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The Influence of Lighting Settings on Museum's Brand Image and Human Satisfaction in Exhibition Halls Using Virtual Reality

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Abstract. This paper analyses the influence of museum lighting design on the brand image and human satisfaction inside exhibition halls, taking Birmingham museum and art gallery as the case study of this research focusing on the exhibition that included the ancient Egyptian displays. Four different generated lighting scenes using virtual reality were generated. The results showed that the lighting had an impact on the brand image and affect the willingness of people to revisit the museum and recommend it to family and friends. This research considers the museum's visitors as active participants not just passive recipients of environmental stimuli. The research tried to provide a better understanding of how the exhibition environment in terms of lighting is perceived and provide further insight into how exhibition lighting design can enhance the visitor's experience and create a brand image. According to the research results, visitors tend to be willing to return and stay longer in the presence of diverse and exciting lighting settings.

Keywords: Brand Image · Lighting · Museums · Virtual Reality

1 Introduction

Light in "museum quality" has become the benchmark, even for other types of architecture. The main objective of this research is evaluating how lighting can be used as a branding tool which contributes to the brand image of museums that encourages community engagement. Good museum lighting not only meets the requirements of the visitors, but also of the curators and operators as visual comfort, optimum perception of the exhibits, clear and safe orientation in the building lead to a high quality experience, and also conservation of the exhibits as well as economic efficiency and sustainability which are important factors. Lighting concepts which meet these criteria contribute to preserving the cultural heritage of humanity for future generations. The term atmospherics was first used in describing the design of retail environments, where it has been defined as "the conscious designing of space to create certain effects in buyers" (Kotler, 1974). The idea behind the atmospherics is that the environ-

ment has the ability to influence behavior of people which will then influence people in distinctive and anticipated ways through design options. Kotler described atmospherics as a “silent language” a language that is similar to body language, spatial language or temporal language (Kotler, 1974). The influence of Atmospherics takes place through emotional and sensory mechanisms (Kotler, 1974), which leads to behavioral patterns with behavioral outcomes that take place on a subconscious level (Turley & Milliman, 2000).

Atmospherics is now broadly recognized as an important component of quality experience in different leisure settings (Chang & Horng, 2010), and the expression is now commonly used by marketers as a way to explain the overall design and atmosphere of a leisure, retail or service environment (Baker et al. (2007), it is concluded that atmospheric factors such as colour schemes, layout, lighting and signage are important factors to create the overall perception of an exhibition environment as it characterizes the visitor’s experience from a marketing perspective. An investigative study that used the open-ended interview technique suggested that atmospheric factors were important factors for people in describing their visit (Roppola, 2012). According to (Caldwell, 2000) the impact of a museum’s brand image and satisfaction on loyalty have not been profoundly analysed among museum visitors. It is important to find out the effective means to make visitors interested in heritage assets. Therefore, visitor satisfaction is the main component of museum experience and brand image is considered the significance of the museum’s brand in visitor’s mind.

1.1 The Influence of Museum’s Brand Image and Satisfaction on Visitors’ Loyalty

Exhibitions are considered effective branding tools as every exhibition has its own theme and its narration that specifically reflect a museum’s brand image (Wallace, 2006). The word of mouth is an important support as the positive messages of friends and family members’ are reliable sources, which show visitors’ honest impressions (Simpson and Siguaw, 2008). Visitors’ loyalty is also related to repeated experiences as these imply a psychological commitment of preference (Chi and Qu, 2008). Previous literature shows loads of research on the relationship between tourists’ loyalty and their satisfaction for example research by (Radder et al., 2013; Gallarza and Gil, 2006; Harrison & Show, 2004). Specifically, Radder et al. (2013) expressed that visitor’s satisfaction has a positive impact on loyalty. While, Yuksel et al. (2010) conclude that satisfaction is a fundamental element that leads to loyalty. Yet still, other studies have demonstrated that other factors also have a major effect on loyalty such as visitor experience quality or other experiences dimensions and destination image (Campón-Cerro et al., 2016; Wu, 2016; Radder et al., 2015). A research has been conducted in the Reina Sofia Museum, one of the most famous and visited museums of Madrid in which it was found that (Virto et al, 2017) to compare the influence of visitors’ satisfaction and perceived image on their loyalty. Researchers have stated that visitors’ after a tourism experience can generate not only positive attitudes towards loyalty intentions but also disloyalty (Tian-Cole et al., 2002; Tsai and Wang,

2016). Customer loyalty's bond becomes stronger when these organizations show their commitment to their customers across marketing strategies, by firstly gathering information of their customers' needs and preferences (Chen and Gursoy, 2001).

Loyalty has been related to different aspects which includes attitudinal, behavioral or combined intentions (Jacoby and Chestnut, 1978). Attitudinal loyalty indicates that visitors recommend the visit or revisit the place (Bigné et al., 2001; Konecnik and Gartner, 2007). While, the behavioral loyalty is defined by visitors' intentions of revisiting the exhibition and repeating the experience (Lee et al., 2007; Yoon and Uysal, 2005). Composite loyalty is the combination of attitudinal and behavioural loyalty (Backman and Crompton, 1991; Petrick, 2004).

1.2 The Link Between Satisfaction and Loyalty

In order to assess the affective and cognitive elements of people's experiences in spaces, satisfaction should be measured (del Bosque and San Martin, 2008; Mason and Paggiaro, 2012; Yoon and Uysal, 2005), compared against the expectations concerning the visit (Agyeiwaah et al., 2016). Accordingly, visitors will then start to make a reference framework so that they can generate comparative judgments (Campón-Cerro et al., 2016). Therefore, it is a concern that has to be considered for long-term business success (Kim et al., 2012; Pappu and Quester, 2006). Previous studies have indicated an adequate level in the relationship between satisfaction and loyalty throughout encouraging revisit intentions and recommendations to others (Campón-Cerro et al., 2016; Chi and Qu, 2008; Wu, 2016). It has been discussed that visitors are more likely to be fascinated by major attractions in the first time (Polo Peña et al., 2013) and tend to spend more time, while repeated visitors tend to visit fewer places and spend more time at each attraction (Oppermann, 2000).

1.3 Impact of Lighting Design on Brand Image

It is shown by history that companies benefit from architectural design and symbols to be able to communicate their brand identity (Messadat, 2005). Service businesses needs to adopt consistent design strategies to assist in forming a uniform image to the consumer to have a well-defined brand identity. Although design parameters as furniture, colour and material have been recognized more widely in the 1960s within visual guidelines (Meggs, 1983), lighting design is considered relatively new. To market a brand, it is considered as "a name, term, sign, symbol or design, or a combination of them, intended to identify the goods or services of one business that offer a service to differentiate them from those of competitors" according to American Marketing Association (Kotler 2000). The museum's main aim is to communicate a brand strategy of the museum brand image in the mind of the visitor as a receiver in what is called the visual identity of a brand (Kirby and Kent, 2010). In addition to the actual personality of a brand (Aaker, 1997) there are long known characters when it comes to conveying a specific visitor's experience.

Architecture is considered as a symbol as museums benefit from the architectural design and symbols to help them in communicating their brand identity (Messadat, 2005). Raffelt has developed a psycho-lexical inventory to consider different design dimensions, which define the architectural expression in addition to the brand-related response dimensions (Raffelt, 2011). She studied the branding literature and connected prototypical design styles in architecture to brand impressions. The brand personality was defined by Aaker as the “set of human characteristics associated with the brand” (Aaker, 1997). Raffelt assumed from literature and examined by tests a scale for empirical studies about architectural design in Germany.

Raffelt assumed a four-factor solution to be the the most adequate solution to capture the data. The research explained more than 80% of the brand personality variances through temperament, competence, attractiveness, and naturalness. It was observed by Flynn that bright spaces become considerably clearer and more spacious in comparison to darker situations (Flynn, 1977). Another study showed that visitors observe more displays under bright lighting unlike soft lighting (Areni and Kim, 1994) which could be linked to attractiveness. Raffelt tested that “if there is a change in the lighting concept from general lighting to accent lighting or another type of lighting would achieve a significant change in the brand image” A bright environment could also be regarded as an association to daylight and respectively to naturalness. Hence, the hypothesis is generalized for all parameters. Brightness leads to higher values for visitor experience and visits, temperament, competence, attractiveness, and naturalness.

Raffelt also tested the effect of general lighting with down lights whether it is often linked to low budget environments or not. This was examined through different lighting and room situations where the participants were asked to give their opinion on light and brand issues. It was found that Illumination with down lights leads to lower values for price, temperament, competence, attractiveness, and naturalness when compared to wall washing and accent lighting. Raffelt came up after thorough analysis of the literature that there are four abstract store concept stereotypes which are Low Budget, Colour, Black Box, and Minimalism. The lighting for the low budget stereotype was based on a uniform lighting design with recessed down lights to enhance a functional and simple appearance. In contrast, accent lighting and coloured projection on track mounted luminaires created effect lighting for the colour shop concept. The black box design was based on grazing and accent light by track mounted luminaires to create an intense contrast. Additionally, the minimalistic concept used recessed down lights and wall washers for an even illumination of the surfaces.

Baker developed a typology of the museum environment that categorized space atmospherics as either ambient (temperatures, sounds, odours), design (layout, colour, interior design), or social (presence of other customers and store employees) (Baker, 1987). It is the design elements of the exhibition atmosphere that are of interest to this study. Both atmospherics and existing research into the museum visitor’s experience have been strongly influenced by the theories and techniques associated with environmental psychology (Bitgood et al, 2006, Ng, 2003). Environmental psychology is the study of the interplay between people and their environment, where the environment is understood to comprise both physical and sociocultural elements (Holahan, 1982; McAndrew, 1993). In the environmental psychology theory, the person and environment are both considered as holistic integrated wholes (Holahan, 1982). The

environment simultaneously comprises multiple contexts across different scales. Psychological responses to this environment are either perceptual, cognitive, or affective which mutually interact and affect behaviour. These responses in turn influence the environment, creating a reciprocal person-environment relationship. In this transactional model of environmental psychology, the person-environment interaction is the main subject of study and one cannot be fully understood in the absence of the other (Bitgood, 2006; Holahan, 1982). Applying these principles of environmental psychology to the museum environment, the visitor-exhibition dynamic can be considered to progress in space and time as the visitor perceives, processes, responds to and interacts with the exhibition environment (Bitgood, 2011, Falk et al, 1998, Holahan, 1982).

2 Research Methodology

Quantitative numeric data was collected using surveys through the use of Virtual Reality. Then the data was analyzed using descriptive and inferential analysis. The aim of the quantitative phase was to find out any statistical relationship between museum's brand image and visitors' willing to revisit, and recommend the museum to others and the existing lighting settings through different generated lighting scenes. To obtain an evaluation of four different light settings and two exhibition views, the experiment participants were asked to write their opinion regarding light and brand aspects, using Likert scale to quantify this stimulus and subjective reactions. The lighting was evaluated via the following five factors Uniform/Differentiated, Bright/ Dark, Warm/ Cool, Diffused/Contrast, evenly lit/Targeted and Colourful / Neutral. A 3D realistic computer rendering tool was chosen as the method to mimic the exhibition space found in reality and create visualizations for the chosen exhibition hall that had Egyptian displays in the Birmingham Museum in UK. A virtual model of an exhibition hall, similar in dimensions to the actual hall in the Birmingham Museum in UK, was designed and modelled. This method had been used in previous studies (Bregman, 2002; Briand Decre & Pras, 2013; Hidayetoglu et al., 2012; Kernsom & Saha-chaisaeree, 2010; Schielke & Leudesdorff, 2015; Wardono et al., 2012) and it had been verified for its accuracy in representing the actual scene (Engelke et al 2013). In this study, the scenes of chosen exhibition room with various colour and lighting arrangements will be simulated using a 3D realistic computer rendering program that projected images of the exhibition hall to evaluate the brand image created by the museum, five-level Likert scale on used tendency to revisit, tendency to recommend to others and how visitors find the image of the exhibition through lighting. Since Likert scale has been widely used for experiments, and numerous studies exist, which discuss its reliability and validity. Therefore, the Likert five-point scale (1-5) in the semantic differential method will be used to evaluate the computer-generated scenes of the simulated exhibition with different colour and lighting conditions for each question, which quantify the visual scene and subjective reactions with either 'Strongly disagree' and 'Strongly agree' at the different ends of the scale axis.

2.1 Experiment Design

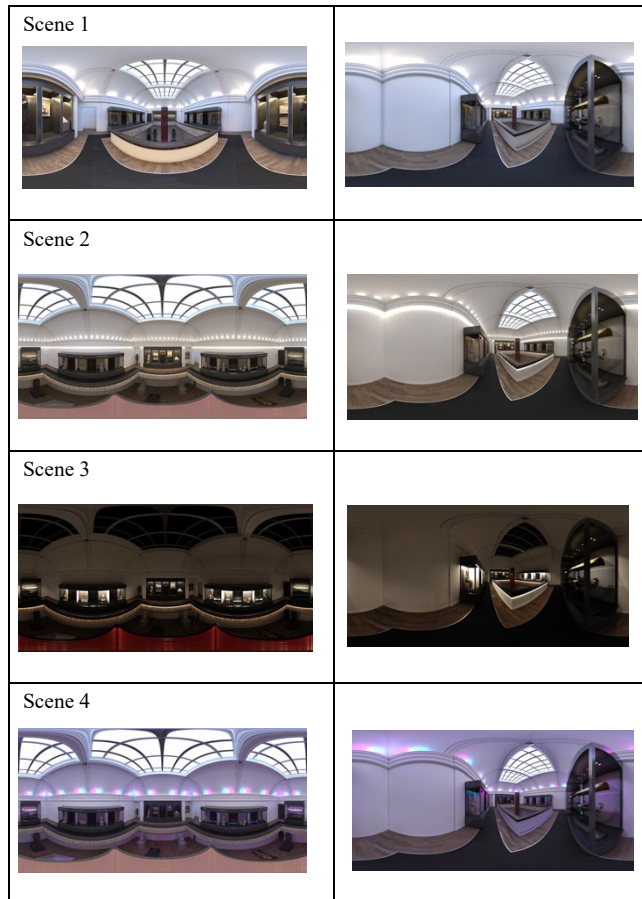
A total of 66 participants for the four scenes conducted the survey, around 25% of participants had an architecture education, 5% had a lighting design background and 70 % came from other fields as (political science, dentistry and physics, civil Engineering and law etc.) there were 40% undergraduates and 60% are graduates. These percentages indicate a normal type of visitors who come from various background without a specific experience in visual fields which is mostly the situation of real museum visitors. There were 36 males (55%) and 30 females (45%) among the participants. The age range of participants was restricted to be from 18 to 50 years old to represent a similar age group of museum visitors.

3 Procedures of the Experiment

To obtain an evaluation of four different light settings and four exhibition views, the experiment participants were asked to write their opinion regarding light and brand issues. A 3D realistic computer rendering tool was chosen as the method to mimic the exhibition space found in reality and create visualizations for the chosen space. A virtual model of an exhibition hall, similar in dimensions to the actual hall in the Birmingham museum, was designed and modelled. There are some key variables to be examined in this study included colour hues, lighting arrangements/ distribution (general lighting and accent lighting) and correlated colour temperatures (daylight and warm white). As those are the key variables present in leading museums exhibition halls based on a thorough review and analysis of architecture and exhibition design literature.

The generated lighting scenes were based on visual perception theories and qualitative lighting design guidelines. Therefore, four scenes will be generated for each exhibition view. The existing scene (Birmingham Museum in UK) which is the first scene is downwards (DL) and general lighting that has an even illumination of the horizontal and vertical surfaces. Second simulated generated scene is accent lighting (AL) and wall washers (WW) as objects on the wall are drawn together because they share the same light, large quantities of indirect light are bounced into the space. Third scene is dark and dramatic which is the black box scene, where the whole environment had a black surface and just the displays are lit. The black box design consisted of accent and grazing light (AG) by track-mounted luminaires to also create an intense contrast. Finally, fourth scene is of different color hue (cool colours) using accent lighting and coloured projection (AP) which draws people attention and determine where people will move as it is considered as a highlighting technique. Bluish purple colour is used for the projection in order to have a visual distinction against the other interior colours, without causing strong irritating colour contrasts with the two cool colours. The four scenes of the exhibition hall in 360 form in shown in table 1.

Table 1. Four simulated scenes of the main hall at the Birmingham Museum in UK.



4 Data Analysis and Results

Spearman correlation was used to check the research hypothesis which stated that the more the lighting characteristics of the exhibition spaces are diverse and exciting, the better the exhibition space is perceived, the longer visitors will stay and be willing to return thus contributing positively to the museum's brand image. The test will show whether there is a link between how visitors perceived the atmosphere in terms of different lighting settings and how they reacted in contributing to the museum brand image. The results show the correlation, significance and number of observations. In order to determine the statistical significance, the standard alpha level of 0.05 was used. The correlation table showed significant relationship between different types of lighting and branding parameters, there is a positive relationship between

Bright/Dark, evenly lit/Targeted and Colorful / Neutral and the willing of people to revisit the exhibition because of the lighting conditions, $\rho = 0.275$, $n=160$, $p<0.000$, $\rho = 0.174$, $n=160$, $p<0.028$, $\rho = 0.314$, $n=160$, $p<0.000$ respectively. There is a strong positive relationship between recommending the visit of the exhibition hall to others and Diffused/Contrast Lighting, $\rho = 0.309$, $n=160$, $p<0.000$ and also a positive strong relationship with Colourful/Neutral, $\rho = 0.352$, $n=160$, $p<0.000$. All lighting parameters has a relationship with the willingness of people to recommend to other people to visit the exhibition hall for the preferred lighting settings except for warm/Cool as the relationship is not statistically significant as shown in table 2. This proves the hypothesis that the more exciting the lighting characteristics of the exhibition, the longer visitors will stay and be willing to return thus contributing positively to the museum's brand image.

Table 2. Results of the spearman correlation test.

Correlations		Encourage to Revisit	Recommend to Others	Gives Specific Image
Uniform/ Differentiated	Correlation Coefficient (rho)	0.143	0.159*	0.104
	Sig. (2-tailed).	0.072	0.044	0.190
	N	160	160	160
Bright/ Dark.	Correlation Coefficient (rho)	0.275**	.0169*	-0.056
	Sig. (2-tailed).	0.000	0.032	0.480
	N	160	160	160
Warm/ Cool	Correlation Coefficient (rho)	0.454**	0.003	-0.0130
	Sig. (2-tailed).	0.000	0.970	0.100
	N	160	160	160
Diffused/ Contrast	Correlation Coefficient (rho)	-0.011	0.309**	-0.042
	Sig. (2-tailed).	0.891	0.000	0.601
	N	160	160	160

Evenly lit/ Targeted	Correlation Coefficient (rho)	0.174*	0.162*	0.053
	Sig. (2-tailed).	0.028	0.041	0.505
	N	160	160	160
Colorful / Neutral	Correlation Coefficient (rho)	0.314**	0.352**	0.144
	Sig. (2-tailed).	.000	.000	.069
	N	160	160	160

5 Conclusion

The results indicated that visitor's satisfaction according to lighting has an impact on their loyalty and hence their willingness to revisit the museum and recommend it to others. According to (Gursoy et al., 2014) who stated that when visitors become loyal they tend to recommend it to others and hence affecting the museum brand image. Therefore, the objective of increasing visitors' satisfaction will increase visitors' loyalty thus improving their willingness to return and enhancing the brand image. Therefore, visitor's lighting preferences that leads to visitors' satisfaction should be taken into consideration when designing exhibition halls to create spaces that really work for people and enhance their willingness to return.

One of the important contribution of this research is shedding light on museum's brand image in relation to visitors' lighting preferences and hence their satisfaction as it has a positive impact on loyalty and therefore, visitors' loyalty contributing to the whole brand image through recommending the museum to others and willing to return. The other contribution that was considered is that loyalty itself has a direct relationship with two aspects that contribute to the museum brand image which are revisit and recommendation intentions. Yet still, there are some limitations, this research just took place in one museum which is the Birmingham museum therefore future research should extend the analysis on more museums in addition to analysing other atmospherics other than lighting and analyse its effect on the museum brand image.

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