Consumer preferences in the design of airport passenger areas

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Abstract

In recent decades, commercial developments have become increasingly important for the overall profit of airports. However, little is known about consumer preferences regarding the design of passenger areas, which is striking as the design of terminal buildings affects consumers' emotional state and shopping behaviour. The aim of this study was therefore to investigate how architectural design characteristics are valued by airport passengers, using visualizations of hypothetical passenger areas.

Discrete choice experiments were used to investigate passenger preferences for eight design characteristics. Data on 346 passengers were collected in June 2008 in departure and transfer areas at Amsterdam Airport Schiphol.

Analyses showed that passengers preferred a passenger area with a curvilinear roof, a curved layout, the presence of greenery, no decoration reflecting the distinctiveness of Holland, warm lighting, wide dimensions and white materials. Signage had no influence.

1. Introduction

Airports historically aim to process passengers and their luggage in the most efficient and rapid way possible. Initial design guidelines emphasized the way architecture could be used to facilitate passenger flows (Odoni & de Neufville, 1992). Most terminal buildings were designed to facilitate passenger flow in a constrained way from check-in, through security into the departure area, and from there to the boarding gates. Between the subsequent processing sites, passenger mobility is constrained by corridors and walls (Adey, 2008). From the perspective of passenger logistics, the commercial developments at the airport seem to be at odds with the operational management processes. Shopping passengers may not only forget the time and consequently delay their flights, but commercial developments might also block off visual lines that facilitate passengers' wayfinding and reduce their orientation. However, in recent decades commercial developments have become increasingly important for the overall profit of airports. Commercial revenues now account for around half of total revenues (Graham, 2009). To enhance revenues from retail, passenger areas are being designed or redesigned to limit and quite rigidly enforce the movement of passengers in such a way that they might be seduced by the many shops to which they are exposed (Adey, 2008).

Airports intensively monitor consumer preferences, and several literature studies have investigated consumer behaviour to improve wayfinding (Adey, 2008; Churchill, Dada, de Barros, & Wirasinghe, 2008; Correia, Wirasinghe & de Barros, 2008a), or to improve access travel times and modes of transport (Tsamboulas & Nikoleris, 2008) to support their operations processes and to increase retail revenues. However, very little is known about how consumers value the design of airport passenger and retail areas. This lack of knowledge is striking, since the atmospherics of terminal buildings affect the emotional state of consumers, either encouraging them to remain in the retail areas and to evaluate the setting and purchases in the shops, or discouraging them from doing so (Adey, 2008; Omar, 2002).

To enhance revenues from commercial activities, one needs to increase the amount of pleasure generated by sales and consumption settings and to prevent extreme levels of arousal (Russell & Mehrabian, 1977). For the airport, it is therefore highly important that airport design reduces stress in passengers, as this will increase their revenues from retail (Adey, 2008). To address passenger satisfaction with the design of passenger areas and to investigate whether pleasure and arousal levels were affecting their satisfaction with the design of passenger areas, an alternative research method was applied in this study. The general method of monitoring passenger satisfaction with the passenger areas and services was thought to yield too generic responses. Like other airports, Amsterdam Airport Schiphol ('Schiphol airport') extensively monitors passenger satisfaction using questionnaires, but the use of semantic questions seemed insufficiently sensitive for the purposes of the study. We therefore investigated how design characteristics were valued by passengers using a questionnaire with visualizations of hypothetical passenger areas, and evaluated the influences of emotional states on the appreciation of these design characteristics.

In the sections that follow, we first discuss the literature on architectural design characteristics that we included in the study. We then discuss the measurement of preferences

and the pilot study we conducted. Thereafter, we report and discuss the design and results of the choice experiments with visualizations and their relationship with general indices and indices measuring pleasure and arousal.

2. Architectural design characteristics

In view of the increasing importance of commercial revenues to the total revenues of airports (Graham, 2009), the design of passenger areas might benefit from research insights into consumer preferences in retail design. Bell (1999) found that consumer shopping behaviour was dependent on whether the consumer liked the shopping area (affect), the physical attractiveness (visual amenity), the quality and range of products and shops, price fairness, the convenience of location and customer service. Turley and Milliman (2000) referred to customer services as human factors and also included in this category such factors as crowding. They evaluated the influences of atmospherics on three types of outcomes: purchase behaviour, time spent in a shopping mall, and whether consumers felt attracted to the shopping environment (approach behaviour) or not attracted to it (avoidance behaviour). Mehrabian and Russell (1974) posited that consumers' approach and avoidance behaviour is mediated by their emotional state. It might be concluded from the review by Turley and Milliman (2000) that purchase behaviour and the valuation of the shopping mall could be considered valid measures of consumer satisfaction. Following the classification of Turley and Milliman (2000), we now provide an overview of evidence regarding the atmospheric variables that are of interest to the present study.

2.1. Exterior factors

Design/architecture: The preference for exterior architectural design factors has mostly been investigated in residential settings and focused on three characteristics of façades, namely silhouette or shape complexity, massing or façade articulation, and surface complexity. The highest user preferences were found for surface complexity; shape complexity was found to be least preferred (Stamps III, 1999). Whereas Stamps III (1999) emphasized a more geometrically based approach in his review, Herzog and Shier (2000) used a sample of students to assess a variety of buildings. The students were also asked for their building preferences. Using a composite measure of complexity (including visual richness, ornaments, curves, contoured walls, texture variation and fancy windows), they found that after adjustment for differences in maintenance, higher complexity is preferred over lower complexity. In their review, Turley and Milliman (2000) found that only a few studies had examined the influence of exterior architectural design factors on customer behaviour; however, all these studies suggested that exterior architectural design factors are of importance. In contrast, Kent and Kirkby (2009) suggest that exterior architectural design factors are not very important in the formation of a retail image by consumers. In this study, the design of the building created a space that was valued, but the exterior design was not

significant in the construction of a retail image in such a way that respondents identified a particular style. Zielke and Toporowski (2009; 2012) investigated the negative effects on price perception of shop atmospherics by comparing a shop with conventional exterior design architecture with a shop with an 'appealing' exterior design architecture. They found that in the absence of price and brand information, the students interpreted appealing exterior architecture as a cue for higher prices. However, if brand or particularly price information was available, then there was no longer a difference in price perception between conventional and appealing architecture.

Accessibility: Turley and Milliman (2000) reported that accessibility was not included in many studies, but the few researchers who did, found that this is important to consumers. Thang and Tan (2003) included accessibility with other exterior variables like merchandising, promotion, facilities and services, and found that accessibility ranked high. Pan and Zinkhan (2006) conducted an extensive literature search and were able to include in a meta-analysis 45 studies that involved determinants of repatronage behaviour. They found that levels of services and accessibility were all significantly related to the repatronage behaviour of customers. Repatronage behaviour is to be considered a kind of approach behaviour (Mehrabian & Russell, 1974).

2.2. General interior factors

The general interior factors summarized by Turley and Milliman (2000) are music, olfactory stimuli (including tobacco smoke), colour and floor coverings. The colour and materialization of a shopping mall are interrelated, as for instance brickwork introduces a certain colour. Another important general interior factor is daylight ingress, or more generally lighting, including both daylight and the shopping mall's artificial lighting.

A colour's hue or gradation is determined by its wavelength. Short wavelengths are associated with 'cool' colours, and long wavelengths with 'warm' colours. Cool colours (purple, blue, green) were found to be preferred over warm colours like yellow or red (Mehrabian & Russell, 1974; Yildirim, Akalin-Baskaya, & Hidayetoglu, 2007). However, Mehrabian and Rusell (1974) found that people's muscle activity responded more quickly to red than to green. Brengman and Geuens (2004) showed that light colours stimulate consumers to explore the environment, and that these colours were preferred over dark colours. In a passenger area, cool colours might be preferred to warm colours, as these colours will calm people who may have higher stress levels than usual (Mehrabian & Russell, 1974; Stone, 2003). In contrast, recreational shoppers found a red environment more pleasurable; this resulted in more approach behaviour in recreational shoppers compared to a blue environment, whereas no such effect was observed in task-oriented shoppers (van Rompay, Tanja-Dijkstra, Verhoeven, & van Es, 2012). Much of the colour research in retail concentrates on the effects of a colour's hue, and neglects the other two dimensions of colour, namely saturation and value. Saturation refers to the intensity or amount of pigment in a colour; value refers to its darkness or lightness (Labrecque, Patrick, & Milne, 2013).

Saturation, but not value was found to have an effect on excitement: the more saturation, the higher the excitement (Labrecque & Milne, 2012). However, it has long been recognized that the perceived height of a room increases with increasing ceiling value or lightness. Rooms also appeared higher when the lightness of the walls was increased, and the effects of ceiling lightness and wall lightness were generally found to be additive (Oberfeld, Hecht, & Gamer, 2010). It had traditionally been thought that the perceived height of a room was influenced by the lightness contrast between walls and ceiling, and that this finding might be used to influence the perceived height of a ceiling according to the kind of activities that take place in a space (Baird, Cassidy, & Kurr, 1978).

Empirical evidence on materialization is almost entirely lacking (Turley & Milliman, 2000). Rutkin (2005) studied the influence of several architectural design characteristics on preferences for hotel lobbies, using sketches of a hypothetical lobby. She found that the scale of the lobby, the materials used, access to daylight and views, and seating type and arrangement had a clear relationship with the overall preference for spaces.

In addition to colour and materialization, another important characteristic that contributes to the atmospheric is lighting (Turley & Milliman, 2000). Warm lighting might even overcome the rather negative effects on consumer behaviour associated with warm colours like orange (Babin, Hardesty, & Suter, 2003).

2.3. Layout and design factors

A considered layout of terminal buildings will help passengers to orientate themselves. Bitgood and Dukes (2006) argued that economy of movement is a powerful empirical principle in understanding the way passengers walk through terminal buildings. From the right-hand side, passengers will either continue straight ahead or turn right; from the left-hand side, they will turn left or walk straight ahead. If it is economical (i.e. if it takes less effort), they will cross to the other side. This results in asymmetric walking patterns and different routes when traveling between two locations, depending on which location is the origin and which is the destination (Yang & Schwaninger, 2011). Yang and Schwaninger (2011) showed that in addition to this asymmetry in walking patterns, passengers prefer the route whose initial direction is towards the destination, and avoid routes whose initial direction is not towards the destination. Buechner, Wiener & Hölscher (2012) used eye-tracking data to show that respondents primarily attend to the signs straight ahead of them. In general, orientation is easier where there is a straight layout, as passengers can see where they are going to (Spies, Hesse, & Loesch, 1997). Wayfinding inside an airport involves using environmental clues. Airport terminals are generally considered complex buildings, but architectural design make spatial orientation and wayfinding easier by providing passenger areas with wide open dimensioning, which contrasts with the low ceiling areas containing security and immigration. This induces a sense of relaxation, encouraging passengers to spend money in the commercial parts of the terminal building (Fewings, 2001).

In designing passenger areas, there might be a tension between the need to facilitate airport logistics and the need to maximize commercial revenues. These different aims of the organization add to the complexity of the service environment (Bitner, 1992). According to Bitner (1992), space/function (e.g. layout) and signs, symbols and artefacts are major composite dimensions of the service environment affecting passenger behaviour. Wakefield and Baker (1998) showed that the layout that would support logistics the most – that is, a straight layout (an I or L shape) facilitating orientation and wayfinding – was less interesting to consumers than the star layout, whereby one cannot see the end of the hallway. Better layout and signage made passengers feel more at ease, but did not result in consistent approach behaviour (Ang, Leong, & Lim, 1997). To some extent, similar findings were found in a qualitative study using a more holistic approach to examine the role of atmospherics in the creation of an hedonic shopping experience (Ballantine, Jack, & Parsons, 2010). Too much or too little space had negative effects, and the perception of space adequacy was also related to levels of clutter in the shop. A proper use of signage might be a solution. Signs and the number of level changes were found to be important indicators of orientation at an airport (Churchill, et al., 2008; Fewings, 2001). Correia, Wirasinghe & de Barros (2008b) showed that passengers evaluate orientation as being amongst the three most important determinants of an airport's level of services.

2.4. Point-of-purchase and decoration factors

Most of the studies focused on product displays and point-of-purchase information, as well as promotional signs, while neglecting greenery and other decoration factors like art works (Brengman, Willems, & Joye, 2012; Turley & Milliman, 2000). Yet, greenery might have a restorative effect on passengers, particularly those who are already experiencing strain from the journey to the airport or from an earlier flight, the check-in and security checks, etc. (Joye, Willems, Brengman, & Wolf, 2010). Brengman et al. (2012) recently reported evidence of the restorative effects of in-store vegetation. They found that foliage in a complex servicescape, but not in a lean servicescape (Bitner, 1992), elicited feelings of pleasure and reduced stress in passengers, and influenced their approach and avoidance behaviour in a favourable way. They further showed that the impact of integrating greenery in complex shop environments on approach and avoidance intentions was fully mediated by its impact on feelings of pleasure and stress.

2.5. Human factors

Turley and Milliman (2000) included in this category the personal characteristics of both personnel and consumers, and crowding.

In recent decades, environmental design researchers often used the theoretical framework of Russell and Mehrabian (1977) that physical and social stimuli in the environment directly affect the emotional state of a passenger, thereby influencing his or her

behaviours in it. The environment might elicit an emotional response consisting of three main emotional dimensions, namely pleasure (ranging from happiness to unhappiness), arousal (denoting a combination of physical activity and mental alertness, ranging from sleepy to frantic) and dominance (ranging from extreme feelings of lack of control to feelings of being influential and powerful). They argued that these three dimensions were both necessary and sufficient to describe any emotional state. However, the justification of dominance as an independent emotional state has been disputed (Donovan, Rossiter, Marcoolyn, & Nesdale, 1994; Yani-de-Soriano & Foxall, 2006). According to Yani-de-Soriano and Foxall (2006), dominance depends on the openness of the consumer behaviour setting. Relatively closed settings increase the avoidance behaviour of consumers, and vice versa.

The physical environment might influence not only someone's emotional state, but also his or her decision-making process. Puccinelli, Goodstein, Grewal, Price, Raghubir, and Stewart (2009) derived from their review of consumer behaviour literature that specific elements of consumer behaviour play important roles during various stages of the consumer decision-making process. Goals influence consumers' shopping behaviour, their satisfaction with the shopping experience and their perception of the shopping environment. Goals help to structure information and provide the context for organizing knowledge into a scheme to memorize. Goals might be considered central to a network of information. Attitudes and affect are part of this network of associations, as well as very meaningful cues in the shopping environment (Puccinelli, et al., 2009).

Crowding is considered a human variable (Turley & Milliman, 2000). It is distinguished from density, which is the objective measure of the number of persons or objects in a space (Stokols, 1972). If density restricts or interferes with someone's goals and activities, the environment will be perceived as crowded (Eroglu, Machleit, & Barr, 2005); the strength of this effect might differ among individuals. This kind of perceived crowdedness is referred to as human crowding, as opposed to spatial crowding. Spatial crowding perceptions are based on the density of the spatial configuration in a space (Machleit, Kellaris, & Eroglu, 1994). The effect of spatial crowding appears to be mediated by emotion and goal-setting behaviour (hedonic or utilitarian shopping goals) (Eroglu, et al., 2005; Machleit, Eroglu, & Mantel, 2000). There is some evidence that the shop layout (grid, free-flow layout and presence of aisle tables) rather than ceiling height accounts for the perceived spatial crowdedness (Lee, Kim, & Li, 2011). The relationship between satisfaction and perceived human crowding seems to be rather weak (Eroglu, et al., 2005; Lee, et al., 2011; Machleit, et al., 2000), but there is suggestive evidence that there might be a positive relationship between perceived human crowding and satisfaction after adjusting for the influence of spatial crowdedness (Eroglu, et al., 2005).

3. Measuring passenger preferences

In this section, we introduce the general methodology used for quantifying consumer preferences in the design of airport passenger areas. In both marketing research (Kuhfeld,

2010) and engineering design research (Orsborn, Cagan, & Boatwright, 2009), utility functions have been successfully employed to relate characteristics of a designed space to passenger preferences. A utility function is a tool used by economists to describe a person's utility, that is, the measure of satisfaction gained by using a certain good or service. A benefit of a utility function is that it can represent a complex space in which many 'design factors' or 'attributes' each account for a dimension. A utility function offers a means to describe the relationship of all these attributes to a person's utility (Orsborn, et al., 2009). In evaluating a set of multiple attributes, a person will maximize his or her personal utility function, and therefore utility functions can be used to determine an optimal set of trade-offs (Kuhfeld, 2010; Orsborn, et al., 2009).

In measuring the utility for a product, one can distinguish between the revealed and the stated preference method (Adamowicz, Louviere, & Williams, 1994). The former is based on observation of the actual choices made by households and individuals, and it assumes that people reveal their preferences by their actions. However, an evaluation of existing settings would not easily relate passenger preferences to utility functions, because revealed preferences research only captures peoples' opinion on economic goods, like product pricing (Hanley, Wright, & Adamowicz, 1998). As we were interested in quantifying design characteristics that capture aesthetics in a relatively realistic task by asking passengers to choose from a set of pictorial representations, we asked passengers for their stated preferences. We used images to avoid the problem of presenting semantic scales to passengers about attributes that are usually visualized to show what these are like. Semantic scales have been used at airports to investigate preferences for passenger areas, but they were not sensitive enough to identify differences in preferences for distinctly designed passenger areas amongst visitors.

Some stated preference methods require respondents to rank or rate alternatives according to their preferences. There are a number of disadvantages associated with the use of these methods as a means to obtain preference data (Hensher, Rose, & Greene, 2005). The first problem is the arbitrarily choice of the scale: why choose a 10-point rating scale and not a 100-point scale, or vice versa? Even on an 11-point scale, it makes a difference whether the anchors are assigned the numbers [0,10] or [-5,5] (Fischhoff, 2005). Another issue is that all respondents are assumed to use the scale in a similar cognitive way. However, it might well be that one respondent rates an alternative with a 6, whereas another respondent actually values it the same but applies a 5. Third, the most common way to analyse these data is by means of regression analysis with the rating or ranking as dependent variable. Although ratings may best be assumed to be interval scaled, they are most likely ordinal scale variables. Rankings are by definition measured on an ordinal scale. Although commonly applied, using such data as the dependent variable in regression analysis violates the requirement that the dependent variable be continuous (Hensher, et al., 2005). Furthermore, ranking or rating alternatives according to one's preferences does not necessarily imply that this preference translates into a choice. Choosing between alternatives overcomes this problem, and it addresses the criticism that there may be cognitive/perceptual differences between two respondents. If two respondents value a passenger area in the same way, this will be clear from their choice, whereas their rankings or ratings might be different (Hensher, et al., 2005).

A common way to assess preferences is therefore the two-alternative or referendum question. This so-called contingent valuation choice method is to be distinguished from the discrete choice experiments. A discrete choice experiment is a sequence of multinomial choice questions (Adamowicz, Boxall, Williams, & Louviere, 1998). Discrete choice experiments are characterized by two elements. First, a respondent is asked to make a discrete choice between two or more discrete alternatives in a *choice set*; second, the alternatives in a choice set are constructed by means of an *experimental design* that varies one or more attributes within and/or between respondents in such a way that information related to preference parameters of an indirect utility function can be inferred (Carson & Louviere, 2011; Kuhfeld, 2010). There is some evidence that discrete choice experiments are better in estimation and provide a better understanding of the choices made by respondents than the contingent valuation method using a referendum approach (Mogas, Riera, & Bennett, 2006).

4. Pilot study

The literature review revealed the potential importance to the design of passenger areas of exterior and interior architectural design characteristics, along with layout and design factors, point-of-purchase and decoration factors, as well as human factors. However, it did not provide sufficiently detailed information about these factors, particularly not regarding exterior architectural design factors. We thus decided to do an explorative study into customer preferences regarding passenger areas. We were also keen to involve practitioners in the field in order to draw upon their expertise. We therefore conducted a pilot study and interviewed experts before deciding which main design characteristics to use in the further study. We conducted interviews with 11 experts, most of whom work at Schiphol airport. The interviewees comprised three architects, three design and styling experts, four general managers/directors and one developer/consumer.

During the interviews, the interviewees were first asked to rank the importance of the design of the passenger areas relative to other factors that potentially influence the atmospherics of the passenger areas. These factors, which were taken from the literature review and based on the researchers' own ideas, were (ranked according to their revealed importance): 1. safety; 2. hygiene; 3. design of the space; 4. indoor climate; 5. customer friendliness; 6. crowding; 7. presence of catering; 8. comfortable seating; 9. kind of shops; 10. presence of other services like toilets; 11. number of shops; 12. price level of catering and shops; and 13. size of retail area. Participants were given two blank cards on which they could provide additional characteristics of importance. The features added in this way were: the distinctiveness of Holland, selling novelties and specialties, variation and differentiation in the impression of the space, overview, and speed of the logistic process. Although we provide a ranking, agreement between experts was rather low (Kendall's W = 0.47).

Second, experts were asked to rank specified architectural design characteristics according to their importance. These characteristics were taken from the literature review and based on the researchers' own ideas. There was only moderate agreement amongst the experts

on the importance of architectural design characteristics (Kendall W=0.53). In order of revealed importance, these were: 1. overview (which in Dutch embraces both the presence of visual lines and spatial crowding); 2. lighting; 3. transparency (ingress of daylight through the ceiling and the transparency of used materialization); 4. colour; 5. materialization; 6. distinctiveness; 7. greenery; and 8. decoration. Using two more blank cards, the interviewees also mentioned additional characteristics that could be of relevance. These were the identity/authenticity of Holland, form (curved), odour, acoustics, and the feel of furniture.

5. The current study

5.1. Methods

5.1.1. Participants

The participants consisted of 346 passengers at Schiphol airport. Passengers in the departure area were intercepted after clearing security and immigration to ensure that they were in a more relaxed mood. Similarly, transfer passengers were intercepted after they had left their planes and entered the transfer area. Departure and transfer passengers were separately sampled using the same sampling protocol, as immigration and security measures prevented them from accessing the other passenger areas. Using an interceptive random approach, 1500 passengers were asked to participate in the study; a total of 346 (23%) agreed to participate. There were 196 passengers from the departure area and 150 transfer passengers.

Table 1 summarizes the descriptive characteristics. Of all passengers involved, 56.4% were from Holland, while 43.6% were from abroad. The average age of the passengers was 34.5 years (95%Ci: 33.1–36.0). Most of the respondents were between 20 and 39 years (51.4%); 12.7% were younger than 20 years; 34.1% were between 40 and 64 years, and 1.7% were 65 years or older. There were no significant differences (p>0.05) in age between departure and transfer passengers.

Most (78%) of the passengers were travelling for recreational purposes; only 22% were travelling for business. The destination of 52.6% of the passengers was within the European Union.

Passengers were asked for their highest completed educational level, either according to Dutch standards (for passengers who filled out the Dutch version) or according to the following levels: primary education, lower/intermediate secondary education, higher secondary education, junior/intermediate vocational education, senior vocational education, higher professional education, university. The grading in educational answering categories was designed so that passengers could easily find the appropriate answer, but this yielded low cell counts in some cells. Therefore, primary education, lower/intermediate secondary education and higher secondary education were recoded into low level of education; junior/intermediate vocational education and senior vocational education were recoded into medium level of education; the remainder were recoded into high level of education. There

were no significant differences (p>0.05) in education between departure and transfer passengers.

Gross annual income was asked for in 5 answer categories: less than €20,000, €20,000–€30,000, €40,000–€50,000, over €50,000 and no answer. There were no significant differences (p>0.05) in income between departure and transfer passengers.

5.1.2. *Materials*

We used discrete choice experiments to measure respondents' preferences for design characteristics of passenger areas (Kuhfeld, 2010). As explained by Kuhfeld (2010), we used a multinomial logit (MNL) model to estimate the design factors (or 'attributes') from the choices the respondents made from the alternatives.

We first developed an experimental design in SAS. To prevent an overload of information in the discrete choice experiments, and following Miller (1956), we decided to limit the number of attributes to 7 plus or minus 2. We finally decided to use 8 attributes with 2 or 3 attribute levels, as this number of attributes allowed us to develop a 100% efficient fractional factorial design with only 72 images. We did not use the full factorial design, because there would have been as many as 384 unique images possible, using 7 attributes with 2 levels and 1 attribute with 3 levels (2*2*2*2*2*2*2*3). Moreover, in the questionnaire, respondents were asked to choose between two images of a passenger area in a discrete choice set (see Figure 1). With this number of images, there are 73,536 ((384*384)/2) unique pairs to make. We thus used an algorithm that optimized the number of pairs using an efficient fractional factorial model derived in SAS (Kuhfeld, 2010). We found that the optimal number of discrete choice sets of two images each would be 36. Since we considered this too much for one person to deal with, we made three versions of the questionnaire with 12 discrete choice sets each. In the questionnaire, respondents were randomized into one of the three versions of the questionnaire. From the experimental design we obtained a detailed prescription of what attribute levels should be present in each image of a choice set, and such for all choice sets in the three versions of the questionnaire.

We aimed to develop discrete choice experiments without using semantic information in the conceptualization of the attributes, because previous research at Schiphol airport appeared to be not sensitive enough to measure differences in preferences regarding architectural design characteristics. The results of the literature review and the outcomes of the pilot study were considered in deciding about the attributes to be visualized in the images. Characteristics such as odour and acoustics were therefore discarded. Following the classification of Turley and Milliman (2000), we decided to conceptualize form as exterior architectural design factor; colour, materialization and lighting as interior architectural design factors; layout, dimensioning and signage as layout and design factors; and greenery and the distinctiveness of Holland as point-of-purchase and decoration factors. Human factors were assessed in a separate part of the questionnaire.

This set of factors covered the major ones mentioned in both the literature review and the pilot study. In the pilot study, overview was mentioned as the most important factor, and since this has at least partly to do with layout and dimensioning, we decided not to include this as a separate factor. Transparency was also considered important in the pilot study. We therefore tried to visualize the transparency of materialization, but since we were not satisfied with the conceptualization and because we had to omit one design factor due to the limitation of the experimental design of the discrete choice experiments, we left out this factor in the further development of the discrete choice experiments. The distinctiveness and the identity/authenticity of Holland were combined into a single decoration factor. Table 2 describes for all eight architectural design characteristics the two or three levels of each attribute visualized in the further research. We used Google SketchUp and Photoshop to visualize all eight design characteristics, employing different layers for each attribute level.

Exterior architectural design factor. Form was elaborated in the roof construction, as either a *curvilinear* or an *orthogonal* roof. The terminal buildings of Schiphol airport have orthogonal roof constructions, but some other European airports apply curvilinear roof constructions (see also Figure 1).

Interior architectural design factors. Regarding colour and materialization, some of the results in the literature review stem from laboratory studies that were readily able to distinguish between colour and materialization. In designing a passenger area, however, colour and materialization might be closely related. Materialization like glazing is considered a 'cold' colour, whereas the application of wood is associated with a warm colour. Therefore, in addition to white and dark colouring, a third level was included in which wood colours were applied. The three levels were defined as follows: the *white level* was visualized with a light-coloured floor, shop atmospherics and roof (see Figure 2 and also the left-hand image in Figure 1); the *black level* was visualized with a dark-coloured floor, shop atmospherics and roof (Figure 2); the *wood level* had a warm-coloured floor, and wood colours were used for the shop atmospherics and roof (see Figure 2 and also the right-hand image in Figure 1). For the third interior design factor – lighting – two settings were applied in Photoshop. In the first level, *cold lighting*, without additional atmospheric lighting, was used. The other setting, *warm lighting*, had a warm orange lighting with additional atmospheric lighting. The difference between 'warm' and 'cold' lighting is illustrated in Figure 2.

Layout and design factors. In the images, layout was elaborated as a *straight layout* (see the right-hand image in Figure 1) or a *curved layout* (the left-hand image in Figure 1). For dimensioning, two levels were chosen: *narrow*, which was based on the minimum width (5 metres) as currently present at Schiphol airport; and *wide*, which is the maximum width (25 metres) at the airport (see also Figure 4: wide dimensioning in the left-hand image, narrow dimensioning in the right-hand image). Signage was conceptualized either as *no signage* or *signage*, in which case there were signs referring to gates, along with a clock and a flight information panel as currently applied at the airport (see also Figure 1 both images).

Point-of-purchase and decoration factors. The first of these two factors – greenery – was conceptualized by *no greenery* or *greenery* by omitting plants from or inserting some

plants in the images. The second factor – the distinctiveness of Holland – was conceptualized using the way Schiphol airport emphasizes its authenticity. At the airport, this theme is present in artworks, a round yellow (Dutch) cheese, an artwork referring to a clog, big cows and Delft blue tiles. In the images, the distinctiveness of Holland either was present as visualized by using the cow as found in the departure areas, and the Delft blue tiles (level labelled as *Holland;* see Figure 1), or there was no such reference (level labelled as *indifferent*).

Human factors. Pleasure and arousal were measured via semantic differential affective adjective pairs regarding their emotional state (pleasure: 6 word pairs, alpha reliability=0.89; arousal: 6 word pairs, alpha reliability= 0.73). Both arousal and pleasure were measured on a 7-point (L+++, L++, L+, 0, R+, R++, R+++) semantic differential scale (Brengman, 2002; Brengman & Geuens, 2004). We left out the dominance dimension, since the justification of dominance as an independent emotional state had been disputed (Donovan et al., 1994), although more recently others have again focused on dominance (Yani-de-Soriano & Foxall, 2006). However, dominance still has a rather low alpha (Brengman & Geuens, 2004) and also considering the length of the questionnaire, we decided to leave out dominance. As we argued before, constructs like arousal and pleasure are ordinal scaled measures. Therefore, in the further analyses pleasure and arousal scores were dichotomized using the median as threshold. In addition to the 12 discrete choice questions, additional data were collected on demographics, travel information and shopping behaviour at the airport.

5.1.3.   *Procedure*

Data were collected with a laptop during two consecutive weeks in June 2008 at Schiphol airport. During the first week, data were collected in the departure area, and in the second week they were collected in the transfer areas. Two stands with two laptops with internet access and two interviewers were positioned in the passenger areas. One of the interviewers was present throughout the two weeks; the other interviewer was a Schiphol airport employee, and this position was taken by several employees.

A total of 346 respondents filled out either the Dutch version (n=205) or the English (n=141) version of the questionnaire. The average time to complete the questionnaire was 12.5 minutes. Although both departure and transfer passengers were sampled in consecutive weeks, and using the same study protocol, we carefully checked for significant differences between the two groups in order to detect unintended bias. We did not find significant differences between the two samples in demographic information. Nor did we find a significant interaction of the samples with the individual attributes using multinomial logit modelling. All interactions of sample with attributes had p-values of $p>0.24$. We therefore decided to handle both samples as one sample in the further analyses.

Results were analysed in SAS 9.2. SPSS 18.0 was used in additional analyses. Multinomial logit models were used to model the relationships between a polytomous

response variable and a set of regressor variables. Multinomial logit models are a broad class of models. Generalized logit and conditional logit models were used to model customer choices. The generalized logit model was used to analyse the choices as a function of the characteristics of the individual making the choice. In SAS, the CATMOD procedure directly fits the generalized logit model. Therefore, CATMOD was used to analyse an interaction between samples and choice behaviour. The conditional logit model was used to analyse the choice among the two alternatives as a function of the 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. This model was used to analyse the influence of the attributes. A mixed model was used to study how choice depends on both attributes and individual characteristics like pleasure, arousal and age (Kuhfeld, 2010). A threshold of $p < 0.05$ was generally used in significance testing of the main effects. Interactions were considered significant at a significance level of $p < 0.01$.

5.2. Results

5.2.1.   Architectural design characteristics

As explained, we employed utility functions to relate architectural design characteristics to passenger preferences. The choice patterns of all passengers were analysed using the conditional multinomial logit model. This model assumes that the passengers make choices from the alternatives that maximize their perceived utility. In Table 3, for all eight attributes that were systematically varied in the images, the importance of the selected attributes in choosing the passenger area that was most attractive to them is shown as the estimated utility of all eight factors. The higher the estimated absolute utility, the more weight the characteristic has in deciding about attractiveness. For example, form shows the highest estimate for the utility (0.78), meaning it is the most important attribute in choosing the most preferred passenger area. The reference level of form is orthogonal, which means that a curvilinear form (i.e. a curvilinear roof construction) is more preferred than the orthogonal form. The hazard ratio (HR) is 1.0 if both alternatives are equally preferred. The HR shows that the impact an attribute has on the choice profile likelihood. It is more than twice as likely that the image – representing a profile of architectural design characteristics – will be chosen if the form of the roof is curvilinear than if it is orthogonal. Table 3 shows that passenger preferences were significantly dependent on all design characteristics, except for signage.

The utility estimates are relative estimates, and if the 95% confidence intervals of the HR do not include the utility estimate of one of the other attributes, this can be used to cluster the attributes according to their influence on passengers' choices. Figure 3 shows the attributes ordered from most influential to not influential. The two architectural design characteristics that most strongly influence passenger preference are form and one of the colour schemes. Passengers prefer the form of a curvilinear roof over that of an orthogonal

roof (0.78), and clearly prefer the use of white materials over black materials (0.77). Passengers also preferred wood-coloured materials over black materials (0.37), but not as much as they preferred white materials over black materials. A curved layout is another design characteristic that is more important than dimensioning, wood-coloured materials, use of warm lighting and no decoration underscoring the distinctiveness of Holland, but its impact is comparable to that of greenery. In general, passengers preferred an area with a curvilinear roof, a curved hallway, the presence of greenery, no decoration emphasizing the distinctiveness of Holland, the use of warm lighting, a wide dimensioning and an emphasis on white materials (i.e. a white floor, shop atmospheric and roof). Figure 4 (left-hand part) shows the most preferred passenger area. The right-hand part of Figure 4 shows the least preferred design of a passenger area.

5.2.2.   Influence of human factors on architectural design characteristics

The influence of the emotional state of mind (i.e. pleasure and arousal) on passenger preferences was assessed. The average sum score was 32.90 (sd=6.52) for pleasure and 23.25 (sd=5.64) for arousal. Further analyses were done with the dichotomized scores for pleasure and arousal using a mixed logit model. Passengers reporting high levels of pleasure preferred warm lighting much more than did passengers with low levels of pleasure (HR=0.77; X^2=9.95, df=1, p < 0.01). No such relations were found for arousal. Neither pleasure nor arousal affected passenger preferences for further architectural design characteristics.

5.2.3.   Influence of demographics on preferences for design

Relationships between demographics and colour and lighting. In general, white or wood-coloured materials were preferred to black materials. However, male respondents appreciated black or wood-coloured materials in a passenger area much more than white materials (interaction between men and black materials: HR=1.44; X^2=8.79, df=1, p < 0.01; interaction between men and wood-coloured materials: HR=1.41; X^2=7.60, df=1, p < 0.01).

In addition, Dutch and transfer passengers preferred white to black materials much more than did foreign passengers (HR=0.66; X^2=11.90, df=1, p < 0.01) and passengers who were starting their journeys at Schiphol airport as compared to transfer passengers (HR=0.54; X^2=22.01, df=1, p < 0.01), respectively. For wood-coloured materials, similar findings were found for departure passengers compared to transfer passengers. The former valued the wood-coloured passenger area much more than the black area, relative to transfer passengers (HR=0.68; X^2=7.71, df=1, p < 0.01). Thus, in general both a white and a wood-coloured area were preferred to a black one, especially among women and departure passengers.

Departure passengers not only valued white and wood-coloured materials more strongly than did transfer passengers, but also more strongly preferred warm lighting over cold lighting than did transfer passengers (HR=0.68; X^2=12.52, df=1, p < 0.01).

6. Discussion

The aim of this study was to investigate how design characteristics were valued by passengers, using a questionnaire with visualizations of a hypothetical passenger area with retailers at a main airport. In general, passengers had a clear preference for a wide passenger area with curved hallways, a curvilinear roof, the use of a light-coloured materials for the floor, shop atmospherics and roof, along with warm and atmospheric lighting. Greenery was missed by passengers, and as this adds to a sense of comfort, this may be one way to increase revenues from commercial activities. In contrast to the situation at the time of the study, passengers more often preferred no decoration reflecting Dutch identity in the passenger areas, than a clear reference to the distinctiveness of Holland.

Signage was the only design characteristic that was not involved in passengers' decision-making about which area they preferred. One possible explanation might be that signage is a different feature, important for logistics but not for the perception of spaces and atmospherics. Another explanation might be that passengers first found out where they had to go before spending time on anything else. In evaluating the perception of the passenger areas, the signs might be therefore irrelevant to them.

We found no influence of arousal levels on preferences for a hypothetical passenger area, but we did find an influence of pleasure on the perception of architectural design characteristics, namely colour and lighting. Passengers most preferred white and wood coloured materials, and passengers with high levels of pleasure preferring them even more, confirming the results of others (Babin, et al., 2003; Brengman & Geuens, 2004; Van Hagen, Peters, Galetzka, & Pruyn, 2008) that someone's affective state influences preferences for colour and lighting in a retail or waiting space. Our results are also in line with findings that cold colours have a different affective connotation than warm and dark colours (Crowley, 1993; Yildirim, et al., 2007).

However, whereas Brengman (2002) and Babin et al. (2003) found an influence of both arousal (excitement) and pleasure (evaluation), we found only an influence of pleasure, as did Van Hagen et al. (2008). Since the airport tries to reduce stress and increase the sense of wellbeing in order to enhance spending behaviour, this might explain the lack of influence of arousal on the valuation of the design characteristics of the hypothetical passenger area. The relative absence of negative stimuli and the relative presence of positive stimuli creates an experience associated with hedonic consumption (Arnold & Reynolds, 2012). Since Van Hagen et al. (2008) studied passenger perceptions in a waiting room of a railway station, the situation might to some extent be comparable to the setting in the current study.

At first sight, our findings seem to be at odds with those of Chebat and Morrin (2007). Although they found that mall decor colour schemes significantly influenced shoppers' perception of the mall and their appraisal of the product quality, they did not find an influence of pleasure (or arousal) on mall perception and appraisal of product quality. They concluded

from this that the effect of atmospheric mall decor colour schemes on consumer perceptions may be largely driven by cognitive rather than affective mediational routes. However, Chebat and Morrin (2007) used green trees and plants in the cold-coloured scheme, and yellow and red flowers and curtains in the warm-coloured scheme. Although they did not use visualizations but manipulated the mall itself, they did a pilot study using photos changed accordingly in Photoshop and found comparable results to their main experiment in the shopping mall. We, however, systematically added green plants to our images or omitted them. The presence of greenery made an important difference in our study. Passengers felt more attracted to passenger areas decorated with greenery than to those without greenery, which accords with the results of Chebat and Morrin (2007). We also did not find an interaction of pleasure and arousal with greenery, but as mentioned, we did find an influence of pleasure on passenger preference for the colour of materials. It would be interesting to further investigate whether the effects of colour and lighting, but not the effects of greenery, might be mediated by affective rather than cognitive routes (Chebat & Morrin, 2007; Morrin & Ratneshwar, 2003).

Our study underscores the importance of assessing several architectural design characteristics simultaneously. As mentioned by, for instance, Babin, Chebat, and Michon (2004) and Babin et al. (2003), the implicit assumption of several studies that environmental cues affect consumer behaviour in isolation from other clues, seems to be invalid. Babin et al. (2003) reported combined effects of colour and warm (soft) lighting, as we also found: both colour and lighting added to the valuation of the passengers. The importance of our study is that we addressed several environmental clues simultaneously, so that we could investigate their relative values.

Our results emphasize the importance of architectural design features like form, layout and dimension. We found that these characteristics – namely a curvilinear roof construction and a wide and curved hallway – were relatively strongly valued compared to characteristics like lighting or a decoration factor reflecting the distinctiveness of Holland. It is therefore quite remarkable that in retail atmospheric research the focus seems to be on interior design and that the relevance of architecture is generally ignored. Only Rutkin (2005) did a study into the relevance of several architectural design characteristics on preferences for hotel lobbies, using sketches of a hypothetical lobby. She found a clear relationship of the scale of the lobby, the materials used, access to daylight and views, and seating type and arrangement with the overall preference for spaces.

Finally, we should like to emphasize the possible importance of culture in the valuation of design. In this study, we found some evidence of cultural differences in the way particularly coloured materials are appreciated. Dutch and transfer passengers preferred a white to a black passenger area much more than did foreign passengers, as did passengers who started their journeys at Schiphol airport compared to transfer passengers. The differences might be partly related to the differences between the departure area and the transfer area, as there was a black floor with a sparkled effect in the former and not in the latter. The transfer area had a light-coloured roof and light-coloured floor tiles. Passengers had the possibility to comment in a closing question and some mentioned that they liked this

floor in the departure area. However, about 25% of the departure passengers were from the transfer area and were thus transfer passengers. Another explanation might be that the valuation has to do with the way the characteristics were visualized. Although this applies to all of the characteristics, it might well be that there was too much black with a black floor, a black roof and somewhat darkened shops fronts in the images. Nevertheless, we recommend that in designing or redesigning a passenger area, much more attention should be paid to the cultural background of those for whom the passenger area is intended, although this issue also needs further research.

7. References

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Figure 1 Example of a choice question in the questionnaire. The left image shows a curvilinear roof, a curved layout, a wide dimension and light (white) colours/materialization; the right image shows an orthogonal roof, a straight layout, a minimum dimension and warm colours/materialization.
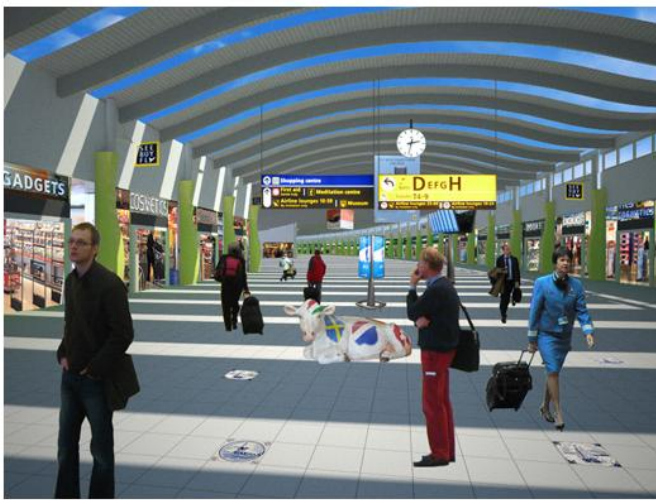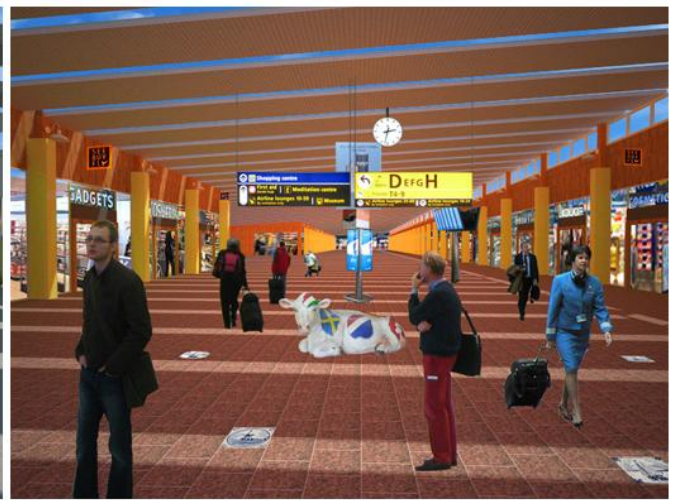
Figure 2 Overview of the different levels for Colour and Lighting. The white level of Colour was visualized with a light-coloured floor, shop atmospherics and roof (top row left-hand side); the black level was visualized with a dark-coloured floor, shop atmospherics and roof (top row right-hand side); the wood level had a warm-coloured floor, and wood colours were used for the shop atmospherics and roof (see bottom row right-hand side). Lighting was visualised as cold lighting (bottom row left-hand side, together with the white coloured materials, or as warm lighting (top row left-hand side, same white coloured materials).
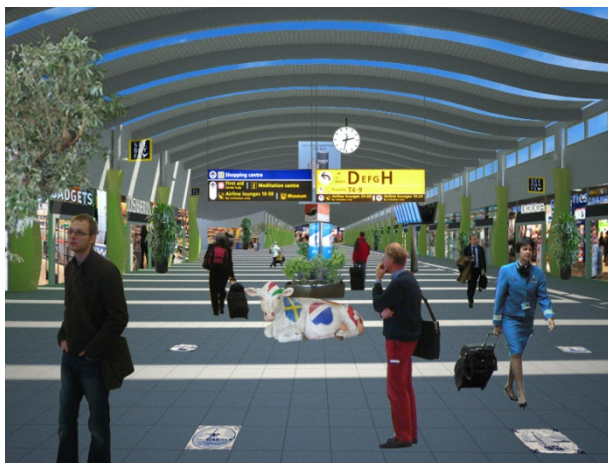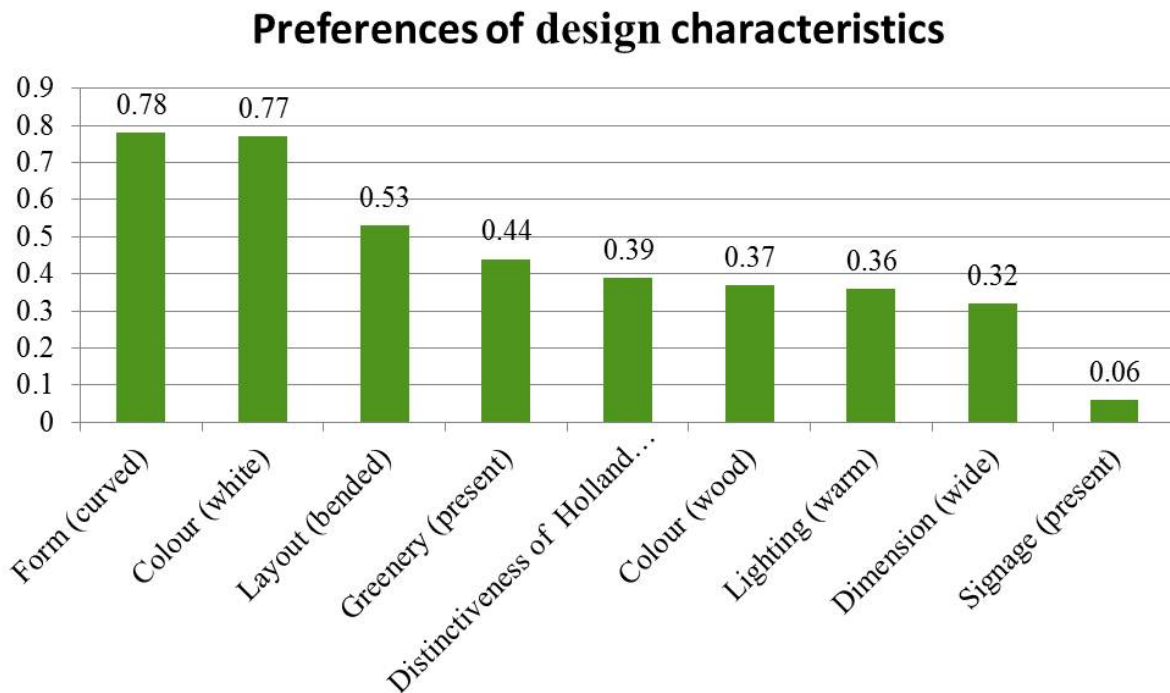
Figure 3 Passenger preference for design characteristics

Figure 4 Left: the most preferred passenger area; right: the least preferred passenger area. The most preferred passenger area would be a wide one with a curved layout and a curvilinear roof; a light-coloured floor, shop atmospherics and roof, along with warm and atmospheric lighting; the presence of greenery; and no reference to the 'distinctiveness of Holland' (no cow or no Delft blue tiles, as in the left-hand image).

Table 1 Descriptives of the total group (N=346), the departure passengers (N=196) and the transfer passengers (N=150)

8.	%	Mean	95% CI
Age[a]			
Total group		34.5 yrs.	33.1–36.0 yrs.
Departure passengers		34.3 yrs.	32.4–36.2 yrs.
Transfer passengers		34.8 yrs.	32.6–37.0 yrs.
Gender[a]			
Total group	♀ 39.3%		
Departure passengers	♀ 40.8%		
Transfer passengers	♀ 37.3%		
Education[a]			
Total: low	13.9%		
Total: medium	16.2%		
Total: high	67.9%		
Departure: low	16.1%		
Departure: medium	13.0%		
Departure: high	70.8%		

Transfer: low	11.6%
Transfer: medium	21.1%
Transfer: high	67.3%

[a] Differences between departure and transfer passengers are not significant at $p < 0.05$.

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

Design characteristic	Level 1	Level 2	Level 3
1. Form	Orthogonal	Curvilinear	
2. Layout	Straight	Curved	
3. Dimension	Wide	Narrow	
4. Colour	White	Black	Wood
5. Lighting	Cold	Warm	
6. Distinctiveness of Holland	Holland	Indifferent	
7. Signing	Signage	No signage	
8. Greenery	Greenery	No greenery	

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

characteristic	Reference characteristic	DF	Utility	SE	X²	p	HR	95%CI HR
1. Form (curvilinear)	Orthogonal	1	0.78	0.05	230.4	<0.01	2.19	1.98 – 2.42
2. Layout (curved)	Straight	1	0.53	0.05	107.1	<0.01	1.69	1.53 – 1.87
3. Dimension (wide)	Narrow	1	0.32	0.05	45.8	<0.01	1.38	1.26 – 1.52
4. Colour (wood)	Black	1	0.37	0.06	35.9	<0.01	1.45	1.28 – 1.63
Colour (white)	Black	1	0.77	0.06	165.3	<0.01	2.16	1.92 – 2.43
5. Lighting (warm)	Cold	1	0.36	0.05	54.7	<0.01	1.43	1.30 – 1.57
6. Distinctiveness of Holland (indiff.)	Present	1	0.39	0.05	64.5	<0.01	1.47	1.34 – 1.61
7. Signage (present)	No signage	1	0.06	0.05	1.7	0.19	1.07	0.97 – 1.17
8. Greenery (present)	No Greenery	1	0.44	0.05	80.2	<0.01	1.56	1.41 – 1.72