred to as approaching behaviour;

the latter is referred to as avoidance behaviour (Brengman & Geuens, 2004; Mehrabian & Russell, 1974; Stone, 2003; Yildirim, Akalin-Baskaya, & Hidayetoglu, 2007).

### General interior design characteristics

The overall perception of the interior environment has been investigated by examining characteristics such as flooring, lighting, cleanliness, temperature, wall texture, and use of colour. Some studies consider the colour and materials as one characteristic since changes in materials also lead to the altered colour of the environment. For instance, by changing the material from concrete to bricks, the surface colour will also change. All studies concluded that user perception of the interior environment affects the avoidance or approaching behaviours, as well as the time spent in the environment and the rate of sales (Brengman & Geuens, 2004; Mehrabian & Russell, 1974; Stone, 2003; Yildirim et al., 2007).

Colour, as an interior design characteristic in its own right, is used to attract more visual attention. Multiple aspects of colour including colour spectrum, colour volume, colour saturation, the intensity of brightness, colour coherence, and coordination have been investigated to examine their effect on behavioural and emotional responses. Brengman and Geuens (2004) indicated that bright colours stimulate consumers to explore the environment, and that customers prefer these to darker colours. Some studies have suggested that spaces with cool colours such as blue, green, and purple have a higher positive effect than warm colours such as red, orange, and yellow (Bellizzi, Crowley, & Hasty, 1983; Quartier, Vanrie, & Van Cleempoel, 2014; Yildirim, Capanoglu, Cagatay, & Hidayetoglu, 2012). Jacquier & Giboreau (2012) also tested spaces with different colours and examined their effect on emotions. They showed that an environment with a warmer colour is perceived to be more crowded and less attractive, and that an environment with a cooler colour is generally preferred over one with warmer colours. Cool colours can create a positive and reliable image, while warm colours can lead to excitement and spending more time in the environment. Generally, cool colours are associated with more relaxation, more space, and non-arousal (Yildirim, Hidayetoglu, & Capanoglu, 2011). The results of a study by Chebat and Morrin (2007) that examined the colour spectrum and its effect on humans showed that cool colours (purple, blue, green) are more preferred than warm colours such as yellow or red. In environments where passengers are present, cool colours may be preferred to warm colours because the cool colours may calm those with a higher level of stress. In contrast, leisure buyers with no intention to purchase consider a warm (red) environment more pleasant than an environment with a cool (blue) colour, although no significant effect was observed among purchasers with purchase intention (Chebat & Morrin, 2007).

Another important interior design characteristic is lighting, since it affects the perception of the interior design. A large number of studies addressed the relationship between lighting and human emotions, performance and cognition. The significance of lighting in the design of stores has often been considered in marketing studies, but few studies have focused on its effect on user preferences regarding the environment. Mehrabian and Russell (1974) interpreted the light effect as 'the ability to provoke people'. Flynn, Hendrick, Spencer, and Martyniuk (1979) is one of the pioneers in measuring the mental image of the environment for different lighting using a semantic scale. In a study on the lighting effect of an office, Knez & Enmarker (1998) found that the physical arrangement of an environment and the use of artificial light can significantly affect the mental states of its users. Durak, Olguntürk, Yener, Güvenç, & Gürçınar (2007) reported that two similar spaces can be perceived differently due to the lighting colour, the type and location of light sources, and the light arrangement, all features that contribute to the quality of light. Van Erp (2008) studied the perception of the environment with natural and artificial lighting and found that high intensity lighting was generally preferred over low intensity light; the same was true for light with a low colour temperature compared to light with a high colour temperature. Using the original colour cycle, divided into two parts of cool and warm colours, Wang, Liu, Hu, & Liu (2018) indicated that the light spectrum significantly affects the environment perception. Generally, warm light creates a more relaxed environment than cool light (Hughes et al., 2020).

Natural light access is another significant characteristic that is dependent on lighting. A large number of studies investigated light access in terms of health and energy efficiency. In an office building, Boubekri (1995) examined the workers' satisfaction with the overall lighting conditions. This study indicates that proximity to windows affected their appraisals of lighting. In another study, Durak et al. (2007) explores the effect of different lighting arrangements (general lighting, wall washing, and cove lighting) with different illuminances (500 lux and 320 lux) on the perception of a room. They found that lighting can influence someone's mood, as they were able to generate different impressions using different lighting arrangements at different illuminances. They found that wall washing and cove lighting were preferred lighting arrangements for conveying different impressions. Quartier et al. (2014) explored the impact of lighting on the perception of atmosphere and on the emotions and behaviour of consumers. They found that realistic lighting settings can have subtle effects on the perceived atmosphere and experienced emotions and therefore stated that lighting in itself can be used to communicate a certain image. Few studies have been conducted on user preferences in terms of transparency and light access. Cheung and Chung (2008) observed that daylight is a significant means of affecting the perception and understanding of an environment. Also, based on many studies and in a diversity of usage, access to daylight through the window and the outlook were found to be key factors for users' satisfaction (Boyce, Hunter, & Howlett, 2003; Del Hoyo-Meléndez, Mecklenburg, & Doménech-Carbó, 2011; Kilic & Hasirci, 2011). The quality of indoor lighting affects the comfort and satisfaction of individuals in a particular space. Indeed, as Clevenger and Rogers (2017) showed in a simulation study using illuminance calculations, an airport can accommodate different user groups, all with different visual requirements and relationships to the luminous environments.

### *Layout and design characteristics*

The second category of layout and design characteristics includes characteristics like equipment, allocated floor space, product grouping, traffic flow, location of buildings, and allocation of space among buildings.

Ang et al. (1997) assessed the effect of layout and signage on consumer emotional response in two retail settings and found that better designed service environments yielded higher comfort to costumers, although poorly designed service environments did not cause displeasure but resulted in neutral customer evaluations. The precise layout of an environment helps individuals navigate and find their pathway, and to feel in personal control. In a different study on the effect of layout and design, Smith and Burns (1996) investigated the optimal use of a corridor in the store and indicated that the layout and the form of the walls are one of the factors affecting customer price perceptions. Research by Cotter et al. (2017) investigated people's preferences for curved soft forms in contrast to angled forms and evaluated the effect of individual differences on these preferences. They found that people prefer the curved form to the angled format.

The ceiling is another layout and design characteristic. The ceiling height has long been recognised as an influence on how people perceive the space, and this is associated with the interior environment quality. Fischl and Gärling (2004) found that the ceiling height is one of the three significant architectural components affecting the mental health of customers. The ceiling height can lead to the development of a certain atmosphere, which is a significant feature of interior design in the store space. Researchers suggested that low ceilings can encourage users to silence (Berman et al., 1995; Moore et al., 1996). Also, Gort (2007) indicated that in some conditions low ceilings increase the feeling of density and congestion, while in some circumstances, they would enhance the sense of pleasure. Savinar (1975) concluded that a higher ceiling leads to less congestion. However, few studies have dealt with the users' preferences regarding ceiling height. Few studies also investigated the users' preferences for the shape of the ceiling at airports and on ships. In a simulation study using 3D renderings of passenger areas, passengers prefer spaces with a curved ceiling, a curved layout, with greenery and without warm light decorations, coupled with wide

dimensions and white materials (Van Oel & Van den Berkhof, 2013). Similarly, in a simulation study with 3D renderings of a ship, the effect of environmental design characteristics was investigated on the passengers' perception of the safety level. The results indicated that the curved ceiling and smooth walls without fracture gave the passengers the impression of greater safety (Ahola & Mugge, 2017).

### *Distinct points and decoration*

The decoration is the third category of environmental design characteristics affecting user preferences, including characteristics such as greenery, information boards and road signs. Signs and information boards can help to improve the building layout. Having too many signs and information boards can cause a feeling of information overload in customers, while they get bored if there is a shortage of information.

Greenery is another significant characteristic affecting users' feelings and preferences, though often ignored in the store environment. It was reported that greenery has a positive effect on humans and reduces stress, though it is not clear how it affects the store atmosphere and behaviour within it (Bringslimark, Hartig, & Patil, 2009; Ulrich, 1993; Van den Berg, 2009). While a large number of environmental psychology studies have studied the store layout and the green environments separately, the greenery has rarely been investigated in the marketing context. There is some suggestive evidence that store greenery positively influence customers' emotions and their response to the store, especially in crowded stores (Brengman, Willems, & Joye, 2012; Joye, Willems, Brengman, & Wolf, 2010).

### *This study*

The current research is firmly rooted in the intersection of psychology and architecture (van Oel, Mlihi, & Freeke, 2021; Van Oel & Van den Berkhof, 2013). Environmental design descriptions are complicated as these physical design characteristics are processed and memorised as configurational information (Hoegg & Alba, 2008; Lengen & Kistemann, 2012). Therefore, environmental designs are better described as visuals than in words (van Oel et al., 2021; Van Oel & Van den Berkhof, 2013). Thus, 3D modelling was chosen because it best represents the architectural information while defining the space. By combining 3D modelling with the method that is usually referred to as 'discrete choice experiments', it becomes possible to investigate preferences of users such as passengers or consumers.

To investigate the role of selected design characteristics on the passengers' preferences and to evaluate the effect of emotional states, travellers' anxiety, enjoyment and satisfaction, on the passengers' preferences for the design characteristics, the current study was modelled (see Figure 1) after the Dutch study into the design characteristics of passenger preferences (Van Oel & Van den Berkhof, 2013). That study used 3D renderings in line with conditions at Amsterdam Airport. In the current study, the visualisations were modelled after the Persian airport in Tehran using the design characteristics as previously reviewed.

## Method

### *Participant*

The participants consisted of 450 passengers at Mehrabad International Airport in Tehran, Iran. All these passengers stemmed from Terminal No. 2. The passengers were selected after departing security gates and before arriving at their flight gate to ensure they were completely relaxed. Using an interceptive random approach, 450 passengers were randomised into one of the 6 versions of the questionnaire. Of these, 435 subjects finalised the questionnaire. Table 1 presents the respondent's descriptive information. The passengers included 32.2% females ($N = 140$) and 67.8% males ($N =$

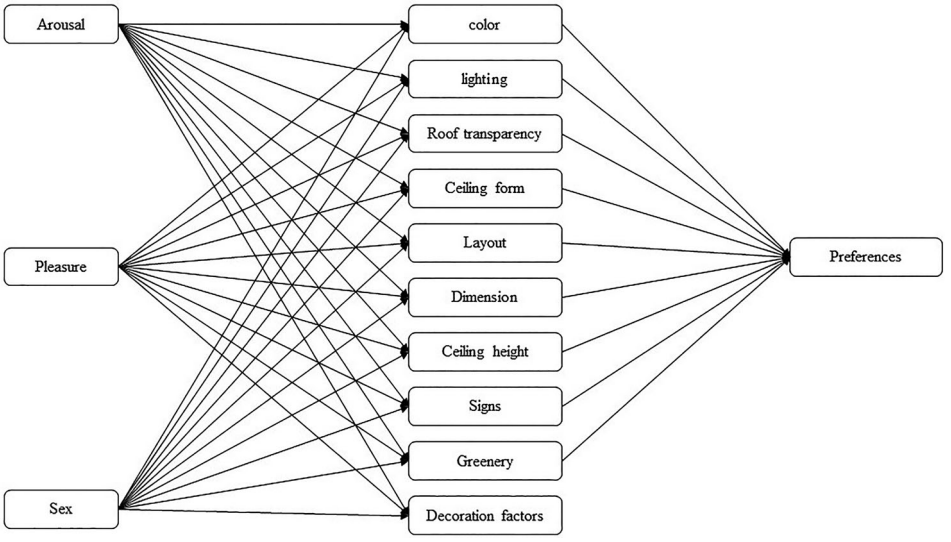


**Figure 1.** Theorical model.

295). The largest frequency of 45.5% was related to the age range 26–35. Those aged 36–45 amounted to 22.3%, and the lowest frequency of 13.2% belonged to the age range 46 and above. Most of the passengers travelled for business purposes. Regarding the level of education, 35% of the passengers had obtained middle education level (bachelor's degree); 34.2% had completed a high level of education (master's degree or above); the remaining 31.3% had received training at a lower educational level (under-diploma, diploma, and associate degree) Table 2 summarises the descriptive characteristics.

## *Study design*

It was decided to use the characteristics in Table 1 in the Discrete Choice Experiments (DCE) regarding the passenger areas. To obtain sufficient statistical power, 3 versions of 12 DCE were made following a receipt derived through optimisation in SAS (Kuhfeld, 2010). Optimisation is important because there are 9 design characteristics used with 2 levels, and 1 design characteristic with 3 levels. Without optimisation and with a full factorial design, 1536 (3*2*2*2*2*2*2*2*2*2 = 1536) separate renderings would be needed. Optimisation was achieved by using the fractional factorial design. Following Kuhfeld (2010), it was possible to develop the study using a total of 72 images or 36 Discrete Choice Sets using a 100% efficient fractional factorial design model in SAS

**Table 1.** Passengers' descriptive information.

| Age | % |
|---|---|
| Under 25 | 19 |
| 26–35 | 45.5 |
| 36–45 | 22.3 |
| 46 and over | 13.2 |
| Gender | |
| Female | 32.2 |
| Male | 67.8 |
| Education level | |
| Low (under-diploma, diploma, and associate degree) | 31.3 |
| Middle (bachelor's degree) | 34.5 |
| High (master's degree and more) | 34.2 |

**Table 2.** Design characteristics and the levels as applied in the hypothetical passenger areas in the questionnaire.

| Categories | Design characteristic | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|
| General interior design | Colour | Black | White | Warm(wood) |
| | Lighting | Cold | Warm | |
| | Roof transparency | With transparency | Without transparency | |
| | Ceiling form | Straight | Curve | |
| Layout and design | Layout | Straight | Curve | |
| | Dimension | Wide | Narrow | |
| | Ceiling height | High | Low | |
| Distinct points & Decoration | Signs | With signs | Without signs | |
| | Greenery | With greenery | Without greenery | |
| | Decoration factors | With decoration | Without decoration | |

(Kuhfeld, 2010). Since a questionnaire with 36 discrete choice experiments was considered too much for one person, 3 versions, each with 12 discrete choice experiments, were made. These renderings were then combined in Adobe Photoshop.

## *Questionnaire*

For the discrete choice experiments to be included in the questionnaire, the design characteristics had to be further conceptualised into renderings. Based on the literature review, design characteristics were chosen in each of the categories: for general interior design characteristics, colour and light were chosen; for layout and design characteristics, the composition of the walls and the dimensions of the space were varied; and signs and greenery were chosen as distinct points and decoration. All design characteristics with their levels are presented in Table 2.

The design characteristics were then further conceptualised and visualised in 3D MAX as explained below. Figure 2 shows an example of how the resulting renderings were included in the questionnaire.

### *General design characteristics*

Some laboratory studies dealt with the difference between material and colour. However, in designing a hypothetical terminal, it is not possible to distinguish between colour and material. Also, Van Oel and Van den Berkhof (2013) considered materials such as glass as cool colours, and wood was viewed as a colour level. Therefore, in addition to the two levels of black and white, a third level was added which was wood (warm) colour. Hence, the three levels of colour were defined as follows: the white level was illustrated using a white floor with dark veins (Figure 2, left-hand side); the black level was illustrated using black floor and white veins (Figure 2, right-hand side),


**Figure 2.** Example of a choice question in the questionnaire.

and the warm level was illustrated by the wood colour on the floor coupled with white veins (Figure 4, right-hand side). For the second design characteristic, lighting, two light arrangements were considered in the 3D Max software. First, all scenes were lit with constant light (skylight), after which two warm and cool light levels were added with point lights in the environment. Figure 2. illustrates the difference between these two lighting types. Cool light refers to light with a temperature of 6500° (Figure 2, right-hand side); warm light is associated with a temperature of 1500° (Figure 2, left-hand side). In some studies, such as the study conducted by Van Oel and Van den Berkhof (2013), the ceiling form is considered as a variable of external design factors since it forms the skyline. However, the present study considered the ceiling form as an interior design characteristic as it is visible and recognisable according to passengers. Hence, two levels were considered for the ceiling form. The first level of the right-angle form is simulated using a straight and right-angle structure with a smooth ceiling covering it (Figure 2, left-hand side). The second level of the curved form is simulated using a curved structure and a curved ceiling cover (Figure 2, right-hand side). Ceiling transparency is another characteristic of interior design determining the magnitude of the duct and the rate of sky view. This feature also includes two levels; the first level is the transparent ceiling, providing 33% of the sky view (Figure 2, right-hand side), while the second level is a ceiling without transparency and provides 0% sky view (Figure 2, left-hand side).

### *Layout and design characteristics*

The width of the pedestrian paths depends on the flow of passengers, although the architecture of the building can also affect it. In measuring the width of the hall, both wide (22 m, see Figure 2, left-hand side) and narrow (15 m, see Figure 2, right-hand side) examples were used. Layout was created with two straights (Figure 2, right-hand side) and curved (Figure 2, left-hand side) levels. Two levels were selected for the dimensions, including a dimensional feature, a subcategory of layout factors and the ceiling height. The ceiling height was considered at two levels: low floor to ceiling height equal to 16 m (Figure 2, right-hand side), and high floor to ceiling height of 21 m (Figure 2, left-hand side).

### *Distinct points and decoration characteristics*

Signs were considered as a layout characteristic in the study of Van Oel and Van den Berkhof (2013); however, in some studies, the signs were considered as decorative characteristics. The present study followed the latter, i.e. the signs have been considered as decorative factors at two levels. The first level involves the presence of signs in visible points (Figure 2, left-hand side) while the second level refers to the absence of signs in visible points (Figure 2, right-hand side). Greenery is the second feature of the decorative characteristics referring to the presence (Figure 2, left-hand side) and absence (Figure 2, right-hand side) levels. Finally, the last decorative characteristic is the decorative signs themselves (airplane replica), with the present study investigating them at presence (Figure 2, left-hand side) and absence (Figure 2, right-hand side) levels.

### *Human factors*

Pleasure was measured by the semantic differential spectrum considering emotional state (pleasure 6 pairs of words, alpha = 0.89; arousal 6 pairs of words, alpha = 0.73). Both pleasures were measured by a seven-point semantic differential scale (Brengman, 2002; Brengman & Geuens, 2004). According to the studies conducted by Donovan and Rossiter (1994) on store atmosphere and purchasing behaviour and recent studies by Yani-de-Soriano and Foxall (2006), domination was also considered as the third dimension. However, as indicated by Brengman and Geuens (2004) the reliability of the domination dimension was far less than the reliability of the pleasure scale. Therefore, this dimension was not considered in the present study.

In the further analyses, pleasure and arousal scores were dichotomised using the median as the threshold. In addition to 12 discrete questions, additional data were collected on the field variables including age, gender and education levels.

### Procedure

In the questionnaire, respondents were asked to choose their preferred image between the two images of the terminal. An example of such a choice set is down in Figure 2.

The data were collected by a laptop over the course of 10 days in August 2017, at Terminal No. 2, Mehrabad Airport, Tehran. A total of 450 questionnaires were completed, of which 435 were correct and usable. Respondents generally needed less than 15 minutes to complete the questionnaire. First, the respondents were provided with a printed questionnaire that measured the personality traits, travel characteristics and emotional characteristics of each individual. After completing the first part, the second part of the questionnaire was provided on a laptop. The respondents were randomly assigned a version to reduce bias. Then respondents were asked to choose their preferred images from within a set, and were asked to do so 12 times (see Figure 2).

### Data analyses

Main effects were investigated in SAS 9.4. The conditional logit model was used to analyse the choice between the two renderings (configurations) as a function of the design characteristics of the alternatives. In SAS, the PHREG procedure was used after preliminary data processing to fit a conditional logit model. The PHREG procedure fits the Cox proportional hazard model to survival data and the partial likelihood of Breslow has the same form as the likelihood in a conditional logit model, as Kuhfeld (2010) explains. This model was used to analyse the influence of the design characteristics. The PHREG procedure uses the Hazard Ratio as an effect measure and Firth-corrected 95% confidence intervals (CI) were requested. A threshold of $p < 0.05$ was used in significance testing of the main effects; for testing of interaction effects, a threshold of $p < 0.01$ was used. All preparations for data analyses in SAS were done in SPSS version 23. SPSS was also used to obtain descriptive information.

## Results

### Architectural design characteristics

The results of the analyses using the conditional multinomial logit model are summarised in Figure 3. Here, the utility function indicates the passengers' preferences. Figure 3. displays all 10 of the design characteristics that were varied in the discrete choice experiments. Based on the passengers' choices, it can be decided which design characteristics were most important when choosing which of the two images they liked most. The higher the value, the more important a design characteristic was in decision making.

The ceiling form, for instance, represented the highest rate of utility (0.24), signifying that ceiling form is the most significant feature for choosing the best terminal hall according to the passengers.

The straight ceiling is considered as the reference level. This means that the curved form of the ceiling is more popular than the straight form. If both alternatives are treated equally, the hazard ratio (HR) will equal 1.00. If the HR >1, this indicates that the level of interest is preferred over the reference level. If the form of the ceiling is curved, it will be chosen approximately 1.28 times more often than had it been the straight form. Table 3 indicates that all characteristics affect passengers' preferences, as in nearly all levels of interests the *p*-value is below 0.05. Colour made a significant difference but this was only true for wood. If the colour scheme was white or black, it did not influence their choice.

Figure 3 illustrates the characteristics from the most to the least effective. The two characteristics of ceiling form and transparency have the greatest effect on the passengers' preferences. Passengers preferred the curved ceiling instead of the straight ceiling (0.248), and they obviously preferred the transparent ceiling to the ceiling with no transparency (0.241). Further, they preferred the presence

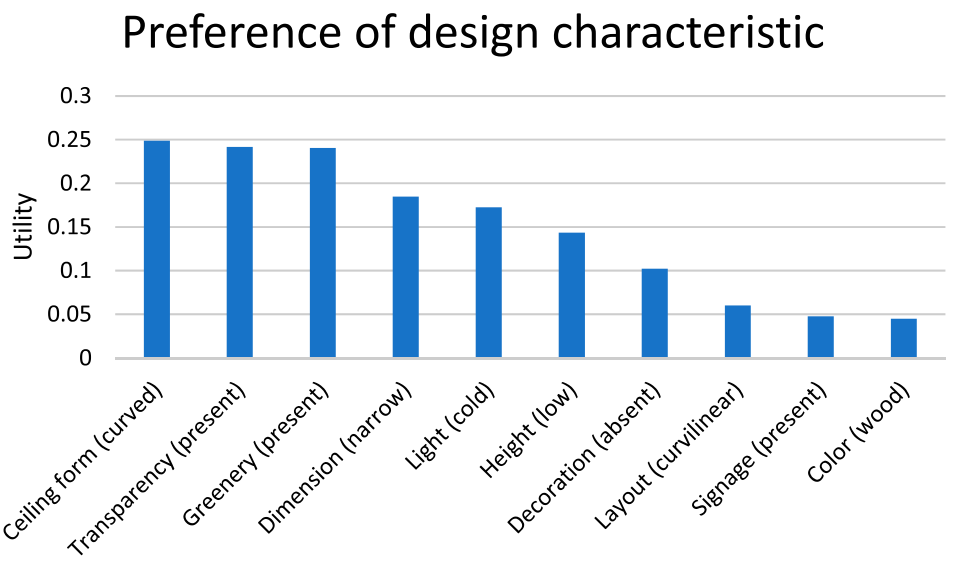


**Figure 3.** Passengers' preferences of design characteristics.

of greenery rather than its absence (0.24). The feature dimensions constituted other features investigated, with passengers preferring a narrower hall compared to a wide hall (0.184). Passengers preferred cold lighting to warm lighting (0.172). High ceiling (0.143) was another characteristic of architectural design that was more significant than the absence of decoration (0.102), curvilinear layout (0.059), presence of signs (0.047) and colour. Passengers preferred wood colour to white (0.106). In general, passengers preferred wood-coloured spaces, cool light, transparency, curved ceiling form, curved layout, narrow hall, low ceiling height, presence of signs, presence of greenery and absence of decorations. In Figure 4, the image on the right presents the terminal hall with the greatest preference, while the image on the left displays the least preferred terminal hall.

### *Influence of human factors on architectural design characteristics*

As for the effect of emotional states on passengers' preferences, it was found that the arousal level affected the preferences for the design characteristics of colour, dimension, form, light and

**Table 3.** Passenger preference (utility estimates) for the design characteristics.

| Level of Interest | Reference level | DF | Parameter Estimate | Standard Error | Chi-Square | Pr > ChiSq | Hazard Ratio | 95% Ci HR |
|---|---|---|---|---|---|---|---|---|
| 1. Colour (black) | White | 1 | 0.016 | 0.028 | 0.358 | 0.5494 | 1.017 | 0.96–1.07 |
| Colour (wood) | White | 1 | 0.106 | 0.028 | 14.34 | 0.0002 | 1.112 | 1.05–1.17 |
| 2. Light (cold) | Warm | 1 | 0.171 | 0.022 | 56.15 | <.0001 | 1.187 | 1.13–1.24 |
| 3. Transparency (present) | Absent | 1 | 0.240 | 0.023 | 107.99 | <.0001 | 1.271 | 1.21–1.33 |
| 4. Form (curved) | Orthogonal | 1 | 0.249 | 0.023 | 116.33 | <.0001 | 1.283 | 1.22–1.34 |
| 5. Layout (curvilinear) | Straight | 1 | 0.058 | 0.022 | 6.55 | 0.0105 | 1.060 | 1.01–1.10 |
| 6. Dimension (narrow) | Wide | 1 | 0.184 | 0.023 | 63.83 | <.0001 | 1.203 | 1.15–1.25 |
| 7. Height (low) | High | 1 | 0.143 | 0.023 | 39.17 | <.0001 | 1.155 | 1.10–1.20 |
| 8. Signage (present) | absent | 1 | 0.047 | 0.023 | 4.09 | 0.0430 | 1.048 | 1.00–1.09 |
| 9. Greenery (present) | absent | 1 | 0.240 | 0.023 | 107.45 | <.0001 | 1.272 | 1.21–1.33 |
| 10. Decoration (absent) | present | 1 | 0.100 | 0.023 | 18.60 | <.0001 | 1.106 | 1.05–1.15 |


**Figure 4.** The least (left side) and most preferred terminal hall (right side).

transparency. Individuals with a medium or high arousal level selected white coloured material more often than black coloured material (interaction between medium arousal level and black materials: HR = 0.60, $\chi2 = 18.66$, df = 1, $p < 0.01$; interaction between high arousal level and black materials: HR = 0.64, $\chi2 = 11.01$, df = 1, $p < 0.01$). Individuals with a medium arousal level preferred narrow terminal to wide terminal (HR = 1.26, $\chi2 = 8.54$, df = 1, $p < 0.01$). Also, people with medium or high arousal levels preferred curved terminal rather than straight terminal (interaction between medium arousal level and curved terminal: HR = 1.28, $\chi2 = 8.15$, df = 1, $p < 0.01$; interaction between high arousal level and curved terminal: HR = 1.40, $\chi2 = 11.32$, df = 1, $p < 0.01$). In addition, people with a high level of arousal preferred the ceiling with the transparency rather than oblique (HR = 1.34, $\chi2 = 8.41$, df = 1, $p < 0.01$). Meanwhile, the level of pleasure also affected the design characteristics dimension and greenery. People with a high level of pleasure preferred narrow terminal rather than wide terminal (HR = 1.30, $\chi2 = 16.54$, df = 1, $p < 0.01$). In addition, individuals with a high level of pleasure preferred the presence of greenery compared to its absence (HR = 1.21, $\chi2 = 8.70$, df = 1, $p < 0.01$). The levels of arousal and pleasure did not influence other design characteristics.

### *Influence of demographics on design preferences*

Women significantly preferred white material to black material (HR = 1.17, $\chi2 = 7.49$, df = 1, $p < 0.01$), and they preferred the presence of greenery compared to its absence (HR = 0.848, $\chi2 = 11.35$, df = 1, $p < 0.01$). In addition, women preferred the presence of signs rather than its absence (HR = 1.16, $\chi2 = 9.80$, df = 1, $p < 0.01$). On the other hand, gender had no significant effect on passenger preferences on other design characteristics.

## Summary and discussion

In some cases, the finding of this study is odd compared to other similar studies. In this study, the effect of the decoration on the passenger's preferred preferences was not significant. Meanwhile, in two similar studies in different cultural contexts (Bogicevic et al., 2016; Van Oel & Van den Berkhof, 2013), this characteristic was influential on the passenger's preferences and their satisfaction. On the other hand, in the Van Oel and Van den Berkhof (2013) study, it was revealed that cultural differences affect the passenger's preferences for environmental characteristics.

The present study focussed on investigating the passengers' preferences relating to the features of airport architecture based on renderings of the terminal hall in a different cultural setting than previous studies in Western-Europe (Van Oel & Van den Berkhof, 2013) and the US (Bogicevic et al., 2016). The passengers generally preferred a terminal hall with a curved and transparent

ceiling, low width and low height, cool lighting, warm material colour, presence of greenery and absence of decorations. Signage was also significant, but it only had a small effect on passengers' choices. In both the Dutch and the Persian settings, wood-like materials were preferred over black. In the present study, if passengers only had to choose between a white or a black colour scheme, did this not affect their choices. The latter is particularly important as there was suggestive evidence from the Dutch study that, in general, passengers were inclined to prefer a white colour scheme to a black colour scheme, which was found to be particularly true for departing (Dutch) passengers. In addition, Persian passengers preferred cold light more than warm, while in a similar study in the Dutch cultural setting passengers preferred warm light to cold light (Van Oel & Van den Berkhof, 2013). Whereas this may be suggestive of cultural differences, Jonauskaite et al. (2019) pointed out that an alternative explanation might be that such might also be explained by a difference in geographical gradient. The Dutch might prefer warm lighting because of the association with positive emotions, whereas the Persians prefer cold lighting for the same reason. Another possible explanation might be related to the fact that cool colours are associated with relaxation and passengers prefer these colour schemes for their restorative effects (Van Oel & Van den Berkhof, 2013).

Additional support for the idea that environmental design characteristics are important ways to reduce stress in passengers and to invoke restorative effects, comes from their preferences for the form and transparency of the ceiling. Ceiling form and transparency account for the greatest passenger preferences. Most studies considered the ceiling form as an external design variable. However, the present study considers the form of the ceiling as a visible characteristic of the interior design as it largely influences the presence and quality of daylight. Daylight is important as it plays a significant role in increasing individual satisfaction, comfort and a positive feeling among buyers (Clevenger & Rogers, 2017; Heschong et al., 2016). It has long been recognised that the environmental design might influence passengers' emotional state (Mehrabian & Russell, 1974; Russell & Lanius, 1984).

Given that passengers with increased levels of arousal preferred transparent and curved ceilings over oblique straight ceilings, the current findings lend support to the idea that natural light had a strong positive and restorative effect on passengers. Preferences for restorative designed passenger areas are not (only) culturally determined, as comparable findings for restorative designs were found in the Dutch (Van Oel & Van den Berkhof, 2013) and American studies (Bogicevic et al., 2016).

This study corroborated the previous findings of Van Oel and Van den Berkhof (2013) that people preferred the absence of decoration over the presence of commercial references to Dutch culture (i.e. Dutch Cheese and old Delftware-inspired tiles), as the current study also showed disapproval of the rather commercial looking decoration. In contrast, Bogicevic et al. (2016) used artwork as a decorative element, which was found to be positively evaluated as part of the general design. Therefore, these results suggest that the nature of the decoration might deserve further attention in future research, as greenery was also favoured in both settings. There is suggestive evidence that greenery may relieve stress and this could be an additional reason to use greenery for decoration, eventually in addition to artworks (Babin, Chebat, & Michon, 2004; Brengman et al., 2012; Chebat & Morrin, 2007).

The other interior design factors of height, layout and dimension also influenced passengers' preferences in a way that corroborates findings from other studies. Passengers preferred spaces with curved walls and layout over straight designs. Several other studies indicated that curved or curvilinear designs were more attractive to users than straight design (Kottasz, 2006; Van Oel & Van den Berkhof, 2013; Zacharias, 2002). It is thought that curved corridors are more attractive to passengers because they introduce some level of surprise (Massara, Liu, & Melara, 2010), and the interaction that was found between preferences for curvilinear designs over straight designs among passengers with increased levels of arousal or excitement can be considered as supportive evidence. Interestingly, in the present study a preference for a lower ceiling, particularly amongst passengers with high levels of pleasure, and the general preferences for a narrower corridor over a larger dimensioned space, contrast with the results in the Dutch study. This might be explained by a difference in the levels of arousal and pleasure. In the Dutch study, the average sum score was 32.90 (sd = 6.52) for pleasure

and 23.25 (sd = 5.64) for arousal, and this was lower/higher/comparable to the levels as found in the current study. This might be suggestive of different experiences amongst passengers in both studies. Unfortunately, passengers were not asked in either study how familiar they were with air travel, as this might hint at a potential explanation. It seems unlikely that passengers could not see the difference between the different dimensions of the design, because passengers were randomised into versions and would make random choices. If they would have made random choices, a clear significant preference would not have been detected. Another potential explanation might be that in the current study, passengers evaluated the dimensioning against the human scale of the design (Fogué & Lammineur, 1995), however, this deserves further research.

### *Limitations*

The findings of the present study are solely generalisable to the passenger terminal space and cannot be generalised to the total airport space such as the store space, service space, office space, etc. This is because this study only investigated the passenger terminal space while other sections remained uninvestigated. Further, considering the nature of this research and sample, only passengers were considered as the users of the environment, but clearly there are other stakeholders that were excluded from participation in the study. This research did not explore the technical characteristics and structural quality of the building such as the interior climate, the building structure, the fragrances, and the interior sounds as recommended, for instance, by Bogicevic et al. (2016). However, instead of verbalising the visual information, like they did, the present study used visualisations as we consider it important to use a more holistic approach. Moreover, by using renderings that were modelled after a realistic situation, this study overcomes the problem that, for instance, layover passengers might have different settings in mind.

## Conclusion

With the need to increase total revenues, airports have begun to use commercial retail and services including restaurants, cafes and hotels to attract more customers and satisfy their needs (Han et al., 2014). A well-designed airport may provide great service to clients and consumers and increase their satisfaction, and in turn their spending behaviours. This study indicates that, in the eyes of Persian passengers', designers could design a terminal with a curved and transparent ceiling, warm material colour (wood), wood coloured floor, cool lighting, low width and height, with greenery and without any further decorations. There is some suggestive evidence that there are either geographical or cultural differences between passenger preferences in the current study and comparable studies from countries with a more northern gradient and a more Western culture. This was found to be particularly true for lighting and certain colour schemes. For other interior design characteristics, the shape of the ceiling and the amount of daylight, as well as the presence of greenery, it may well be that these preferences reflect passengers' restorative needs. These might be considered more universal needs as they were more pronounced amongst passengers with increased levels of arousal. The results can be used by architects and designers in their future plans and in revisiting the existing designs.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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## References


Ahola, M., & Mugge, R. (2017). Safety in passenger ships: The influence of environmental design characteristics on people's perception of safety. *Applied Ergonomics*, *59*, 143–152. doi:10.1016/j.apergo.2016.07.021

Babin, B. J., Chebat, J. C., & Michon, R. (2004). Perceived appropriateness and its effect on quality, affect and behavior. *Journal of Retailing and Consumer Services*, *11*, 287–298. doi:10.1016/j.jretconser.2003.09.002

Bellizzi, J. A., Crowley, A. E., & Hasty, R. W. (1983). The effects of color in store design. *Journal of Retailing*, *59*(1), 21–45.

Berman, B., Evans, J. R. (1995). *Retail management: A strategic approach, 6th edition*. Englewood Cliffs, NJ: Prentice Hall .

Bogicevic, V., Yang, W., Cobanoglu, C., Bilgihan, A., & Bujisic, M. (2016). Journal of air transport management traveler anxiety and enjoyment : The effect of airport environment on traveler's emotions. *Journal of Air Transport Management*, *57*, 122–129. doi:10.1016/j.jairtraman.2016.07.019

Boubekri, M. (1995). Appraisal of the lighting conditions in an office building: Results of a survey. *Indoor Environment*, *4* (3-4), 162–169.

Boyce, P., Hunter, C., & Howlett, O. (2003). *The benefits of daylight through windows*. Troy: Rensselaer Polytechnic Institute.

Brengman, M. (2002). *The impact of colour in the store environment: An environmental psychology approach.* (Doctoral dissertation, Ghent University).

Brengman, M., & Geuens, M. (2004). The four dimensional impact of color on shopper's emotions. In B. E. Kahn & M. F. Luce (Eds.), *NA - Advances in Consumer Research* (pp. 122–128). Association for Consumer Research.

Brengman, M., Willems, K., & Joye, Y. (2012). The impact of in-store greenery on customers. *Psychology & Marketing*, *29* (11), 807–821. doi:10.1002/mar.20566

Bringslimark, T., Hartig, T., & Patil, G. G. (2009). The psychological benefits of indoor plants: A critical review of the experimental literature. *Journal of Environmental Psychology*, *29*, 422–433. doi:10.1016/j.jenvp.2009.05.001

Chebat, J., & Morrin, M. (2007). Colors and cultures : Exploring the effects of mall décor on consumer perceptions★. *Journal of business Research*, *60*, 189–196. doi:10.1016/j.jbusres.2006.11.003.

Chen, Y., Wu, C., Koo, T. T. R., Douglas, I., Chen, Y., Wu, C., … Douglas, I. (2020). Determinants of airport retail revenue : A review of literature determinants of airport retail revenue. *Transport Reviews*, *40*, 479–505. doi:10.1080/01441647.2020.1738586

Cheung, H. D., & Chung, T. M. (2008). A study on subjective preference to daylit residential indoor environment using conjoint analysis. *Building and Environment*, *43*, 2101–2111. doi:10.1016/j.buildenv.2007.12.011

Clevenger, C. M., & Rogers, Z. (2017). Managing daylight in airports. *Journal of Architectural Engineering*, *23*, 04017006. doi:10.1061/(ASCE)AE.1943-5568.0000245

Correia, A. R., Wirasinghe, S. C., & de Barros, A. G. (2008). Overall level of service measures for airport passenger terminals. *Transportation Research Part A: Policy and Practice*, *42*(2), 330–346.

Cotter, K. N., Silvia, P. J., Bertamini, M., Palumbo, L., & Vartanian, O. (2017). Curve appeal: Exploring individual differences in preference for curved versus angular objects. *i-Perception*, *8*(2), 2041669517693023.

de Barros, A G, Somasundaraswaran, A K, & Wirasinghe, S C. (2007). Evaluation of level of service for transfer passengers at airports. *Journal of Air Transport Management*, *13*(5), 293–298.

Del Hoyo-Meléndez, J. M., Mecklenburg, M. F., & Doménech-Carbó, M. T. (2011). An evaluation of daylight distribution as an initial preventive conservation measure at two Smithsonian Institution Museums, Washington DC, USA. *Journal of Cultural Heritage*, *12*, 54–64. doi:10.1016/j.culher.2010.05.003

Donovan, R. J., & Rossiter, J. R. (1994). Store atmosphere and purchasing behavior. *J. Retail*, *70*, 283–294. doi:10.1016/0022-4359(94)90037-X

Durak, A., Olguntürk, N. C., Yener, C., Güvenç, D., & Gürçınar, Y. (2007). Impact of lighting arrangements and illuminances on different impressions of a room. *Building and Environment*, *42*(10), 3476–3482.

Durak, A., Olguntürk, N. C., Yener, C., Güvenç, D., & Gürçınar, Y. (2007). Impact of lighting arrangements and illuminances on different impressions of a room. *Building and Environment*, *42*(10), 3476–3482.

Edwards, B. (2004). *The modern airport terminal: New approaches to airport architecture*. London: Taylor & Francis.

Fischl, G., & Gärling, A. (2004). *Enhancing well-being in health care facilities by architectural design? A methodological study*. Toronto: Hogrefe & Huber Publishers.

Flynn, J. E., Hendrick, C., Spencer, T., & Martyniuk, O. (1979). A guide to methodology procedures for measuring subjective impressions in lighting. *Journal of the Illuminating Engineering Society*, *8*, 95. doi:10.1080/00994480.1979.10748577

Foqué, R., & Lammineur, M. (1995). Designing for patients: A strategy for introducing human scale in hospital design. *Design Studies*, *16*(1), 29–49.

Gort, D. H. (2007). *Kleur bekennen. Een experimenteel onderzoek naar de invloed van omgevingsfactoren voor Poppodium Atak Enschede*. Master's thesis, University of Twente.

Graham, A. (2009). Journal of air transport management: How important are commercial revenues to today's airports ? *Journal of Air Transport Management*, *15*, 106–111. doi:10.1016/j.jairtraman.2008.11.004

Han, H., Kim, W., & Hyun, S. S. (2014). Overseas travelers' decision formation for airport-shopping behavior. *Journal of Travel & Tourism Marketing*, *31*, 985–1003. doi:10.1080/10548408.2014.889643

Heschong, L., Wright, R. L., Okura, S., Heschong, L., Wright, R. L., & Daylighting, S. O. (2016). Daylighting impacts on retail sales performance. *Journal of the Illuminating Engineering Society*, *31*(2), 21–25. doi:10.1080/00994480.2002.10748389

Hoegg, J., & Alba, J. W. (2008). *A role for aesthetics in consumer psychology.*

Hughes, N., Ryan, B., Hallewell, M., Coad, N., Grant, A., Parrott, N., … Thompson, K. (2020). Identifying new concepts for innovative lighting-based interventions to influence movement and behaviours in train stations. *Lighting Research & Technology*, *52*(8), 976–990. doi:10.1177/1477153520904405

Jacquier, C., & Giboreau, A. (2012). *Perception and emotions of colored atmospheres at the restaurant*. Predicting perceptions: Proceedings of the 3rd international conference on appearance (pp. 165–167). Lulu Press.

Jonauskaite, D., Abdel-Khalek, A. M., Abu-Akel, A., Al-Rasheed, A. S., Antonietti, J. P., Ásgeirsson, Á. G., …, Mohr, C. (2019). The sun is no fun without rain: Physical environments affect how we feel about yellow across 55 countries. *Journal of Environmental Psychology*, *66*, 101350.

Jonauskaite, D., Abu-Akel, A., Dael, N., Oberfeld, D., Abdel-Khalek, A. M., Al-Rasheed, A. S., … Mohr, C. (2020). Universal patterns in color-emotion associations are further shaped by linguistic and geographic proximity. *Psychological Science*, *31*(10), 1245–1260.

Joye, Y., Willems, K., Brengman, M., & Wolf, K. (2010). The effects of urban retail greenery on consumer experience: Reviewing the evidence from a restorative perspective. *Urban Forestry & Urban Greening*, *9*, 57–64. doi:10.1016/j.ufug.2009.10.001

Kilic, D. K., & Hasirci, D. (2011). Daylighting concepts for university libraries and their influences on users' satisfaction. *The Journal of Academic Librarianship*, *37*(6), 471–479. doi:10.1016/j.acalib.2011.07.003

Knez, I., & Enmarker, I. (1998). Effects of office lighting on mood and cognitive performance and a gender effect in work-related judgment. *Environment and Behavior*, *30*(4), 553–567.

Kottasz, R. (2006). Understanding the influences of atmospheric cues on the emotional responses and behaviours of museum visitors. *Journal of Nonprofit & Public Sector Marketing*, *16*(1-2), 95–121. doi:10.1300/J054v16n01_06

Kuhfeld, W. F. (2010). *Marketing research methods in SAS*. Cary, NC: SAS Institute. Inc.

Lam, L. W., Chan, K. W., Fong, D., & Lo, F. (2011). Does the look matter? The impact of casino servicescape on gaming customer satisfaction, intention to revisit, and desire to stay. *International Journal of Hospitality Management*, *30*(3), 558–567. doi:10.1016/j.ijhm.2010.10.003

Lee, Y.-K., Lee, C.-K., Lee, S.-K., & Babin, B. J. (2008). Festivalscapes and patrons' emotions, satisfaction, and loyalty. *Journal of Business Research*, *61*(1), 56–64. doi:10.1016/j.jbusres.2006.05.009

Lengen, C., & Kistemann, T. (2012). Sense of place and place identity: Review of neuroscientific evidence. *Health & Place*, *18*(5), 1162–1171. doi:10.1016/j.healthplace.2012.01.012

Massara, F., Liu, S. S., & Melara, R. D. (2010). Adapting to a retail environment : modeling consumer – environment interactions 63. *Journal of Business Research*, *63*(7), 673–681. doi:10.1016/j.jbusres.2009.05.004

Mehrabian, A., & Russell, J. A. (1974). *An approach to environmental psychology*. Cambridge, MA: the MIT Press.

Moore, G. T., Lane, C. G., Hill, A. B., Cohen, U., McGinty, T., Jules, F. A., … Work, L. L. (1996). *Recommendations for child care centers*. Milwaukee: Center for Architecture and Urban Planning Research, University of Wisconsin–Milwaukee.

Quartier, K., Vanrie, J., & Van Cleempoel, K. (2014). As real as it gets: What role does lighting have on consumer's perception of atmosphere, emotions and behaviour? *Journal of Environmental Psychology*, *39*, 32–39. doi:10.1016/j.jenvp.2014.04.005

Russell, J. A., & Lanius, U. F. (1984). Adaptation level and the affective appraisal of environments. *Journal of Environmental Psychology*, *4*(2), 119–135. doi:10.1016/S0272-4944(84)80029-8

Savinar, J. (1975). The effect of ceiling on personal space. *Man-environment Systems*, *5*, 321–324.

Smith, P., & Burns, D. J. (1996). Atmospherics and retail environments: The case of the "power aisle". *International Journal of Retail and Distribution Management*, *24*, 7–8.

Stone, N. J. (2003). Environmental view and color for a simulated telemarketing task. *Journal of Environmental Psychology*, *23*(1), 63–78. doi:10.1016/S0272-4944(02)00107-X

Thang, D. C. L., & Tan, B. L. B. (2003). Linking consumer perception to preference of retail stores: An empirical assessment of the multi-attributes of store image. *Journal of Retailing and Consumer Services*, *10*(4), 193–200. doi:10.1016/S0969-6989(02)00006-1

Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. *The Biophilia Hypothesis*, *7*, 73–137.

Van den Berg, A. E. (2009). Restorative effects of nature: Towards a neurobiological approach, in: *Human diversity: Design for life, proceedings of the 9th international congress of physiological anthropology,* (pp. 132–138). Delft, The Netherlands, 22–26 August 2008.

Van Erp, T. (2008). *The effects of lighting characteristics on atmosphere perception*. Unpublished manuscript for Philips Research, Eindhoven, Netherlands.

van Oel, C. J., Mlihi, M., & Freeke, A. (2021). Design models for single patient rooms tested for patient preferences. *HERD: Health Environments Research & Design Journal*, *14*(1), 31–46. doi:10.1177/1937586720937995

Van Oel, C. J., & Van den Berkhof, F. W. D. (2013). Consumer preferences in the design of airport passenger areas. *Journal of Environmental Psychology*, *36*, 280–290. doi:10.1016/j.jenvp.2013.08.005

Wakefield, K. L., & Baker, J. (1998). Excitement at the mall: Determinants and effects on shopping response. *Journal of Retailing*, *74*(4), 515–539. doi:10.1016/S0022-4359(99)80106-7

Wang, H., Liu, G., Hu, S., & Liu, C. (2018). Experimental investigation about thermal effect of colour on thermal sensation and comfort. *Energy and Buildings*, *173*, 710–718.

Yani-de-Soriano, M. M., & Foxall, G. R. (2006). The emotional power of place: The fall and rise of dominance in retail research. *Journal of Retailing and Consumer Services*, *13*(6), 403–416. doi:10.1016/j.jretconser.2006.02.007

Yildirim, K., Akalin-Baskaya, A., & Hidayetoglu, M. L. (2007). Effects of indoor color on mood and cognitive performance. *Building and Environment*, *42*(9), 3233–3240. doi:10.1016/j.buildenv.2006.07.037

Yildirim, K., Capanoglu, A., Cagatay, K., & Hidayetoglu, M. L. (2012). Effect of wall colour on the perception of hairdressing salons. *JAIC-Journal of the International Colour Association*, *7*, 51–63.

Yildirim, K., Hidayetoglu, M. L., & Capanoglu, A. (2011). Effects of interior colors on mood and preference: Comparisons of two living rooms. *Perceptual and Motor Skills*, *112*(2), 509–524. doi:10.2466/24.27.PMS.112.2.509-524

Zacharias, J. (2002). Choosing a path in the underground: Visual information and preference, in: *ACUUS international conference urban underground space: a resource for cities,* (pp. 14–16). Torino.