Asia-Pacific Journal of Science and Technology: Volume: 27. Issue: 27. Article ID.: APST-27-06-20. Research Article

APST

Asia-Pacific Journal of Science and Technology

https://www.tci-thaijo.org/index.php/APST/index

Published by the Research and Technology Transfer Affairs Division,
Khon Kaen University, Thailand

Effects of illuminance and correlated colour temperature on emotional state and perception of Thai customers in clothing retail stores

Natthamol Phumchan[1,*] and Nuanwan Tuaycharoen[1]

[1]Faculty of Architecture, Kasetsart University, Bangkok, Thailand
[*]Corresponding author: Natthamol.ph@ku.th

Received 27 August 2021
Revised 30 December 2021
Accepted 8 January 2022

Abstract

Lighting is an important environmental factor that stimulates the emotional response of consumers, hence, promoting consumer's purchase. This research focused on how the illuminance and correlated colour temperature (CCT) affected the emotional response of Thai customers in clothing retail stores. The first investigated the effect of horizontal illuminance levels on the emotional state and perception of participants who viewed different Ten lighting scenes projected on a screen. The subjects evaluated their emotional states and perception on a five-point Likert scale questionnaire. The second experiment was carried out under lighting conditions using 1:10 scale models. Nine lighting scenes containing mixed CCT were evaluated in this experiment using the similar scales as the first experiment. These scenes were homogenous light and mixed light of CCT of 2700K, 4000K and 6500K. Results in the first experiment showed that different illuminance levels impacted the emotional state and perception of participants who represented customers in clothing retail stores at high statistical significance (p<0.01) with an illuminance of 400 lux achieving optimal scores. The second indicated that CCT affected the emotional state and perception at high statistical significance (p<0.01). Homogenous light scenes (Cool White (CW+CW)) consisting of ambient lighting at 4000K and accent lighting at 4000K gave the highest scores. These findings suggested the recommended lighting design characteristics to improve clothing sales as suitable for Thai people.

Keywords: Illuminance, CCT, Emotional response, Clothing retail

1. Introduction

The clothing business shows continual growth, with cut-throat competition between traditional bricks and mortar stores and the online market. In-store sales increase the chances of unplanned purchases. Many studies suggested that a well-designed store environment increased opportunities for consumer spending [1]. The Stimulus-Organism-Response (SOR) theory of Mehrabian and Russell [2] posits that the physical environment of a shopping store has an effect on consumer perception and modifies behaviour. The perception process begins with receiving stimuli from the environment that then trigger emotional state such as pleasure, arousal and dominance. Using the SOR theory, many studies identified several effects of environmental stimuli on customer emotional states including lighting, colour, air quality, music, temperature, scent and design of the store indoor environment [3-9]. Lighting influences the store environment and can impact consumer perception and behaviour [10,11]. Lighting affects customer perception through their vision [12] and then regulates purchasing decisions [13].

Several environmental cues of emotional customer responses to retail atmospherics have been studied to determine their impact on the shopping experience.

Yoo C, Park J, MacInnis DJ [3] demonstrated that environmental stimuli affecting store attitudes through design, lighting, air quality, inside decoration and music, while Fiore AM, Dennis C, Kim J [5] found that in-store environmental stimuli included ambient cues (music, lighting, scent and temperature), design cues (parking wall colour and size of parking space) and social cues (crowding and staff appearance).

Xu Y [6] showed that store environmental stimuli such as ambience, design, employees and crowding influenced the emotional state of Generation Y consumers, while Kumar A. [7] suggested that the in-store environment consisting of ambient cues, design cues and social cues influenced customer behaviour. Chang HJ, Eckman M, Yan RN.[8] investigated the impact of the store environment on impulse buying behaviour, with results indicating that environmental stimuli consisted of ambient characteristics, design characteristics and social characteristics, while Hari GM, Piyush KS, Surabhi K [9] noted that store environment stimuli including the ambience (temperature, air quality, noise lighting and music), space (layout, equipment and furnishings) and signs (signage, personal, artifacts and style of décor) impacted customer behaviour.

Previous evidence suggested that emotional states act as a mediator between the physical store environment and customer behaviour response. The store environment is an important stimulant that affects emotional states and consumer behaviour and this situation can increase the opportunity for consumer purchases [1]

The effect of lighting on consumer emotional response has generated copious research [10,11,14-18] investigated the differences between two lighting conditions (soft and bright light) on customer interaction with displays. They found that bright lighting attracted customers to approach to product. Summers TA, Hebert PR. [17] also used the SOR model to examine the effect of display lighting on approach-avoidance behaviour of customers. Augmenting the lighting increased consumer interaction with the product.

Park NK, Farr CA. [19] investigated the effects of three factors as 1) correlated colour temperature (CCT) (3000K vs. 5000K), 2) colour rendering index (CRI) (75 vs. 95) and 3) age (older vs. younger) on readability by figure to background value contrast, colour perception and adequate room lighting for elderly consumers in a retail store environment. Results showed that a higher colour temperature light source created a warmer sensation for older adults than younger adults. Older adults also felt more comfortable than younger participants under all lighting conditions, while higher colour-rendering light sources also improved readability. Warmer lighting made reading difficult for older adults because there was less contrast.

Park NK, Farr CA. [20], the SOR model to investigate the effects of light colour on perceptions, emotional states and behavioural intentions between different cultural groups. Their results showed that consumers were aroused and pleased by certain lighting conditions. They also found that cultural differences affected both perceptions and behavioural intentions of "approach-avoid" in a retail environment.

Later, Baumstarck A, Park NK [21] investigated the impact of CCT, intensity, glare and lighting installation (overhead and frontal lighting) of dressing room lighting on customer perception using the SOR theory framework of Mehrabian and Russell. Results showed that dressing room lighting direction impacted facial shadowing and perceived roominess, while frontal lighting gave a better performance. The evidence indicated that lighting design in stores was one of the most important factors to promote a conducive retail visual environment.

Lighting standards differ in other countries, especially in the USA and the UK. In Thailand, the current standard in retail lighting is derived from the CIE European standard [22]. Many studies have highlighted the differences between Thai and European people in terms of visual perception and culture [20,23]. However, no study exists relating to retail lighting design preferences for Thai people. The main purpose of this study was to explore the effects of lighting on the emotional state and perception of Thai customers in clothing stores. Two experiments were conducted. The first investigated the effect of illuminance on the emotional state and perception of Thai customers in clothing retail stores, while the second explored the effect of correlated colour temperature (CCT). Findings can be used as a guideline to design suitable lighting for Thai clothing stores.

The study model, based on the SOR theory of Mehrabian and Russell [2] described the relationship between lighting conditions and the emotional states and perceptions of Thai people on their purchasing behaviour in retail clothing stores. Several studies have used the Mehrabian-Russell (M-R) model of emotional states as a mediator of retail lighting [17-19]. The study framework based on SOR model is shown in Figure 1.

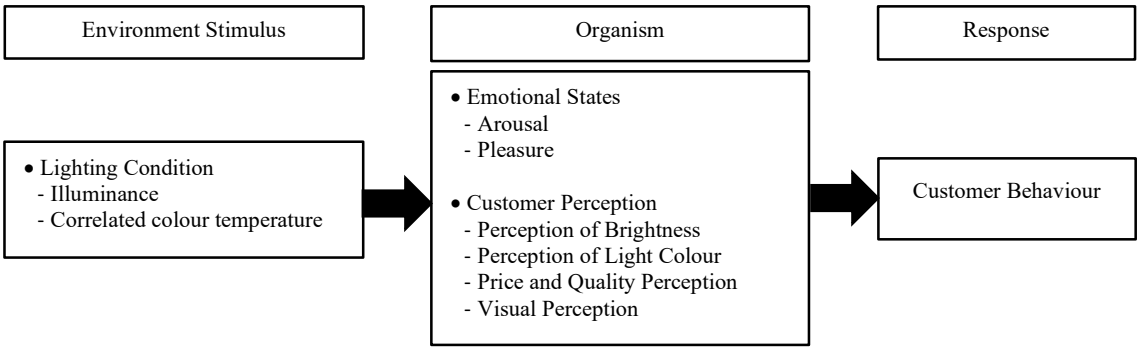

Figure 1 Study framework based on the SOR model.

2. Materials and methods

2.1 Experiment 1

2.1.1 Participants

To investigate the effect of illuminance on emotional state and perception of customers in clothing retail stores, 50 undergraduate students from the Faculty of Architecture, Kasetsart University aged 18-60 were selected. This age range was chosen because those younger than 18 required less light, while those over 60 required more light than the average person [13]. None of the participants suffered from colour blindness or other eye problems that might affect the results. The time taken to conduct the experiment ranged from 25 to 45 min, with the average as 31 min.

2.1.2 Experimental setting

The experiment was carried out under lighting conditions in a medium-class ready-to-wear clothing store using a simulation of DIALux 4.13. The clothing store had an area of 100 m^2 with ceiling height of 3.5 metres (10 x 10 x 3.5 m^3). This clothing store was selected for the study since the brand had the highest number of clothing outlets in Thailand. The floor, ceiling and walls were white with white furniture. These colours of investigated clothing store in this study were obtained from the results of pre-test survey, which shown that these colours were used in most of the Thai clothing stores. All investigated images of lighting conditions were projected onto a screen in a completely dark experiment room. This method has been used in many previous retail lighting studies. [24]

2.1.3 Lighting conditions

Ten lighting scenes with average horizontal illuminances of 100, 200, 300, 400, 500, 600, 700, 800, 900 and 1000 lux were assessed in the clothing retail store. These values were selected because 500 lux was the recommended illuminance for most retail lighting [25,26] with the investigated values higher and lower in 100 lux increments. Ambient lighting was achieved using four fluorescent sidelights (GE Lighting F32T8/SPX30/ECO) mounted on the ceiling. The lighting met IESNA recommendations for a minimum 80 CRI [25] and 3000K light source or warm-white were selected for study because this CCT value was investigated in many previous studies and was found to be suitable for using in retail stores [10,20,21,24]. This method has been used in many previous studies [27]. And there are some previous lighting studies indicated that there is no difference in visual perception between dark laboratory room and real environment [28].

2.1.4 Experimental procedure

When first entering the experiment room, each subject was instructed to sit down for at least 60 sec to adjust their eyes to the lighting conditions [19]. The experiment room was completely dark with no external light interference (the average illuminance measured on the floor laboratory room by a lux meter was 0-5 lux). Ten lighting scenes consisting of different average horizontal illuminance were randomly shown to each participant. The subjects evaluated their emotional states and perception on a five-point Likert scale questionnaire that was used in many previous studies [19,23]. A Balanced Latin Square experimental design controlled the sequencing and carry-over effects.

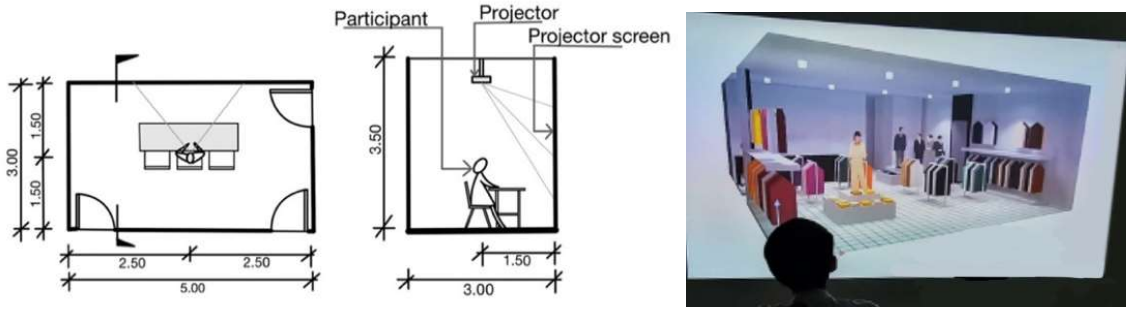

Figure 2 Experimental setting in experiment 1.

2.1.5 Measurement of emotional states and perception

Emotional states and perception were self-measured using a semantic differential scale that has been used in many previous emotional state studies [17-19]. Data were analysed using a one-way Analysis of Variance (ANOVA), with the Sidak t-test employed for further pair-comparison.

Table 1 Emotional states and perception scale.

Emotional state and perception of the participants		Level					
1. Emotional State		5	4	3	2	1	
Arousal	Excited						Calm
	Motivated						Not motivated
Pleasure	Pleasant						Unpleasant
	Like						Dislike
2. Perception		5	4	3	2	1	
Perception of brightness	Bright						Dim
Perception of light colour	Cool						Warm
Price and quality perception	Clear						Unclear
	High quality						Low quality
Visual perception	Uniformity						Not uniform
	Enough						Not enough

2.2 Experiment 2

2.2.1 Participants

To investigate the effect of correlated colour temperature on emotional state and perception of customers in clothing retail stores, 50 undergraduate students from the Faculty of Architecture, Kasetsart University aged 18-60 were selected for reasons explained earlier. All the subjects had normal eyesight with no inherent eye problems that might impact the results. Participants spent between 25 and 45 min to complete the experiment and the average time taken was 31 min.

2.2.2 Experimental setting

The experiment was carried out under lighting conditions in a medium-class ready-to-wear clothing store using 1:10 scale models. This method has been used in many previous retail lighting studies and was time-efficient and within budget, with no evidence of any scaling effect on the results [29-31]. Each subject was sat 20 cm. from the back of the model and fixed his/her eyes at the height 1.50 m (in 1:10 scale) from the floor. Therefore, only small areas outside the model that could be seen within his/her visual field. The clothing store had an area of 100 m^2 with ceiling height of 3.5 meters (8 x 10 x 3.5 m^2) and a white floor, ceiling, walls and furniture.

2.2.3 Lighting condition

Nine lighting scenes of clothing retail stores containing mixed CCT were tested in this experiment. CCT of 2700K, 4000K and 6500K were selected for study because these values were also investigated in many previous studies [19,29,32] and lamps with these CCT are generally sold in Thailand. The scenes were mixed between homogenous light and mixed light, with 70% ambient lighting and 30% accent lighting. The horizontal illuminance value was held constant at 400 lux (obtained from Experiment 1), while the CRI was held constant at 80 as the normal light source in everyday life.

Table 2 Ambient and accent lighting scenes of different correlated colour temperature values.

Lighting Scene	Ambient Lighting	Accent Lighting
Homogenous light scenes		
1. WW-WW	Warm White 2700K	Warm White 2700K
2. CW-CW	Cool White 4000K	Cool White 4000K
3. DL-DL	Daylight 6500K	Daylight 6500K
Mixed light scenes		
4. WW-CW	Warm White 2700K	Cool White 4000K
5. WW-DL	Warm White 2700K	Daylight 6500K
6. CW-WW	Cool White 4000K	Warm White 2700K
7. CW-DL	Cool White 4000K	Daylight 6500K
8. DL-WW	Daylight 6500K	Warm White 2700K
9. DL-CW	Daylight 6500K	Cool White 4000K

2.2.4 Experimental procedure

When each participant first entered the experiment room, he/she was instructed to sit down for at least 60 seconds, similar to the first experiment [19]. The experiment room was completely dark. The subjects were shown nine lighting scenes in random orders and completed a similar questionnaire to the first experiment. All procedures were similar to the first experiment. The data were analysed using a one-way ANOVA, with the Sidak t-test employed for further pair-comparison.

Figure 3 Experimental setting in experiment 2.

3. Results

3.1 Study of the effect of illuminance on the emotional state and perception of customers in a clothing store for Thai people.

Table 3 shows the effect of illuminance on the emotional state and perception of customers in a clothing store for Thai people. Different illuminances created highly statistically significant differences in arousal (p=0.000), with statistically significant differences in motivation and pleasure (p=0.027 and p=0.010 respectively). Overall results of emotional state showed that different illuminances created highly statistically significant differences in overall emotional state (p=0.000). The value of 400 lux created the highest overall emotional state of customers (mean=3.808), significantly higher than the other illuminance values. For perception, ANOVA results showed a highly significant effect of illuminance on the perception of brightness, light colour, price, quality perception, uniformity and visibility (p=0000), while CCT had a highly significant effect on overall perception (p=0.000). The illuminance value of 400 lux created the highest overall perception (mean=3.847), significantly higher than the other illuminance values.

Table 3 The effect of illuminance on the emotional state and perception of customers in a clothing store for Thai people.

Variable	Illuminance (lux)									
	100		200		300		400		500	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1.Emotional state										
Arousal	2.843	1.222	3.392	1.167	3.784	0.878	3.882	0.738	3.137	1.113
Motivation	3.156	1.172	3.509	0.945	3.784	0.878	3.764	0.862	3.764	1.067
Pleasure	3.333	1.125	3.686	1.067	3.686	0.812	3.882	0.738	3.254	0.913
Like	3.392	1.327	3.666	1.089	3.803	0.916	3.705	0.641	3.411	1.023
Overall emotional state	3.181	1.224	3.563	1.069	3.764	0.867	3.808	0.747	3.279	1.029
2. Perception										
Perception of Brightness	2.647	1.277	3.647	1.277	4.039	0.958	4.156	0.945	3.078	1.213
Perception of Light Colour	3.725	1.114	3.725	0.943	3.372	0.958	3.705	2.602	3.549	1.006
Price Perception	2.725	1.167	3.568	1.204	3.882	0.972	4.039	0.893	3.078	1.128
Quality Perception	2.725	1.217	3.431	1.081	3.666	0.930	3.823	0.994	3.117	1.177
Uniformity	3.019	1.240	3.352	1.110	3.470	0.856	3.823	0.887	3.372	1.112
Visual Perception	2.607	1.250	2.924	1.329	3.960	0.999	4.058	0.881	3.078	1.163
Overall perception	2.908	1.264	3.526	1.159	3.732	0.971	3.872	0.940	3.212	1.141

Table 3 The effect of illuminance on the emotional state and perception of customers in a clothing store for Thai people. (Continued)

Variable	Illuminance (lux)										*p*-value
	600		700		800		900		1000		
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	
1.Emotional state											
Arousal	3.215	1.064	3.509	0.966	3.627	0.958	3.627	0.999	3.627	0.841	0.000**
Motivation	3.451	1.025	3.431	0.984	3.607	0.960	3.509	0.880	3.686	0.882	0.027*
Pleasure	3.392	0.939	3.529	0.856	3.509	0.880	3.529	0.924	3.784	0.855	0.010*
Like	3.490	0.924	3.470	0.783	3.509	0.924	3.509	0.966	3.509	0.937	0.443
Overall emotional state	3.387	0.988	3.485	0.895	3.563	0.926	3.544	0.937	3.730	0.877	0.000**
2. Perception											
Perception of Brightness	3.411	1.151	3.784	1.025	4.019	0.989	3.960	1.019	4.000	0.979	0.000**
Perception of Light Colour	3.451	0.944	3.470	1.007	3.274	1.021	3.392	1.001	3.313	1.067	0.653
Price Perception	3.392	1.096	3.647	1.054	3.882	1.032	3.803	1.058	3.902	0.943	0.000**
Quality Perception	3.235	1.031	3.627	0.958	3.745	0.844	3.725	0.981	3.862	0.938	0.000**
Uniformity	3.235	0.862	3.529	1.026	3.607	0.981	3.607	0.850	3.843	0.924	0.001**
Visual Perception	3.411	1.061	3.686	0.783	3.921	0.989	3.902	1.005	4.058	0.925	0.000**
Overall perception	3.356	1.024	3.624	1.007	3.741	1.002	3.732	0.998	3.830	0.987	0.000**

*Statistically significant (p <0.05)
**Highly statistically significant (p <0.01)

3.2 The effect of CCT on the emotional state and perception of customers in a clothing store for Thai people

Table 4 shows the effect of CCT on the emotional state and perception of customers in a clothing store for Thai people. Different CCT values created statistically significant differences in motivation and preference (p=0.016 and p=0.029 respectively). Overall results of emotional state showed that differences in CCT created highly statistically significant differences in overall emotional state (p=0.000). WW-DL created the highest overall emotional state of customers (mean=3.532), significantly higher than the other CCT values. For perception, ANOVA results demonstrated a highly significant effect of CCT on light colour and quality perception (p=0000 and p=0001 respectively). Results also showed that CCT significantly affected price perception, uniformity and visual perception (p=0.019, p=0. 017 and p=0. 011 respectively). Results showed that CCT also had a highly significant effect on overall perception (p=0.000). DL-DL created the highest overall perception (mean=3.899), significantly higher than the other CCT values.

Table 4 Mean values of the emotional state and perception of different correlated colour temperature.

Variable	Correlated colour temperature (CCT)									
	WW-WW		CW-CW		DL-DL		WW-CW		WW-DL	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1.Emotional State										
Arousal	2.842	1.241	3.394	0.823	3.236	0.913	3.210	1.142	3.105	0.863
Motivation	2.657	0.189	3.473	0.144	3.263	0.139	3.210	0.189	3.447	0.163
Pleasure	2.763	1.101	3.500	0.862	3.210	0.843	3.210	1.211	3.342	0.937
Like	2.473	1.309	3.605	1.151	3.210	1.166	3.157	1.263	4.236	4.895
Overall emotional state	2.684	1.203	3.493	0.934	3.230	0.945	3.197	1.185	3.532	2.588
2.Customer Perception	2.723	1.097	3.741	0.874	3.899	2.832	3.017	1.157	3.140	0.889
Perception of Brightness	3.078	1.194	3.710	0.835	3.763	0.852	3.210	1.043	3.131	0.905
Perception of Light Colour	1.842	0.916	3.842	0.717	4.368	0.785	2.394	1.128	2.973	0.787
Price Perception	2.605	0.789	3.842	0.855	4.684	6.605	3.157	1.053	3.184	0.865
Quality Perception	2.657	0.908	3.605	0.916	3.368	0.997	3.263	1.031	3.263	0.949
Uniformity	3.210	1.043	3.736	0.949	3.605	0.945	3.078	1.238	3.105	0.98
Visual Perception	2.947	1.161	3.710	0.983	3.605	1.001	3.000	1.273	3.184	0.865
Overall customer response	2.723	1.097	3.741	0.874	3.899	2.832	3.017	1.157	3.140	0.889
	CW-WW		CW-DL		DL-WW		DL-CW		*p*- value	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD		
1.Emotional State										
Arousal	3.000	0.986	2.973	0.999	3.473	0.829	3.157	0.789	0.107	
Motivation	3.210	0.151	3.026	0.138	3.342	0.169	3.236	0.138	0.016*	
Pleasure	3.210	0.843	3.236	0.942	3.368	0.882	3.315	1.042	0.106	
Like	3.105	1.007	3.105	0.952	3.210	1.211	3.289	1.112	0.029*	
Overall emotional state	3.131	0.939	3.085	0.934	3.348	0.998	3.250	0.950	0.000**	
2.Customer Perception	3.122	0.835	3.754	2.779	3.114	0.945	3.530	0.892	0.000**	
Perception of Brightness	3.052	0.803	4.605	6.610	3.342	0.878	3.421	0.948	0.110	
Perception of Light Colour	2.973	0.884	3.973	0.636	2.473	0.861	3.868	0.741	0.000**	
Price Perception	3.157	0.789	3.473	0.687	3.184	0.865	3.526	0.829	0.019*	
Quality Perception	3.131	0.875	3.473	0.646	3.263	0.890	3.473	0.892	0.001**	
Uniformity	3.184	0.865	3.526	0.796	3.184	0.896	3.473	0.922	0.017*	
Visual Perception	3.236	0.819	3.473	0.829	3.236	1.050	3.421	0.976	0.011*	
Overall customer response	3.122	0.835	3.754	2.779	3.114	0.945	3.530	0.892	0.000**	

*Statistically significant (p <0.05)
**Highly statistically significant (p <0.01)

4. Discussion

4.1 Theoretical implications

Lighting impacts the emotional state and perception of customers in clothing stores to stimulate impulse buying [33]. Findings indicated that optimal average horizontal illuminance to maximise emotional state and perception of customers in clothing stores for Thai people was 400 lux. This result contrasted with other international illuminance lighting standards as 300 lux for sales area [28] and 200 lux for store boutiques [25]. The illuminance levels found here were higher than the CIE and IES standards in Europe and the United States but this result found were close to MS 1525 standards in Malaysia as 300-400 for General offices, shops, and stores [34]. This situation seemed to indicate that cultural differences could have an effect on this difference of illuminance level. The reason could be supported by several works. Park and Farr (2007) showed that there was a different lighting preference between different cultures [20]. Bergamin et al. (1998) also iris showed that color differences affect visual perception [23]. However, this difference can be from both in terms of experimental methods and cultural differences. Therefore, further work is required to explore more about what is the cause of the difference.

Findings showed that the optimal correlated colour temperature to maximise the emotional state and perception of customers in clothing stores for Thai people was homogenous light of CCT 4000K.

These study results were consistent with previous research on colour of light. Wongmasora K, Inkarojrit V [35] investigated the effect of CCT on the satisfaction of Thai customers at cosmetic counters. Results showed that customers were more satisfied with high CCT light than low CCT. Lin YF, Yoon SY [36] studied the effect of CCT on the perception of store identity. Their results indicated that warm colour light and warm colour surface of the store resulted in customer perception of store identity as luxurious or “high class”. By contrast, cool colour light and cool colour surface of the store were perceived by customers as more “technical”. Their findings concurred with our study since the clothing store used was a medium-class ready-to-wear clothing outlet.

4.2 Study limitations and further studies

Apart from the conclusion made from this study, .to make a more comprehensive conclusion, there should be further works on some issues. This study investigated only one type (a medium-class ready-to-wear clothing store) and some areas only, further work is required for other types of clothing store (luxury clothes retail and low budget clothes retail) and other areas (fitting room, dressing areas, and shop window). Further studies should also be investigated in other groups subjects, such as older adults. Also, this study was carried out in the simulated environment and a scaled model, thus, there should be further study in real clothing shop environment.

5. Conclusion

This study investigated the effects of illuminance levels and CCT on the emotional state and perception of participants representing customers in Thai retail clothing stores. Two studies were conducted.

Results of the first study showed the optimal illuminance impacting both emotional states and customer perception was average horizontal illuminance of 400 lux. The second study results indicated that the optimal CCT was CW-CW (ambient lighting of cool white 4000K and accent lighting of cool white 4000K). These findings suggested the recommended lighting design characteristics to improve clothing sales as suitable for Thai people.

6. Ethical approval

The ethic approval by the Kasetsart University Research Ethics Committee (COE No. COE63/196).

7. Acknowledgements

The authors thank all participants for their participation, support, suggestion from the business owner of case study and Kasetsart University faculty members.

8. References

[1] Kotler P. Atmospherics as a marketing tool. J Retail. 1973;49(4):48-64.

[2] Mehrabian A, Russell JA. An approach to environmental psychology. 1st ed. Cambridge: M.I.T Press; 1974.

[3] Yoo C, Park J, MacInnis DJ. Effects of store characteristics and in-store emotional experiences on store attitude. J Bus Res. 1998;42(3):253-263.

[4] Lin IY. Evaluating a servicescape: the effect of cognition and emotion. Int J Hosp Manag. 2004;23(2):163-178.

[5] Fiore AM, Dennis C, Kim J. An integrative framework capturing experiential and utilitarian shopping experience. Int J Retail Distrib Manag. 2007;35(6):421-442.

[6] Xu Y. Impact of store environment on adult generation Y consumers' impulse buying. J Shopp Cent Res. 2007;14(1):39-56.

[7] Kumar A. The effect of store environment on consumer evaluations and behavior toward single brand apparel retailers [dissertations]. Tennessee: University of Tennessee; 2010.

[8] Chang HJ, Eckman M, Yan RN. Application of the stimulus-organism-response model to the retail environment: the role of hedonic motivation in impulse buying behavior. Int Rev of Retail Distrib Consum Res.2011;21(3):233-249.

[9] Hari GM, Piyush KS, Surabhi K. Impact of Store Atmospherics on Customer Behavior: influence of response moderators. J Bus Manag. 2014;20(1):45-65.

[10] Parsons A. Atmosphere in fashion stores: do you need to change? J Fash Mark Manag. 2011;15(4):428-445.

[11] Siddhibphongsa P, Kim S. The influences of store atmosphere on purchase intention toward a fast fashion brand in Bangkok. AU-GSB e-JOURNAL. 2017;9(1):124-134.

[12] Kubovy M, Bertamini M. Human perception. 1st ed. New York: Routledge; 2006.

[13] Dilaura DL, Houser KW, Mistrick RG, Steffy GR. The lighting handbook: reference and application. 10th ed. New York: The Illumination Engineering Society of North America; 2011.

[14] Baker J, Grewal D, Parasuraman A. The influence of store environment on quality inferences and store image. J Acad Mark Sci. 1994;22(4):328-339.

[15] Faisal Q, Sadia H, Sheikh FH. Influence of retail atmospherics on consumer perception in specialized department stores. Manag Adm Sci Rev. 2015;4(5):758-765.

[16] Kumar I, Garg R, Rahman Z. Influence of retail atmospherics on customer value in an emerging market condition. Great Lakes Herald. 2010;4(1):1-13

[17] Summers TA, Hebert PR. Shedding some light on store atmospherics: influence of illumination on consumer behavior. J Bus Res. 2001;54(2):145-150.

[18] Areni C, Kim D. The influence of in-store lighting on consumers' examination of merchandise in a wine store. Int J Res Mark .1994;11(2):117-125.

[19] Park NK, Farr CA. Retail store lighting for elderly consumers: an experimental approach. Fam Consum Sci Res J.2007;35(4):316-337.

[20] Park NK, Farr CA. The effects of lighting on consumers' emotions and behavioral intentions in a retail environment: a cross-cultural comparison. J Inter Des. 2007;33(1):17-32.

[21] Baumstarck A, Park NK. The effects of dressing room lighting on consumers' perceptions of self and environment. J Inter Des. 2010;35(2):37-49.

[22] Illuminating Engineering Association Of Thailand (TIEA). Guidelines for indoor lighting design. Bangkok: TIEA; 2010.

[23] Bergamin O, Schoetzau A, Sugimoto K, Zulauf M. The influence of iris color on the pupillary light reflex. Graefe's Arch Clin Exp Ophthalmol.1998;236:567-570.

[24] Ko TK, Kim IT, Choi AS, Sung M. Simulation and perceptual evaluation of fashion shop lighting design with application of exhibition lighting techniques. Build Simul. 2016;9(6):641-658.

[25] IESNA. Recommended practice for retail lighting (RP-2-17). New York: Illuminating Engineering Society; 2018.

[26] Commission internationale de l'éclairage (CIE). Lighting of work places - Part 1: Indoor work places. Vienna: CIE; 2001

[27] Tantanatewin W, Inkarojrit V. Effects of color and lighting on retail impression and identity. J Environ Psychol. 2016;46:197-205.

[28] Engelke U, Stokkermans M, Murdoch M. Visualizing lighting with images: converging between the predictive value of renderings and photographs. In: Rogowitz BE, Pappas TN, Ridder H, editors. IS&T/SPIE Electronic Imaging; 2013 3-7 Feb; California, United States. Washington: SPIE; 2013. p. 86510L.

[29] Ampenberger A, Staggl S, Pohl W. Attention guidance, perceived brightness and energy demand in retail lighting. In: Howlett R, Capozzoli A, Serra V, editors. The 8th International Conference on Sustainability in Energy and Buildings; 2016 11-13 Sep; Turin, Italy. New York: Curran Associates, Inc.; 2017. p. 658-668.

[30] Adolfsson E, Yngvesson L, Davoodi A. The impact of scale when using models for daylight analysis [dissertation]. Jonkoping: Jonkoping University; 2018.
[31] Lau JH. Use of scale models for appraising lighting quality. Light Res Tech.1972;4(4):254-262.
[32] Chao, WC, Hong, YL, Hsieh, MC, Wang, EMY, Yang, CC, Su, LC. Effect of correlated colour temperature and illuminance levels on user's visual perception under LED lighting in Taiwan. Ergonomics.2020;63(2):175-190.
[33] Deepika J, Neeraja T. Lighting impact on consumer's shopping behaviour in retail cloth stores. Int J Sci Res. 2014;3(11):933-938.
[34] Department of Standards Malaysia. Energy efficiency and use of renewable energy for non-residential buildings - Code of practice (MS 1525:2014). Selangor: Ministry of Science, Technology and Innovation; 2014.
[35] Wongmasora K, Inkarojrit V. The attributes of colors and light on women's environment, satisfaction and self - appreciation: a case study of cosmetic counter. J Environ Des. 2020;7(1):114-135.
[36] Lin YF, Yoon SY. Exploring the effects of lighting on consumer responses in a retail environment using 3D walk-through animation. Arch Des Res. 2015;28(2):5-24.